

# Industrial and Systems Engineering Master of Science Degree Program in Manufacturing Engineering

## Department of Integrated Systems Engineering The Ohio State University

**Admission Requirements.** In general, preference is given to applicants who are graduates of accredited colleges and universities in the U.S. with a Bachelor of Science degree from an ABET accredited Engineering program, and with a CGPA of 3.2/4.0 or greater. Applicants who are engineering graduates of non-U.S. institutions and are clearly outstanding may be accepted as resources and as faculty workloads permit. GRE test is required of all applicants. TOEFL test is required for any international students from countries on the OSU Admissions Office list (typically where the primary language is not English), unless a bachelor's degree was earned in an English speaking country. (International students who want to be considered for a Graduate Teaching Associate position do, however, need to take the TOEFL to be considered.) These requirements also apply to all students who apply to transfer from another graduate program at OSU to ISE. New international graduate students for whom English is not the first language must certify their proficiency in spoken English before assuming Graduate Teaching Associate (GTA) duties. They may become certified by scoring 28 or higher on the spoken portion of the TOEFL iBT or by scoring at the appropriate level on the Oral Proficiency Assessment (OPA) administered by the ESL Spoken English Program.

**Program Description.** The MS program in Manufacturing Engineering provides for students to pursue their intellectual interests in advancing the technology of manufacturing methods and materials, and design for manufacturing. Faculty members in ISE work with graduate students in small groups, or on an individual basis, toward advancing technology in the following specific areas:

- Polymer composites and nanocomposites manufacturing
- Forming of lightweight materials
- Light metal alloy development
- Light metal casting processes
- Micromachining and precision engineering

The ISE MS program offers two options, a thesis option, and a non-thesis option.

**Course Requirements.** All Manufacturing Engineering MS students must satisfy the general degree requirements defined in the Industrial and Systems Engineering [Graduate Student Handbook](#). MS ISE graduate degree core program minimum requirements include 30 total graduate-level credit hours, of which at least 80% must be taken at OSU (24 semester hours).

For the Manufacturing Engineering MS degree (thesis or non-thesis option), this includes:

- Minimum of 9 semester credit hours of ISE graduate level courses in the sub-discipline of Manufacturing Engineering.
  - **ISE 5501 Fundamentals of Solid State Processing (3 credit hours):** Principles of elastic/plastic deformation of metallic solids, application of heat transfer, mechanical behavior of metals, and tribology to bulk forming processes (forging, extrusion, rolling, wire and bar drawing), sheet metal forming and shearing, and machining of metals by chip-forming processes.
  - **ISE 5502 Fundamentals of Liquid Shaping Processes /MATSCEN 5451 Process Metallurgy (cross-listed course, 3 credit hours):** Principles of liquid metal processing, application of thermodynamics, kinetics, and macro-transport phenomena to primary metals production, refining, and solidification of metal casting alloys.
  - **ISE 5540 Polymer Processing Fundamentals (3 credit hours):** Application of fundamentals of transport phenomena and polymer constitutive equations to the analysis of plastic component manufacture.
- Minimum of 3 semester credit hours of graduate level course work from a second sub-discipline within ISE.
  - **ISE 5200 Linear Optimization (3 credit hours):** Introduction to the linear optimization and applications. Topics include model formulation, solution methods, polyhedral and duality theory, sensitivity analysis, and software usage.
  - **ISE 5100 Performance Modeling and Simulation (3 credit hours):** System modeling using stochastic models and discrete event simulation; system design and decision-making using analysis and simulation tools.
  - **ISE 5700 Cognitive Systems Engineering (3 credit hours):** Human-centered design of consumer products, web sites and complex sociotechnical systems. Topics include human-computer interaction and the design of decision support and distributed work systems.
  - **ISE 6300 Simulation for System Analytics and Decision-Making (3 credit hours):** Students learn how to collect data and perform input analysis, model systems using discrete-event simulation, and inform system design decision-making through defensible output analysis.
- Minimum of 3 semester credit hours of graduate level course work focused on mathematical, statistical, or numerical methodologies.
  - **ISE 5110 Design of Engineering Experiments (3 credit hours):** Plan and analyze experiments relevant to system design. Also, students will learn regression and alternative approaches for on-hand data analysis.
  - **ISE 5503 Manufacturing Processes and Simulation (3 credit hours):** Principles of simulation by numerical methods for manufacturing processes such as casting, machining, sheet forming, and injection molding.
  - **MECHENG 5139 Applied Finite Element Method (3 credit hours):** Overview of finite element method, description of finite element software, modeling requirements and techniques, analysis using general purpose software, and case studies.
- Minimum of 2 semester credit hours of ISE Graduate Research Seminar.

- **ISE 7883 Graduate seminar (1 credit hour), or equivalent seminar course in MATSCEN, MECHENG, or CBE**
- Recommended Manufacturing Engineering elective courses.
  - **ISE 5530 Fundamentals of Tool Engineering (3 credit hours):** Form, function, mechanical elements, common materials, thermal considerations and economic analysis in the design of work---holding fixtures and jigs, dies/molds, and cutting tools.
  - **ISE 5550 Principles of Precision Engineering (3 credit hours):** Principles of precision engineering with focus on design and performance of precision machinery, machine tool metrology and precision manufacturing processes.
  - **ISE 5555 Manufacturing Processes and Machine Tools (3 credit hours):** Analysis of machining processes: cutting, grinding and milling, including descriptive and analytical treatments of machining processes, equipment, and computer control.
  - **MECHENG 5680 Computer Aided Design and Manufacturing (4 credit hours):** Design of machine components, surfaces, and assemblies using parametric and feature---based design principles and advanced design tools.
  - **MECHENG 5682 Fundamentals of Product Design Engineering (4 credit hours):** Fundamentals of the product design process, from concept creation to final implementation, including product architecture and design for manufacture and assembly.
  - **MATSCEN 5441 Physical Metallurgy (3 credit hours):** Physical metallurgy of ferrous and non---ferrous alloys, with emphasis on alloy design, processing and structure---property relations.
  - **ISE 5463 Manufacturing of Energy Systems (3 credit hours):** Design, manufacture and integration of conventional and renewable energy systems including their environmental impact.

**Thesis option program requirements include:**

- Minimum of 22 semester hours of graduate level course work, which must include MS ISE core requirements listed above, plus graduate level Manufacturing Engineering elective courses.
- Minimum of 4 semester hours of thesis research (ISE 8998).
- The total of course hours, plus research hours, must sum to be a minimum of 30 semester hours.
- Successful fulfillment of the Graduate School final thesis examination and thesis document approval requirements.

**Non---Thesis option program requirements include:**

- Minimum of 30 semester hours of graduate level course work, which must include the MS ISE core requirements listed above, plus graduate level Manufacturing Engineering elective courses.
- Successful fulfillment of the Graduate School non---thesis final exit examination requirement.