MASTER OF SCIENCE (M.S.), MAJOR IN ENGINEERING

Major Program
The master of science (M.S.) degree with a major in engineering provides a practical, industry-driven focus via a long-term, targeted technical project or thesis related to real-world engineering applications. These projects will be conducted in partnership with local industries and may involve off-campus collaborations. The degree requires a large-scale project or thesis because the abilities to solve problems, innovate and make immediate contributions to industry are best developed by having students confront a large, open-ended problem; perform detailed research on the problem; develop various solutions; choose and implement the best solution; validate their choice; and effectively communicate the process to professional colleagues, executives, and customers.

Admission Policy
For information regarding admission application requirements and deadlines, please visit The Graduate College website at http://www.gradcollege.txstate.edu/engr.html.

Degree Requirements
The program has two options:

1. A traditional thesis option focused on an academic research topic;
2. A directed technical research option focused on a practical, industry-driven project.

Both degree options require a minimum of 34 hours:

<table>
<thead>
<tr>
<th>Engineering Core</th>
<th>18</th>
</tr>
</thead>
<tbody>
<tr>
<td>Required courses (9 hours)</td>
<td></td>
</tr>
<tr>
<td>Elective courses (9 hours)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>General Core Courses</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 hour of Seminar</td>
<td></td>
</tr>
<tr>
<td>At least 6 hours of thesis or project course work</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Multidisciplinary Elective Courses</th>
<th>9</th>
</tr>
</thead>
</table>

| Total Hours | 34 |

The degree structure is comprised of three separate concentration areas: electrical engineering, industrial engineering, and manufacturing engineering. As part of the application process, students declare a major in one of these three concentrations.

Engineering Core

<table>
<thead>
<tr>
<th>General Required Course</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>ENGR 5310</td>
<td>Probability, Random Variables, &amp; Stochastic Processes for Engineers</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Concentration-Specific Required Courses</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electrical Engineering</td>
<td></td>
</tr>
<tr>
<td>EE 5320</td>
<td>Advanced Computer Architecture and Arithmetic</td>
</tr>
<tr>
<td>EE 5350</td>
<td>Advanced Electronic Circuit Design</td>
</tr>
<tr>
<td>Industrial Engineering</td>
<td></td>
</tr>
<tr>
<td>IE 5320</td>
<td>Modeling and Analysis of Manufacturing Systems</td>
</tr>
</tbody>
</table>

| IE 5340 | Applied Deterministic Operations Research for Engineers |
| MFGE 5316 | Advanced Computer Aided Design and Manufacturing |
| MFGE 5326 | Advanced Robotics in Manufacturing Automation |

<table>
<thead>
<tr>
<th>Engineering Electives</th>
<th>9</th>
</tr>
</thead>
<tbody>
<tr>
<td>Select three of the following:</td>
<td></td>
</tr>
<tr>
<td>EE 5233</td>
<td>Digital Image Processing</td>
</tr>
<tr>
<td>EE 5330</td>
<td>Embedded and Real-Time Computing</td>
</tr>
<tr>
<td>EE 5355</td>
<td>Electronic Materials and Devices</td>
</tr>
<tr>
<td>EE 5360</td>
<td>Thin Film Technology</td>
</tr>
<tr>
<td>EE 5372</td>
<td>Advanced Networking</td>
</tr>
<tr>
<td>EE 5374</td>
<td>Introduction to Wireless Communication</td>
</tr>
<tr>
<td>EE 5377</td>
<td>Statistical Signal Processing</td>
</tr>
<tr>
<td>EE 5385</td>
<td>Optoelectronic Devices</td>
</tr>
<tr>
<td>IE 5310</td>
<td>Advanced Statistical Design of Experiments for Engineers</td>
</tr>
<tr>
<td>IE 5330</td>
<td>Advanced Quality Control and Reliability Engineering</td>
</tr>
<tr>
<td>IE 5343</td>
<td>Non-Linear Optimization Techniques for Engineers</td>
</tr>
<tr>
<td>IE 5345</td>
<td>Advanced Optimization</td>
</tr>
<tr>
<td>IE 5347</td>
<td>Modern Heuristic Optimization</td>
</tr>
<tr>
<td>IE 5397</td>
<td>System Thinking and Analysis</td>
</tr>
<tr>
<td>MFGE 5318</td>
<td>Reverse Engineering and Freeform Fabrication</td>
</tr>
<tr>
<td>MFGE 5320</td>
<td>Polymer Nanocomposites</td>
</tr>
<tr>
<td>MFGE 5328</td>
<td>Advanced Control Techniques</td>
</tr>
<tr>
<td>ENGR 5384</td>
<td>Problems in Engineering</td>
</tr>
</tbody>
</table>

| Total Hours | 18 |

1 Specified by the graduate committee for the student's plan of study.

General Core

<table>
<thead>
<tr>
<th>Seminar Course</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td>ENGR 5100</td>
<td>Seminar in Engineering</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Project OR Thesis Course Work</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project Option (Choose a minimum 6 hours):</td>
<td></td>
</tr>
<tr>
<td>ENGR 5198B</td>
<td>Project</td>
</tr>
<tr>
<td>ENGR 5298B</td>
<td>Project</td>
</tr>
<tr>
<td>ENGR 5398A</td>
<td>Project</td>
</tr>
<tr>
<td>ENGR 5398B</td>
<td>Project</td>
</tr>
<tr>
<td>ENGR 5598B</td>
<td>Project</td>
</tr>
<tr>
<td>ENGR 5998B</td>
<td>Project</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Project Thesis Option (Choose a minimum 6 hours):</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>ENGR 5199B</td>
<td>Thesis</td>
</tr>
<tr>
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<td>Thesis</td>
</tr>
<tr>
<td>ENGR 5399A</td>
<td>Thesis</td>
</tr>
<tr>
<td>ENGR 5399B</td>
<td>Thesis</td>
</tr>
<tr>
<td>ENGR 5599B</td>
<td>Thesis</td>
</tr>
<tr>
<td>ENGR 5999B</td>
<td>Thesis</td>
</tr>
</tbody>
</table>

| Total Hours | 7 |
Multidisciplinary Elective Courses
The multidisciplinary elective courses (9 hours) are specified by the student's graduate committee and are chosen from a set of engineering-related courses from other disciplines including business, technology, mathematics, computer science, physics, or chemistry. Click on the course name for course descriptions or navigate to the appropriate department page.

Business Administration
CIS 5358 IT Systems Project Management 3
CIS 5364 Data Warehousing and Mining 3
CIS 5370 Enterprise Resource Planning 3
MGT 5311 Process Improvement Management in Organizations 3
MGT 5315 New Venture Management 3
MGT 5321 Supply Chain Management 3
MGT 5390 Business Research Methods 3
QMT 5335 Introduction to Forecasting and Simulation 3

Industrial Technology
TECH 5315 Engineering Economic Analysis 3
TECH 5390 Research in Technology 3
TECH 5392 Fundamentals of Microelectronics Manufacturing 3

Computer Science
CS 5306 Advanced Operating Systems 3

Mathematics
MATH 5340 Scientific Computation 3
MATH 5345 Regression Analysis 3
MATH 5376A Design and Analysis of Experiments 3
MATH 5376B Analysis of Variance 3
MATH 5388 Discrete Mathematics 3

Physics
PHYS 5326 Electrical Characterization of Materials and Devices 3
PHYS 5327 Microelectronics Device Physics 3

Material Science, Engineering, and Commercialization
MSEC 7301 Practical Skills in Commercialization and Entrepreneurship 3
MSEC 7302 Leadership Skills in Commercialization and Entrepreneurship 3
MSEC 7310 Nanoscale Systems and Devices 3
MSEC 7311 Materials Characterization 3

All students will have a faculty advisor and a graduate committee composed of a minimum of three graduate faculty members (including the faculty advisor). The faculty advisor will provide technical direction for the student's project/thesis, and the graduate committee will be responsible for approving the project/thesis proposal, receiving project/thesis progress reports, and approving the final project/thesis presentation and written report. Oral thesis defense or oral project presentation will serve as the comprehensive examination.

If a student elects to follow the thesis option for the degree, a committee to direct the written thesis will be established. The thesis must demonstrate the student's capability for research and independent thought. Preparation of the thesis must be in conformity with the Graduate College Guide to Preparing and Submitting a Thesis or Dissertation. The thesis handbook may be accessed at http://www.gradcollege.txstate.edu/docs/Thesis_Diss_Guide.pdf.

Thesis Proposal
The student must submit an official Master's Thesis Proposal form to their thesis committee. The required thesis proposal form may be obtained from The Graduate College at http://www.gradcollege.txstate.edu/gcforms.html. After signing the form and obtaining committee members' signatures, graduate advisor's signature (if required by the program), and the department chair's signature, the student must submit the thesis proposal form with one copy of the proposal attached to the dean of The Graduate College for approval before proceeding with research on the thesis. If the thesis research involves human subjects, the student must obtain exemption or approval from the Texas State Institutional Review Board prior to submitting the proposal form to The Graduate College. If the thesis research involves vertebrate animals, the proposal form must include the Texas State IACUC approval code. It is recommended the thesis proposal form be submitted to the dean of The Graduate College by the end of the student's enrollment in 5399A.

Thesis Committee
The thesis committee must be composed of a minimum of three approved graduate faculty members.

Thesis Enrollment and Credit
The completion of a minimum of six hours of thesis enrollment is required. Enrollment for the thesis will be in course number 5399A for a student's initial thesis enrollment and a thesis B course for each subsequent thesis enrollment in the field in which the subject matter of the thesis falls, e.g., ENG 5399A, ENG 5199B, ENG 5299B, ENG 5399B, ENG 5599B, and ENG 5999B. Preliminary discussions regarding the selection of a topic and assignment to a research supervisor will not require enrollment for the thesis course.

A student will be required to enroll in and pay the fee for at least one hour of the thesis course during any term in which the student will receive thesis supervision or guidance and/or in which the student is using university resources. Failure to register for the thesis course during a term in which supervision is received may result in postponement of graduation. After initial enrollment in 5399A, the student will continue to enroll in a thesis B course as long as it takes to complete the thesis. In the rare case when a student has not previously enrolled in thesis and plans to work on and complete the thesis in one term, the student will enroll in both 5399A and 5399B. The only grades assigned for thesis courses are PR (progress), CR (credit), W (withdraw), and F (failing). If acceptable progress is not being made in a thesis course, the instructor may issue a grade of F. If the student is making acceptable progress, a grade of PR is assigned until the thesis is completed. The minimum number of hours of thesis credit (“CR”) will be awarded only after the thesis is filed in the Alkek Library and the librarian has electronically returned the thesis card to the office of The Graduate College.

A student who has selected the thesis option must be registered for the thesis course during the term or Summer I (during summer the thesis course runs ten weeks for both sessions) in which the degree will be conferred.
Fee Reduction
A master's degree candidate for graduation may be eligible for a one-time fee reduction under V.T.C.A. Education Code, Section 54.054. Please refer to the section titled Fee Reduction in the Additional Fees and Expenses chapter of this catalog for more information.

Thesis Deadlines and Approval Process
Thesis deadlines are posted at the following web page: http://www.gradcollege.txstate.edu/Thes-Diss_Info/T-D_Deadlines.html. The completed thesis must be submitted to the chair of the thesis committee no later than 41 days before the date of the commencement at which the degree is to be conferred.

The following must be submitted to the office of The Graduate College no later than 24 days, not counting weekends or holidays, before the date of commencement at which the degree is to be conferred (see The Graduate College webpage for specific deadlines):

1. The Thesis/Dissertation Committee Approval form bearing original signatures of the student and all committee members.
2. One (1) copy of the thesis in final form, approved by all committee members, on standard paper (Hard-copy Submission Option) or PDF of the thesis in final form, approved by all committee members, uploaded in the on-line Vireo submission system (Vireo On-line Submission Option).

After the dean of The Graduate College approves the thesis, the process is as follows:

1. For the Vireo On-line Submission Option:
   a. No copies are required to be submitted to the Alkek Library. However, Alkek will bind copies submitted that the student wants bound for personal use. Personal copies are not required to be printed on archival quality paper. The student will take the personal copies to the Alkek Library and pay the binding fee for personal copies.

Master’s level courses in Engineering: ENGR (p. 3), EE (p. 5), IE (p. 6), MFGE (p. 7)

Courses Offered
Engineering (ENGR)

ENGR 5100. Seminar in Engineering.
Graduate students attend seminars by invited speakers presenting relevant topics in academia and industry. The schedule of speakers will be developed each semester with strict faculty supervision. This course may only be taken for credit one time. Restricted to students enrolled in the MS Engineering program.
about Seminar in Engineering
Grade Mode: Credit/No Credit

ENGR 5101. Academic Instruction for Engineering Graduate Assistants.
This course is seminar based and covers topics related to teaching and employment responsibilities. Completion of this course is required as a condition of employment for graduate assistants. This course does not earn graduate credit, and is graded on a credit (CR), no-credit (F) basis. Restricted to students enrolled in the MS Engineering program.
about Academic Instruction for Engineering Graduate Assistants
Course Attribute(s): Graduate Assistantship|Exclude from Graduate GPA
Grade Mode: Leveling/Assistantships

ENGR 5198B. Project.
This course represents a student’s continuing project enrollments. The student continues to enroll in this course until the project is completed. The course is graded on a credit (CR), progress (PR), no-credit (F) basis. Registration requires Approval of Committee. Restricted to students enrolled in the MS Engineering program.
about Project
Grade Mode: Credit/No Credit

ENGR 5199B. Thesis.
This course represents a student’s continuing thesis enrollments. The student continues to enroll in this course until the thesis is submitted for binding. The course is graded on a credit (CR), progress (PR), no-credit (F) basis. Registration requires Approval of Committee. Restricted to students enrolled in the MS Engineering program.
about Thesis
Grade Mode: Credit/No Credit

ENGR 5298B. Project.
This course represents a student’s continuing project enrollments. The student continues to enroll in this course until the project is completed. The course is graded on a credit (CR), progress (PR), no-credit (F) basis. Registration requires Approval of Committee. Restricted to students enrolled in the MS Engineering program.
about Project
Grade Mode: Credit/No Credit

ENGR 5299B. Thesis.
This course represents a student’s continuing thesis enrollments. The student continues to enroll in this course until the thesis is submitted for binding. The course is graded on a credit (CR), progress (PR), no-credit (F) basis. Registration requires Approval of Committee. Restricted to students enrolled in the MS Engineering program.
about Thesis
Grade Mode: Credit/No Credit
ENGR 5301. Academic Instruction for Engineering Graduate Assistants.
This course is seminar based and covers topics related to teaching and employment responsibilities. Completion of this course is required as a condition of employment for graduate assistants. This course does not earn graduate credit, and is graded on a credit (CR), no-credit (F) basis. Restricted to students enrolled in the MS Engineering program.
Course Attribute(s): Graduate Assistantship
Grade Mode: Leveling/Assistantships

ENGR 5310. Probability, Random Variables, & Stochastic Processes for Engineers.
This course develops theory underlying analysis and design of systems. Fundamental distributional concepts, applications of statistical methods, and theory of stochastic processes are introduced to create a foundation for mathematical analysis of physical systems involving randomness. Applications to engineering topics are taught, including estimation, control, and systems theory. Prerequisite: IE 3320 or equivalent, or approval of instructor. Restricted to students enrolled in the MS Engineering program.
about Probability, Random Variables, & Stochastic Processes for Engineers
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.

ENGR 5384. Problems in Engineering.
Graduate students investigate a special topic by developing a technical problem, researching the topic, and presenting the findings. Plans will be developed on an individual basis with strict faculty supervision. This course may be repeated once for additional credit with permission of the School Director. Restricted to students enrolled in the MS Engineering program and with approval of instructor.
about Problems in Engineering
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Standard Letter

ENGR 5398A. Project.
This course represents a student’s initial project enrollment. No project credit is awarded until the student has completed the project in ENGR 5x98B. This course is graded on a credit (CR), progress (PR), no-credit (F) basis. Registration requires Approval of Committee. Restricted to students enrolled in the MS Engineering program.
about Project
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Credit/No Credit

ENGR 5398B. Project.
This course represents a student’s continuing project enrollments. The student continues to enroll in this course until the project is completed. The course is graded on a credit (CR), progress (PR), no-credit (F) basis. Registration requires Approval of Committee. Restricted to students enrolled in the MS Engineering program.
about Project
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Credit/No Credit

ENGR 5398A. Thesis.
This course represents a student’s initial thesis enrollment. No thesis credit is awarded until the theses is completed in ENGR 5x99B. This course is graded on a credit (CR), progress (PR), no-credit (F) basis. Registration requires Approval of Committee. Restricted to students enrolled in the MS Engineering program.
about Thesis
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Credit/No Credit

ENGR 5399A. Thesis.
This course represents a student’s continuing thesis enrollments. The student continues to enroll in this course until the thesis is submitted for binding. The course is graded on a credit (CR), progress (PR), no-credit (F) basis. Registration requires Approval of Committee. Restricted to students enrolled in the MS Engineering program.
about Thesis
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Credit/No Credit

ENGR 5399B. Thesis.
This course represents a student’s continuing thesis enrollments. The student continues to enroll in this course until the thesis is submitted for binding. The course is graded on a credit (CR), progress (PR), no-credit (F) basis. Registration requires Approval of Committee. Restricted to students enrolled in the MS Engineering program.
about Thesis
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Credit/No Credit

ENGR 5598A. Project.
This course represents a student’s continuing project enrollments. The student continues to enroll in this course until the project is completed. The course is graded on a credit (CR), progress (PR), no-credit (F) basis. Registration requires Approval of Committee. Restricted to students enrolled in the MS Engineering program.
about Project
5 Credit Hours. 5 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Credit/No Credit

ENGR 5598B. Project.
This course represents a student’s continuing project enrollments. The student continues to enroll in this course until the project is completed. The course is graded on a credit (CR), progress (PR), no-credit (F) basis. Registration requires Approval of Committee. Restricted to students enrolled in the MS Engineering program.
about Project
9 Credit Hours. 9 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Credit/No Credit
This course teaches development of embedded computing systems with strong resource constraints. Key concepts include managing constrained memory and processing speed limitations, and programming for soft and hard real-time constraints. Students will learn use of a Real-Time Operating System (RTOS). Prerequisites: EE 3420 and CS 3339, or equivalent, or approval of instructor. Restricted to students enrolled in the MS Engineering program.

about Embedded and Real-Time Computing
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Standard Letter
about Embedded and Real-Time Computing

EE 5350. Advanced Electronic Circuit Design.
This course includes low and high power RF amplifier design techniques, oscillators, FM demodulators, limiters, and mixer design. Additional topics include circuit design to minimize intermodulation and other forms of distortion, and RD and high-speed analog circuits with emphasis on digital-friendly applications. Prerequisite: EE 4350 or equivalent, or approval of instructor. Restricted to students enrolled in the MS Engineering program.

about Advanced Electronic Circuit Design
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Standard Letter
about Advanced Electronic Circuit Design

EE 5355. Electronic Materials and Devices.
This course covers theoretical concepts applicable to the understanding of unique properties exhibited by electronic materials, especially by dielectrics, oxide semiconductors, ferroelectrics, pyroelectrics, piezoelectrics, magnetic, and multifunctional and multiferroic materials. The various microelectronic devices and modern novel technologies based on these materials are emphasized. Prerequisite: EE 3350, or equivalent, with a grade of B or higher, or approval of instructor. Restricted to students enrolled in the MS Engineering program.

about Electronic Materials and Devices
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Standard Letter
about Electronic Materials and Devices

EE 5360. Thin Film Technology.
This course covers the theoretical and practical aspects of thin film technology in modern devices. The design and fabrication of thin film heterostructures is discussed. Growth and nucleation of epitaxial thin films with diverse properties and devices with combined properties will be emphasized. Prerequisite: EE 3350 or equivalent, with a grade of B or higher, or approval of instructor. Restricted to students enrolled in the MS Engineering program.

about Thin Film Technology
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Standard Letter
about Thin Film Technology

EE 5372. Advanced Networking.
This course develops important theoretical and application topics related to advanced networking. Theoretical topics are introduced using mathematical treatments, including queuing theory and some random processes. The course includes applications of these topics to communications networks, and focuses on architectures, applications and technologies which affect modern computer and data networks. Restricted to students enrolled in the MS Engineering program.

about Advanced Networking
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Standard Letter
about Advanced Networking
EE 5374. Introduction to Wireless Communication.
This course teaches principles and practices in designing and analyzing cellular and other wireless communication systems. Topics include RF propagation modeling, fast and slow fading, modulation, demodulation, coding, and multiple access techniques. Prerequisite: EE 4370. Restricted to students enrolled in the MS Engineering program.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Standard Letter
about Introduction to Wireless Communication

3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Standard Letter

This course develops the theory and applications of random processes using mathematical treatments, including elementary discrete and continuous time linear systems theory, elementary probability, and transform theory. Topics include applications of random processes to information and communication theory, estimation and detection, control, signal processing, and stochastic systems theory. Prerequisite: ENGR 5310 or equivalent, or approval of instructor. Restricted to students enrolled in the MS Engineering program.
about Statistical Signal Processing

3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Standard Letter

EE 5385. Optoelectronic Devices.
This course introduces the student to the concepts, physical operations, and design criteria of state-of-the-art optoelectronic devices and systems used in research, technology, medicine, communication, and other modern applications. Prerequisites: EE 3355, EE 4350, or equivalent, with a grade of C or higher; or approval of instructor. Restricted to students enrolled in the MS Engineering program.
about Optoelectronic Devices

3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Standard Letter

Industrial Engineering (IE)

IE 5310. Advanced Statistical Design of Experiments for Engineers.
This course examines the design and analysis of controlled experiments, demonstrating engineering applications of design of experiments (DOE) in the manufacturing and service industries. Topics include full and fractional factorial designs, response surface methodology, and Taguchi methods. In a semester-long project, students apply DOE to improve a real manufacturing process. Prerequisite: ENGR 5310 or instructor's approval. Restricted to students enrolled in the MS Engineering program.
about Advanced Statistical Design of Experiments for Engineers

3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Standard Letter

This course covers the methods for modeling and analyzing manufacturing systems. Critical manufacturing issues that are addressed by these models include sustainable production systems, material handling systems, scheduling, and supply chains. Prerequisites: IE 3320, IE 3340, and MGFGE 4936; or instructor's approval. Restricted to students enrolled in the MS Engineering program.
about Modeling and Analysis of Manufacturing Systems

3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Standard Letter

IE 5330. Advanced Quality Control and Reliability Engineering.
This course provides in-depth knowledge in reliability modeling and maintenance optimization for components and systems. The course also covers advanced quality control techniques including multivariate process control. Methodologies are applied to solve practical problems arising from various industry domains. Prerequisite: ENGR 5310 or approval of instructor. Restricted to students enrolled in the MS Engineering program.
about Advanced Quality Control and Reliability Engineering

3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Standard Letter

This course introduces students to modeling of linear, non-linear, and integer problems applied to engineering design, manufacturing, service, supply chain, healthcare and electrical systems. Mathematical programming software is emphasized in class exercises, homework, and project. Techniques including revised simplex method, duality theory, sensitivity analysis, and networks are also covered. Prerequisites: CS 1428 and MATH 3377 or approval of instructor. Restricted to students enrolled in the MS Engineering program.
about Applied Deterministic Operations Research for Engineers

3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Standard Letter

IE 5343. Non-Linear Optimization Techniques for Engineers.
This course covers engineering applications of mathematical modeling and computational methods for nonlinear programming problems. The primary goal of this course is to present techniques and strategies essential to optimize non-linear models. Prerequisite: IE 3340 or equivalent, or approval of instructor. Restricted to students enrolled in the MS Engineering program.
about Non-Linear Optimization Techniques for Engineers

3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Standard Letter

IE 5345. Advanced Optimization.
This course covers advanced concepts in linear and integer programming. Solution techniques for stochastic and dynamic programming and formulation and solution of decision models in manufacturing, service, supply chain, healthcare and electrical systems are presented. Prerequisite: IE 5340. Restricted to students enrolled in the MS Engineering program.
about Advanced Optimization

3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Standard Letter

IE 5347. Modern Heuristic Optimization.
This course covers heuristic methods that search beyond local optima such as simulated annealing, tabu search, genetic algorithms, ant-colony systems and particle swarm. Papers from the literature, problem-specific heuristics, evaluation methods, and implementations are discussed. Prerequisite: IE 3340 or equivalent, or approval of instructor. Restricted to students enrolled in the MS Engineering program.
about Modern Heuristic Optimization

3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Standard Letter
IE 5397. System Thinking and Analysis.
This course is an introduction to systems engineering and the systems thinking process, providing important considerations related to the engineering of large scale systems. These considerations include system understanding, modeling and design, the system development process, needs analysis, concept exploration and definition, design, integration and evaluation, and systems engineering management. Prerequisite: ENGR 5310 or approval of instructor. Restricted to students enrolled in the MS Engineering program.

3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Standard Letter

Manufacturing Engineering (MFGE)

Topics include design process, mathematical presentation of wireframe/surface/solid modes, transformation and manipulation of objects, finite element analysis, data exchange, process planning, fundamentals of multi-axis NC programming for turning and milling processes, fundamentals of CAD/CAM systems, CNC code generation by CAD/CAM software for the CNC, and waterjet machines. Registration required instructor’s approval. Restricted to students enrolled in the MS Engineering program.

3 Credit Hours. 3 Lecture Contact Hours. 1 Lab Contact Hour.
Grade Mode: Standard Letter

MFGE 5318. Reverse Engineering and Freeform Fabrication.
The course covers theory, techniques, and applications of Advanced Reverse Engineering & Freedom Fabrication. Topics include reverse engineering generic process, reverse modeling, contact and noncontact scanning, point cloud, geometric modeling, data extraction, rapid prototyping processes, uniform and adaptive slicing, industrial and medical applications, hardware, and software. Co-requisite: MFGE 5316. Registration requires instructor’s approval. Restricted to students enrolled in MS Engineering program.

3 Credit Hours. 3 Lecture Contact Hours. 1 Lab Contact Hour.
Grade Mode: Standard Letter

MFGE 5320. Polymer Nanocomposites.
This course covers polymer nanocomposites focusing on materials, manufacturing, characterization, and applications. The primary focus is on fiber reinforced polymer nanocomposites. Morphological, Thermal, Mechanical, and Electrical Characterization will be discussed in detail. Applications include fire-resistant, ablative, fatigue-resistant, impact-resistant, and bio-based composites. Registration requires instructor’s approval. Restricted to students enrolled in the MS Engineering program.

3 Credit Hours. 3 Lecture Contact Hours. 1 Lab Contact Hour.
Grade Mode: Standard Letter

MFGE 5326. Advanced Robotics in Manufacturing Automation.
This course covers principles and techniques involved in advanced robotics. Topics include introduction to robotics, industrial robotics, robot kinematics, path planning, robot dynamics, advanced control, force control, sensors and actuators, mobile robotics, and introduction to nanorobotics. Registration requires instructor’s approval. Restricted to student's enrolled in the MS Engineering program.

3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Standard Letter

MFGE 5328. Advanced Control Techniques.
This course covers advanced control techniques in manufacturing processes. Topics include modeling of dynamic systems, feedback control systems analysis, stability analysis, PID control, optimal control, programmable logic control, design of control systems, transducer and sensor technology, and digital control. Registration requires instructor's approval. Restricted to students enrolled in the MS Engineering program.

3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Standard Letter