MASTER OF SCIENCE IN ENGINEERING IN INDUSTRIAL AND SYSTEMS ENGINEERING

Graduate Program Coordinator

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Program Description

The industrial engineering program option provides opportunities for interdisciplinary graduate studies toward the Master of Science in Engineering with specialization in engineering management or industrial/manufacturing systems engineering. Students can also pursue study focused on specialized areas of industrial and systems engineering, such as operations research.

All study plans are interdisciplinary and include some coursework from outside the department. They are designed to serve practicing engineers, as well as those students who want to pursue advanced graduate studies beyond the Master of Science in engineering. The ISE program offers five different plans: (1) Thesis, (2) Non-Thesis,(3) Management, (4) Internship or Industry Project, and the (5) Accelerated 4+1 plan.

Admission Requirements

DEGREE PROGRAMS

Applicants must meet all of the general requirements for admission to Graduate Studies. Admission to the program is selective and based on the academic and professional qualifications of the applicant. Applicants with lesser qualifications may be granted provisional graduate student status based on evaluation of their undergraduate records, GRE results (if taken), work experience, and other professional qualifications.

Graduate assistantships may be offered to highly qualified applicants based on the needs of the program and the availability of funding.

The Master of Science in Engineering (MSE) may be characterized as being both career-oriented and flexible. Five different program plans are available to accommodate the needs of nearly every engineering graduate student. Graduate students enrolled in any of the Industrial and Systems Engineering (ISE) graduate programs must complete:

- 30 semester hours for the thesis plan,
- 30 semester hours for the non-thesis plan,
- 33 semester hours for the management plan,
- 30 semester hours for the internship/industry project plan, or
- 30 semester hours for the accelerated 4+1 MSE plan*.

*The accelerated 4+1 MSE plan is only available to students already in the YSU Industrial & Systems Engineering undergraduate program.

The degree requirements consist of core courses, technical courses, graduate internships, and thesis or project courses. The management plan requires a series of business (or other ISE) courses. The internship plan requires 6-9 semester hours of graduate-level internship courses. The internship must be in the Industrial and Systems discipline and comparable to graduate course work. The internship must be approved by the Graduate Program Director.

These degree programs are designed to provide graduate students with the knowledge and skills to excel in professional careers and/or pursue a PhD or doctorate degree in Industrial and Systems Engineering. To obtain a list of core and technical courses required in the ISE graduate program, students should contact the Graduate Program Director.

Program Plans

Thesis Plan

Graduate students choosing the thesis plan are required to complete 30 semester hours of graduate coursework. This generally consists of:

- 6-9 semester hours of core courses,
- 15-18 semester hours of technical concentration courses, and
- 6 semester hours of thesis.

This plan is strongly recommended for all candidates who wish to continue their graduate studies beyond the master's degree. The thesis provides firsthand research experience with experimental design, literature searches, research methodology, technical report writing, and oral presentation of results. Additionally, the thesis option can lead the graduate student to a higher level of expertise in the chosen area of specialization. Students enrolled in this plan are required to have a thesis proposal approved by the faculty advisor and the Graduate Program Director before the end of their second semester into the ISE graduate program.

Non-thesis Plan

The non-thesis plan is designed for students who wish to enhance their knowledge and skills to succeed in careers as practicing engineers, but are unlikely to pursue a PhD or doctoral degree. A total of 30 semester hours of coursework is required for this plan. This generally consists of:

- 6-9 semester hours of core courses,
- 18-21 semester hours of technical concentration courses, and
- 3 semester hours of graduate project.

Graduate students following the non-thesis plan must complete the graduate project under the guidance of a faculty advisor. Students are required to have a project proposal approved by the faculty advisor and the Graduate Program Director before the end of their second semester into the ME graduate program. Graduate students enrolled in a graduate project course will be required to defend the results of his or her project by giving a presentation to the engineering faculty and students.

Management Plan

Students who have been in the work arena and are moving into an engineering management role may wish to choose the management plan. A total of 33 semester hours of coursework is required for this plan. This consists of:

- 6-9 semester hours of core courses,
- 6-9 semester hours of business or industrial and systems engineering courses,
- 12-18 semester hours of technical courses, and
- 3-semester-hour graduate project.

Students enrolled in this plan is required to have a project proposal approved by the faculty advisor and the ISE Graduate Program Director before the end of their second semester in the program. A graduate student enrolled in a graduate project course will be required to defend the results of his or her project by giving a presentation to the engineering faculty and students. Students in the Management Plan should consult the Graduate Program Director and the faculty advisor to develop their course plan.

INTERNSHIP/industry project PLAN

This option is suitable for students who would like to gain practical experience in the industry before graduating with a master's degree. A total of 30

semester hours of coursework is required for this plan. The internship plan consists of:

- 6-9 semester hours of core courses,
- 12-15 semester hours of technical courses, and
- 6-9 semester hours of graduate-level internship courses.

Students enrolled in this plan are required to have an internship/industry project proposal approved by the Graduate Program Director before the end of their second semester into the program.

The graduate internship must be approved by the Industrial and Systems Engineering Graduate Program Director on a case by case basis for graduate course credit. The internship shall be in the industrial and systems discipline and be comparable to a graduate course work. A graduate internship or industry project will require at least 300 hours of work for 3 semester hours of graduate credit, 200 hours of work for 2 semester hours of graduate credit, and 100 hours of work for 1 semester hour of graduate credit. Internship students are strongly encouraged to consult with the STEM Professional Practices Office to seek internship opportunities.

Accelerated 4+1 MSE PLAN

Undergraduate students already in the YSU Industrial and Systems Engineering undergraduate program can apply for admission into the accelerated 4+1 MSE in Industrial and Systems Engineering graduate program after completing 78 semester hours with a GPA of 3.3 or higher. After being admitted into the accelerated 4+1 BE/MSE program, students will be allowed a maximum of nine semester hours of graduate coursework to be double-counted towards both bachelor's and master's degrees upon approval by the Graduate Program Director. An additional three hours of graduate coursework at 6000 level can be completed as an undergraduate and used exclusively for graduate credit.

A total of 30 semester hours of coursework is required for this plan. This consists of:

- 6-9 semester hours of core courses,
- 18-21 semester hours of technical courses, and
- 3 semester hours graduate project or 6 semester hours thesis

Industrial and Systems Engineering Requirements

At the time of initial enrollment, the student will select a program plan (thesis, non-thesis, management, or internship/project) and technical concentration area (engineering management, industrial/manufacturing systems engineering, operations research, etc.) The general requirements for each plan are listed above under Program Plans. Lists of required courses and possible electives for each plan may be obtained from the graduate program option coordinator. Every graduate student is responsible for selecting an area of specialization by signing a special form designed for this purpose. A student may change his or her area of concentration or program of study in consultation with his or her advisor.

In cooperation with an assigned faculty advisor, each student will establish a set of academic goals and desired outcomes, and a coursework plan to meet those objectives. Courses taken without the permission of the advisor may not be used to meet the degree requirements.

Thesis students who have registered for all required thesis hours and have completed all course requirements but have not finished the thesis are required to maintain current student status if they expect to utilize any University service (e.g., parking, computers, library, advisors' assistance, thesis defense, etc.). This can normally be accomplished by registering for at least one hour of thesis credit in ISEN 6990 Special Topics.

ISEN 5801 Operations Research 1 3 s.h.
Formulation and solution of engineering problems using linear programming. Model formulation, the primal, dual, and transportation simplex methods, duality theory, and sensitivity analysis.
Prereq.: MATH 2673.

ISEN 5811L Manufacturing Practices I Laboratory 1 s.h.
Experimental analysis of manufacturing processes. Process control and data acquisition. Experimental design applied to processes including polymer processes, casting, machining, and joining. Three hours laboratory.
Prereq. or Coreq.: ISEN 3723.

ISEN 5812L Manufacturing Practices 2 Laboratory 1 s.h.
Experimental analysis of advanced manufacturing techniques. Advanced sensing and controlling technologies. Real-time monitoring, metrology, and data acquisition. Numerically controlled (NC) machines and programming. Net-shape and additive manufacturing.
Prereq. or Coreq.: ISEN 5823.

ISEN 5820 Advanced Quality for Engineers 3 s.h.
Applications and practices of quality control in industry. Engineering and administrative aspects of quality control programs, process control, and acceptance sampling. Application of quantitative methods to the design and evaluation of engineered products, processes, and systems.
Prereq.: ISEN 3720.

ISEN 5823 Automation 3 s.h.
Principles and applications of sensing, actuation and control. Emphasis on hydraulic and pneumatic systems. Industrial process controllers, sensors and machine vision. Design and cost considerations for industrial automation applications.
Prereq.: MECH 2641, ECEN 2614 or consent of instructor.

ISEN 5825 Advanced Engineering Economy 3 s.h.
An extension of the topics in engineering economy. Analysis of rationale and norm of decision making, risk and uncertainty models, utility theory, measurement of productivity, and advanced project comparison methods.
Prereq.: ISEN 2624.

ISEN 5830 Human Factors Engineering 3 s.h.
Various aspects of human factors in the design of human-machine systems and environments. Study of human sensory, perceptual, mental, psychomotor, and other characteristics; techniques of measuring human capabilities, limitations, safety, comfort, and productivity.
Prereq.: MATH 2673.

ISEN 5850 Operations Research 2 3 s.h.
Formulation and solution of industrial engineering problems using operational research models. Topics include queuing models and the specialization of linear models to equipment replacement, project planning, assignment, and transshipment problems.
Prereq.: ISEN 5801.

ISEN 5880 Management of Technology 3 s.h.
The course discusses major topics in management of technology and innovations. Dynamics of technology innovation, sources of technology innovations, corporate technology strategy, collaboration and intellectual property, structures and process for innovations, idea generation, commercialization of technology and innovations, and market entry.
Prereq.: Senior standing or consent of instructor.

ISEN 5881 Competitive Manufacturing Management 3 s.h.
Basic principles of manufacturing competitiveness. The role of engineers in promoting competitiveness. Discussion of new technologies used in modern manufacturing management including, continuous improvement, waste elimination, JIT, lean production systems, setup time reduction, equipment maintenance/improvement, total quality management, and supply chain management.
Prereq.: ISEN 3723 or consent of instructor.

ISEN 6901 Optimization Techniques 3 s.h.
A study of the theory of optimization and its application to problems from several engineering disciplines. The principles will be applied to constrained and unconstrained engineering problems. Algorithms will be developed for solving optimization problems, which can be formulated as linear, nonlinear, integer, or dynamic programming models.

ISEN 6902 Digital Simulation 3 s.h.
A study of simulation methods using digital computers, random number generation, Monte Carlo techniques, queuing models, and analysis of simulation output. The student will be provided the opportunity to simulate moderately complex systems on digital computers. Primary emphasis will be on models of technical, scientific, and economic systems.

ISEN 6905 Applied Statistics for Design, Quality, and Productivity 3 s.h.
Review of probability and statistics, uncertainty and decision making, statistical inference, and analyzing sources of variation. Risk and reliability, risk assessment, robust and quality design, regression analysis, and analysis of variance. Design of experiments, single-factor and multifactor experiments, design of experiments for product characteristics, process characteristics, and process optimization. General statistical process control, special charts and sampling techniques for control, monitoring, and auditing quality. Economic issues in process/quality control.
Prereq.: ISEN 3710 Engineering Statistics or equivalent.

ISEN 6906 Supply Chain Engineering 3 s.h.
In an expanding global economy, efficient and responsive supply chains are critical to business success. This course explores key aspects of supply chain engineering with an emphasis on mathematical approaches to supply chain analysis. Topics include demand forecasting, inventory modeling and control, facility location, capacity planning, transportation, warehousing, scheduling, material requirements planning and procurement.
Prereq.: ISEN 3710/ISEN 6921 and consent of instructor.

ISEN 6908 Logistics Engineering and Mgt 3 s.h.
Study of logistics from a systems engineering perspective. Covers design of systems for supportability and serviceability, the production and effective distribution of systems for customer use, and the sustaining maintenance and support of systems throughout their period of utilization.
Prereq.: ISEN 3720, ISEN 5801 or consent of the instructor.

ISEN 6910 Design and Analysis Experiment 3 s.h.
For professionals from business and industry, and students. Specific topics will be announced each time the workshop is offered. Credit hours based on frequency and duration of workshop meetings.

ISEN 6912 Network Flows 3 s.h.
Flow problems on networks. Maximum flow minimum cut theorem. Labeling algorithms. Circulation and feasibility theorems. Sensitivity analysis. Incidence matrices. Shortest routes. Minimum cost flows, out-of-kilter algorithm. Critical path networks, project cost curves. Multi-commodity flow problem, billows. Matching problems in graph theory.
Prereq.: ISEN 5801 or MATH 3720.

ISEN 6920 Project Management 3 s.h.
Methods for planning, organizing, scheduling, supporting, and controlling projects. Network techniques, including CPM, PERT, and time-cost trade-off analysis. Techniques for the estimation of time, manpower, and other resource requirements of the projects, including economic and statistical analysis, forecasting, learning curves, and line balancing. Management of time and other resources involved. Case studies and utilization of computer resources for the analysis and presentation of projects.
Prereq.: graduate standing in STEM college.

ISEN 6921 Engineering Statistics 3 s.h.
Development and application of stochastic models of engineering systems. Elementary probability models applied to decision making under uncertainty. Development and use of theoretical probability distributions for describing stochastic systems. Models for point and confidence interval estimation and models for correlation analysis applied to engineering problems.
Prereq.: ISEN 3710 or equivalent.

ISEN 6930 Microcomputer Models for Deterministic Engineering Systems 3 s.h.
Microcomputer model development, implementation, evaluation, and application for deterministic engineering systems. Recognition of engineering systems amenable to analysis as deterministic microcomputer models. Determination of model structure, identification of model parameters, verification of model validity, exercising the model, and interpretation of results.

ISEN 6935 Decision Analysis for Engineering 3 s.h.
Review of probability and statistics, subjective probability, probability models, using data, Monte Carlo simulation, and value of information. Introduction to decision analysis, elements of decision problems, structuring decisions, making choices, creativity, and decision making. Risk attitudes, utility axioms, paradoxes, and conflicting objectives.
Prereq.: ISEN 3710 Engineering Statistics or equivalent, or permission of instructor.

ISEN 6939 Operations & Supply Chain Strategy 3 s.h.
This course explores manufacturing and service processes for transforming resources into technology-based products. It will cover strategies and processes for moving information and materials through the supply chain, strategies to support overall firm objectives, product development programs and capacity utilization requirements. The course will also explore manufacturing for flow design and facility layout; six sigma quality and statistical process control, lean supply chains, logistics, distribution and global sourcing; ERP', and inventory management.
Prereq.: ISEN 3710 or equivalent.

ISEN 6970 Advanced Manufacturing Processes 1 3 s.h.
Advanced manufacturing processes for metallic materials. Included are continuous casting, powder techniques, fluidized bed reactors, and directional solidification.

ISEN 6971 Advanced Manufacturing Processes 2 3 s.h.
Advanced manufacturing processes for nonmetallic materials. Included are sintering, slip casting, plastic forming techniques, and extrusion of nonplastic materials.

ISEN 6990 Special Topics 3 s.h.
Special topics in industrial/manufacturing systems engineering covering areas not otherwise available. Topics are selected by the faculty from fields of current research interest or special emphasis and may vary from semester to semester. May be repeated for a maximum of six semester hours.

ISEN 6992 Graduate Projects 3 s.h.
Analysis, design, research, or other independent investigation on projects selected with the advice and approval of the student's graduate committee.
Prereq.: Permission of instructor.

ISEN 6999 Thesis 1-6 s.h.
Hours arranged. May be repeated.

Learning Outcomes

The student outcomes of the master's degree in ISE are:

1. Student will be able to use and apply discipline knowledge effectively and provide leadership (interpret, analyze and implement solutions to problems/challenges) within an organization.

2. Student will be able to form, facilitate, lead, coordinate and participate in teams.

3. Student will be able to understand organizational processes and behaviors.

4. Student will have a graduate level knowledge of methodological and computational skills with which able to apply effectively.

5. Student will have a graduate level proficiency in collecting, analyzing, and interpreting data

6. Student will have graduate level proficiency in approaching unstructured problems and synthesizing and designing solutions for this problem.

7. Student will have a graduate level proficiency in evaluating the impact of these solutions in the broader context of the organization and society.

8. Student will have a graduate level proficiency in effectively presenting and communicating solutions in the form of written, oral and electronic media.

9. Student will be able to develop skills to support life-long learning within the field of profession of ISE.