

Advanced and Intelligent Manufacturing, MS

The Department of Mechanical and Industrial Engineering offers the Master of Science in Advanced and Intelligent Manufacturing to meet the growing demand for engineers, researchers, and scientists trained in advanced manufacturing and Industry 4.0 technologies. This degree program offers students an opportunity to either train for industry jobs with coursework and co-op experience or prepare for a doctoral program through coursework and research experience. The MIE department offers both core courses and elective courses required to complete the program. Students can take MS Project or MS Thesis under any MIE faculty. This program is designed for engineering and science students planning to pursue careers in advanced and smart manufacturing. The key sectors that require manufacturing professionals include automotive, aerospace, defense, appliances, computing machines, smartphones, and communication equipment. The MS in AIM program helps students acquire knowledge and skills to:

- Build digital (CAD) models of parts and products to support manual and computer-aided manufacturing
- Design, develop, and analyze traditional and advanced manufacturing processes
- Utilize additive manufacturing to produce complex parts with ease and efficiency
- Select manufacturing processes to fabricate parts and products for quality and cost
- Configure and analyze manufacturing systems for efficiency, responsiveness, and high throughput
- Understand the characteristics and challenges of nanomanufacturing processes
- Leverage Industry 4.0 technologies including Internet of Things, cloud computing, sensor analytics for advanced manufacturing
- Adopt condition-based maintenance strategies to achieve high resource utilization
- Apply automation, robotics, and artificial intelligence to make manufacturing smart and self-operational
- Use human-machine interaction tools such as augmented reality and virtual reality
- Analyze human performance in sociotechnical systems such as supply chains
- Apply data analytics methods to gain insights from design and manufacturing data

In the context of this program, the traditional manufacturing covers metal removal, forming, casting, and particulate processes. The additive manufacturing covers topics such as 3D-printed parts using different approaches. The nanomanufacturing covers fabrication as well as printing of micro and nano devices and design and creation of multifunctional materials. Intelligent manufacturing focuses on factory automation, prognostics and health management, dynamic scheduling, cloud-enabled manufacturing, and industrial Internet of Things for manufacturing performance assurance. It also leverages real-time data analytics and control systems, advanced high-fidelity models, networked data, and computation for seamless interoperation of cyber and physical assets in manufacturing facilities.

General Degree Requirements

To be eligible for admission to any of the MS degree programs, a prospective student must hold a Bachelor of Science degree in engineering, science, mathematics, statistics, or an equivalent field. Students in all master's degree programs must complete a minimum of 32 semester hours of approved coursework (exclusive of any preparatory courses) with a minimum grade-point average of 3.000. Students can complete a master's degree by pursuing any of one of the three tracks: coursework option, project option, and thesis option. Specific degree requirements for each of these tracks can be found under the Program Requirements tab. Students may pursue any program either on a full-time or part-time basis; however, certain restrictions may apply.

Specific Degree Requirements

Core courses for the Master of Science in Advanced and Intelligent Manufacturing provide students with a foundation in traditional and advanced materials processing, additive manufacturing, intelligent manufacturing, and digital manufacturing. Students can select electives from a wide range of fields including mechanical engineering, industrial engineering, operations research, and engineering management. Alternatively, students can also take courses outside the MIE department by seeking a prior approval from their faculty advisor or MS thesis advisor. The course curriculum is designed to prepare students for industry jobs as well as for pursuing a doctoral program in manufacturing, mechanical engineering, and industrial engineering.

Academic and Research Advisors

All nonthesis students are advised by the faculty advisor designated for their respective concentration or program. Students willing to pursue the thesis option must first find a research advisor within their first year of study. The research advisor will guide the students' thesis work, and thesis reader(s) may be assigned at the discretion of their research advisor. The research advisor must be a full-time or jointly appointed faculty in the MIE department. If the research advisor is outside the MIE department, before the thesis option can be approved, a faculty member with 51% or more appointments in the MIE department must be chosen as co-advisor, and a petition must be filed and approved by the co-advisor and the MIE Graduate Affairs Committee. Thesis option students are advised by the faculty advisor of their concentration before they select their research advisor(s). The research advisor and co-advisor must serve as thesis readers.

Plan of Study and Course Selection

It is recommended that all new students attend orientation sessions held by the MIE department and the Graduate School of Engineering to acquaint themselves with the coursework requirements and research activities of the department as well as with the general policies, procedures, and expectations.

In order to receive proper guidance with their coursework needs, all MS students are strongly encouraged to complete and submit a fully signed Plan of Study to the department before enrolling in second-semester courses. This form not only helps the students manage their coursework but it also helps the department to plan for requested course offerings. The PS form may be modified at any time as the students progress in their degree programs.

Students pursuing study or research under the guidance of a faculty member can choose project option by taking Master's Project (IE 7945) or Master's Project (ME 7945). An MS project must be petitioned to the MIE Graduate Affairs Committee and approved by both the faculty member (instructor for Master's Project) and the student's academic advisor. The petition must clearly state the reason for taking the project course; a brief description of the goals; as well as the expected outcomes, deliverables, and grading scheme.

Options for MS Students (coursework only, project, or thesis)

Students accepted into any of the MS programs in the MIE department can choose one of the three options: coursework only, project, or thesis. Please see the Program Requirements tab on the top menu of this page for more information. MS students who want to pursue project or thesis options must find, within the first year of their study, a faculty member or a research advisor who will be willing to direct and supervise a mutually agreed research project or MS thesis. Moreover, students who receive financial support from the university in the form of a research, teaching, or tuition assistantship must complete 8 semester hours of thesis.

Students who complete the thesis option must make a presentation of their thesis before approval by the department. The MS thesis presentation shall be publicly advertised at least one week in advance and all faculty members and students may attend and participate. If deemed appropriate by the research advisor, other faculty members may be invited to serve as thesis readers to provide technical opinions and judge the quality of the thesis and presentation.

Change of Program/Concentration

Students enrolled in any of the MIE department programs or concentrations may change their current program or concentration no sooner than the beginning of their second full-time semester of study. In order for the program or concentration change request to be considered by the MIE Graduate Affairs Committee, the student must not be in the first semester of their current program, must have a 3.300 GPA, and have completed at least 8 semester hours of required coursework in their sought program at Northeastern University.

Graduate Certificate Options

Students enrolled in a graduate degree program in the College of Engineering are eligible to pursue an engineering graduate certificate in addition to or in combination with the MS degree. For more information please refer to Graduate Certificate Programs (<https://catalog.northeastern.edu/graduate/engineering/graduate-certificate-programs/>).

GORDON INSTITUTE OF ENGINEERING LEADERSHIP

Master's Degree in Advanced and Intelligent Manufacturing with Graduate Certificate in Engineering Leadership

Students may complete a Master of Science in Advanced and Intelligent Manufacturing in addition to earning a Graduate Certificate in Engineering Leadership (<https://catalog.northeastern.edu/graduate/engineering/multidisciplinary/engineering-leadership-graduate-certificate/>). Students must apply and be admitted to the Gordon Engineering Leadership Program to pursue this option. The program requires fulfillment of the 16-semester-hour curriculum required to earn the Graduate Certificate in Engineering Leadership, which includes an industry-based challenge project with multiple mentors. The integrated 32-semester-hour degree and certificate will require 16 hours of advisor-approved industrial engineering technical courses.

Program Requirements

- Concentrations and course offerings may vary by campus and/or by program modality. Please consult with your advisor or admissions coach for the course availability each term at your campus or within your program modality.
- Certain options within the program may be *required* at certain campuses or for certain program modalities. Please consult with your advisor or admissions coach for requirements at your campus or for your program modality.

Complete all courses and requirements listed below unless otherwise indicated.

Core Requirements

Code	Title	Hours
Complete 16 semester hours from the following: 16		
IE 5360	Digital Manufacturing	
IE 5380	Integrated Automation	
IE 6300	Manufacturing Methods and Processes	
IE 7270	Intelligent Manufacturing	

ME 5640	Additive Manufacturing
ME 6420	Advanced Materials and Technologies in Manufacturing

Restricted Elective Course

Code	Title	Hours
Complete 4 semester hours from the following:		4
IE 6500	Human Performance	
ME 5240	Computer Aided Design and Manufacturing	
ME 7374	Special Topics in Mechanical Engineering (Nano and Microscale Manufacturing)	

Options

Complete one of the following options:

COURSEWORK OPTION

Code	Title	Hours
Complete 12 semester hours from the electives course list below.		12

PROJECT OPTION

Code	Title	Hours
IE 7945	Master's Project	4
or ME 7945	Master's Project	
Complete 8 semester hours from the electives course list below.		8

THESIS OPTION

Code	Title	Hours
IE 7945	Master's Project	4
or ME 7945	Master's Project	
IE 7990	Thesis ¹	4
or ME 7990	Thesis	
Complete 4 semester hours from the electives course list below.		4

In addition to completing the thesis course, students must successfully complete the thesis submission process, including securing committee and Graduate School of Engineering signatures and submission of an electronic copy of their MS thesis to ProQuest.

Electives

Any course in the following list will serve as an elective course, provided the student satisfies prerequisites and program requirements. Students can take electives outside this list with prior approval from the faculty advisor.

Code	Title	Hours
Industrial Engineering		
IE 5617	Lean Concepts and Applications	
IE 6200	Engineering Probability and Statistics	
IE 7200	Supply Chain Engineering	
IE 7215	Simulation Analysis	
IE 7270	Intelligent Manufacturing	
IE 7275	Data Mining in Engineering	
IE 7280	Statistical Methods in Engineering	
IE 7285	Statistical Quality Control	
IE 7290	Reliability Analysis and Risk Assessment	
IE 7315	Human Factors Engineering	
IE 7374	Special Topics in Industrial Engineering	
IE 7615	Neural Networks and Deep Learning	
IE 7945	Master's Project	
IE 7990	Thesis	
IE 7996	Thesis Continuation - Half-Time	
Operations Research		
OR 7230	Probabilistic Operation Research	

4 Advanced and Intelligent Manufacturing, MS

OR 7240	Integer and Nonlinear Optimization
OR 7245	Network Analysis and Advanced Optimization
OR 7310	Logistics, Warehousing, and Scheduling
Materials Engineering	
MATL 6270	Principles, Devices, and Materials for Energy Storage and Energy Harvesting
MATL 6285	Structure, Properties, and Processing of Polymeric Materials
MATL 7365	Properties and Processing of Electronic Materials
Mechanical Engineering	
ME 5245	Mechatronic Systems
ME 5250	Robot Mechanics and Control
ME 5645	Environmental Issues in Manufacturing and Product Use
ME 5650	Advanced Mechanics of Materials
ME 5659	Control Systems Engineering
ME 7247	Advanced Control Engineering
Engineering Management	
EMGT 5220	Engineering Project Management
EMGT 6225	Economic Decision Making
EMGT 6305	Financial Management for Engineers

Program Credit/GPA Requirements

32 total semester hours required

Minimum 3.000 GPA required

- ¹ A thesis is required for all students who receive financial support from the university in the form of a research, teaching, or tuition assistantship. The thesis topic should cover one or more of the areas from statistics, mathematics, optimization, data mining, machine learning, database design, Big Data, visualization tools, or forecasting methods. The thesis should train students for research in data and operations analytics and/or prepare them for a doctoral program.