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.

Application Requirements
The items listed below are required for admission consideration for applicable semesters of entry during the 2017-2018 academic year. Submission instructions, additional details, and changes to admission requirements for semesters other than the 2017-2018 academic year can be found on the program’s web page (http://gradcollege.txstate.edu/programs). International students should review the International Admission Documents (http://mycatalog.txstate.edu/graduate/admission-documents/international) section of the catalog for additional requirements.

- completed online ApplyTexas application
- $40 nonrefundable application fee
- $50 nonrefundable international evaluation fee (if applicable)
- baccalaureate degree engineering, computer science, physics, technology, or a closely related field from a regionally accredited university*
- official transcripts required from each institution where course credit was granted
- minimum 3.0 GPA in your last 60 hours of undergraduate course work (plus any completed graduate courses)
- official GRE scores required with a preferred minimum of 285 (verbal and quantitative sections combined) with no less than 135 in the verbal section and 150 in the quantitative section
- resume/CV
- statement of purpose
- two letters of recommendation

TOEFL or IELTS Scores
Non-native English speakers who do not qualify for an English proficiency waiver:

- official TOEFL iBT scores required with a 78 overall
- official IELTS (academic) scores required with a 6.5 overall and minimum individual module scores of 6.0

This program does not offer admission if the scores above are not met.

*Additional Information
Non-credit (leveling) coursework may be required prior to admission into the program if you lack sufficient background course work. Any required leveling course work must be completed with grades of B or better prior to admission.

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>Course Requirements</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Engineers Core</strong></td>
<td>18</td>
</tr>
<tr>
<td>Required courses (9 hours)</td>
<td></td>
</tr>
<tr>
<td>Elective courses (9 hours)</td>
<td></td>
</tr>
<tr>
<td><strong>General Core Courses</strong></td>
<td>7</td>
</tr>
<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>
<tr>
<td><strong>Multidisciplinary Elective Courses</strong></td>
<td>9</td>
</tr>
<tr>
<td>Total Hours</td>
<td>34</td>
</tr>
</tbody>
</table>

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

Course Requirements

<table>
<thead>
<tr>
<th>General Required Course</th>
<th>Credit Hours</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>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Choose one of three concentrations:</td>
<td>6</td>
</tr>
<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>
<tr>
<td>IE 5340</td>
<td>Applied Deterministic Operations Research for Engineers</td>
</tr>
<tr>
<td>Mechanical and Manufacturing Engineering</td>
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</tr>
<tr>
<td>MFGE 5316</td>
<td>Advanced Computer Aided Design and Manufacturing</td>
</tr>
<tr>
<td>MFGE 5326</td>
<td>Advanced Robotics in Manufacturing Automation</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Engineering Electives</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Select three of the following:</td>
<td>9</td>
</tr>
<tr>
<td>EE 5323</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>EE 5398A</td>
<td>Antenna Theory, Design and Applications</td>
</tr>
<tr>
<td>EE 5398B</td>
<td>Electronic Materials and Beyond for Sustainable Energy</td>
</tr>
</tbody>
</table>
EE 5398C | Multimedia Signal Processing  
EE 5398D | Electroceramics  
ENGR 5384 | Problems in Engineering  
IE 5310 | Advanced Statistical Design of Experiments for Engineers  
IE 5330 | Advanced Quality Control and Reliability Engineering  
IE 5343 | Non-Linear Optimization Techniques for Engineers  
IE 5345 | Advanced Optimization  
IE 5347 | Modern Heuristic Optimization  
IE 5397 | System Thinking and Analysis  
IE 5398A | Healthcare Systems Engineering  
IE 5398B | Response Surface Methodologies  
IE 5398C | Data-Intensive Analysis and Simulation for Engineers  
MFGE 5318 | Additive Manufacturing  
MFGE 5320 | Polymer Nanocomposites  
MFGE 5328 | Advanced Control Techniques  
MFGE 5398A | Multiscale Manufacturing  
MFGE 5398B | Advanced Composite Materials  

Total Hours 18

1 Specified by the graduate committee for the student's plan of study. In addition, a student in a given concentration can choose, as engineering electives, from the above-listed four "Concentration-Specific Required Courses," two each for the other two concentrations. For example, for a student in Industrial Engineering concentration, the list of engineering electives includes the following four concentration-specific required courses for Electrical Engineering and Mechanical and Manufacturing Engineering: EE 5320, EE 5350, MFGE 5316, and MFGE 5326.

**General Core**

**Seminar Course**

ENGR 5100 | Seminar in Engineering 1

**Project OR Thesis Course Work**

6

Project Option (Choose a minimum 6 hours):

ENGR 5198B | Project  
ENGR 5298B | Project  
ENGR 5398A | Project  
ENGR 5398B | Project  
ENGR 5598B | Project  
ENGR 5998B | Project  

Thesis Option (Choose a minimum 6 hours):

ENGR 5199B | Thesis  
ENGR 5299B | Thesis  
ENGR 5399A | Thesis  
ENGR 5399B | Thesis  
ENGR 5599B | Thesis  
ENGR 5999B | Thesis  

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  
QMST 5335 | Introduction to Forecasting and Simulation 3

**Industrial Technology**

TECH 5315 | Engineering Economic Analysis 3  
TECH 5382 | Industrial Ecology and Sustainability Engineering 3  
TECH 5390 | Research in Technology 3  
TECH 5392 | Fundamentals of Microelectronics Manufacturing 3

**Computer Science**

CS 5306 | Advanced Operating Systems 3  
CS 5346 | Advanced Artificial Intelligence 3  
CS 5369L | Machine Learning and Applications 3

**Mathematics**

MATH 5340 | Scientific Computation 3  
MATH 5345 | Regression Analysis 3  
MATH 5388 | Discrete Mathematics 3  
MATH 5376 | Topics courses may be used to fulfill this requirement (example 5376A, 5376B)

**Physics**

PHYS 5326 | Electrical Characterization of Materials and Devices 3  
PHYS 5327 | Semiconductor 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  
MSEC 7340 | Biomaterials and Biosensors 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 student must submit an official Thesis Proposal Form (http://www.gradcollege.txstate.edu/forms.html) and proposal to his or her thesis committee. Thesis proposals vary by department and discipline. Please see your department for proposal guidelines and requirements. After signing the form and obtaining committee members' signatures, the 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 that the thesis proposal form be submitted to the dean of The Graduate College by the end of the student’s enrollment in 5399A. Failure to submit the thesis proposal in a timely fashion may result in delayed graduation.

**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. For a student's initial thesis course enrollment, the student will need to register for thesis course number 5399A. After that, the student will enroll in thesis B courses in their field, e.g., ENG 5399A, ENG 5199B, ENG 5299B, ENG 5399B, ENG 5599B, and ENG 5999B, in each subsequent semester until the thesis is defended with the department and approved by The Graduate College. 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 has been both approved by The Graduate College and released to Alkek Library.

A student who has selected the thesis option must be registered for the thesis course during the term or Summer I (during the 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 on The Graduate College (http://www.gradcollege.txstate.edu) website under “Current Students.” The completed thesis must be submitted to the chair of the thesis committee on or before the deadlines listed on The Graduate College website.

The following must be submitted to The Graduate College by the thesis deadline listed on The Graduate College website:

1. The Thesis Submission Approval Form bearing original (wet) and/or electronic signatures of the student and all committee members.
2. One (1) PDF of the thesis in final form, approved by all committee members, uploaded in the online Vireo submission system.

After the dean of The Graduate College approves the thesis, Alkek Library will harvest the document from the Vireo submission system for publishing in the Digital Collections database (according to the student's embargo selection). **NOTE: MFA theses will have a permanent embargo and will never be published to Digital Collections.**

While original (wet) signatures are preferred, there may be situations as determined by the chair of the committee in which obtaining original signatures is inefficient or has the potential to delay the student's progress. In those situations, the following methods of signing are acceptable:

- signing and faxing the form
- signing, scanning, and emailing the form
- notifying the department in an email from their university's or institution's email account that the committee chair can sign the form on their behalf
- electronically signing the form using the university's licensed signature platform.

Scanned, faxed, or email communications must be submitted to The Graduate College together with the form containing original signatures.

No copies are required to be submitted to Alkek Library. However, the library 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 Alkek Library and pay the binding fee for personal copies.

If a student elects to follow the project option for the degree, a committee to direct the project activity will be established. The project outcomes and deliverables will be specified by the project committee, and will include a written project report (similar in depth to a research thesis). In addition to demonstrating the student's capability for topical research and/or technical development, the project must also demonstrate the student's capability for independent thought and ability to completely resolve an unstructured technical problem. The structure and format of the project report will be specified by the project committee and may leverage portions of the Graduate College's Guide to Preparing and...
Submitting a Thesis or Dissertation. However, the project report will not be submitted to The Graduate College for publication and dissemination.

**Project Proposal**

The student must submit an official Master’s Project Proposal form to their project committee. The required project proposal form may be obtained from the program’s website http://www.engineering.txstate.edu/Programs/Graduate.html. After signing the form and obtaining committee members’ signatures and graduate advisor’s signature the student must submit the project proposal form with one copy of the proposal attached to the Director of the Ingram School of Engineering for approval before proceeding with project activity. If the project activity 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 Ingram School. If the project activity involves vertebrate animals, the proposal form must include the Texas State IACUC approval code. It is recommended the project proposal form be submitted to the Director of the Ingram School by the end of the student’s enrollment in ENGR 5398A.

**Project Committee**

The project committee must be composed of a minimum of three approved graduate faculty members. The chair of the project committee and at least one other committee member must be Ingram School faculty. The committee may contain additional members from industry sponsors or agencies, at the request of the sponsor or the preference of the committee chair.

**Project Enrollment and Credit**

The completion of a minimum of six hours of project enrollment is required. Students will enroll in ENGR 5398A for initial project activity and ENGR 5x98B for subsequent project activity. Preliminary discussions regarding the selection of a topic and assignment to a project supervisor are required prior to enrollment for ENGR 5398A.

A student will be required to enroll in and pay the fee for at least one hour of the project course during any term in which the student will receive project supervision or guidance and/or in which the student is using university resources. Failure to register for the appropriate project course during a term in which supervision is received may result in postponement of graduation. After initial enrollment in ENGR 5398A, the student will continue to enroll in ENGR 5x98B until the project is successfully completed, as specified by the project committee. In the rare case when a student has not previously enrolled in ENGR 5398A and plans to work on and complete the project in one term, the student may enroll concurrently in both 5398A and 5398B. The only grades assigned for project courses are PR (progress), CR (credit), W (withdrew), and F (failing). If acceptable progress is not being made in a project course, the instructor may issue a grade of F. If the student is making acceptable progress, a grade of PR is assigned until the project is completed. The minimum number of hours of project credit ("CR") will be awarded only after the project report is approved by the project committee, and has been submitted to and approved by the Ingram School of Engineering. A student who has selected the project option must be registered for the appropriate project course during the term or Summer I (during summer the project course runs ten weeks for both sessions) in which the degree will be conferred.

**Project Deadlines and Approval Process**

Project deadlines are the same as the thesis deadlines posted at the following web page: http://www.gradcollege.txstate.edu/Thes-Diss_Info/T-D_Deadlines.html. The completed project report must be submitted to the chair of the project 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 Ingram School 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 Project Committee Approval form bearing original signatures of the student and all committee members.
2. One (1) copy of the project report in final form, approved by all committee members, on standard paper (Hard-copy Submission Option) or PDF of the project report in final form, approved by all committee members, submitted to the Ingram School of Engineering.

After the Director of the Ingram School approves the project report, the student may take personal copies to the Alkek Library and pay the binding fee for personal use.

Master’s level courses in Engineering: ENGR (p. 4), EE (p. 6), IE (p. 7), MFGE (p. 8)

**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

1 Credit Hour. 1 Lecture Contact Hour. 0 Lab Contact Hours.

**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

1 Credit Hour. 1 Lecture Contact Hour. 0 Lab Contact Hours.

**Course Attribute(s):** Graduate Assistantship|Exclude from Graduate GPA

**Graduate Mode:** Leveling/Assistantships

**ENGR 5105. Engineering Internship.**

This course is a faculty-supervised, experiential, work-integrated learning course intended to help the student acquire engineering curriculum-related industrial experience and hence successfully make the transition into the workforce. Course cannot be counted toward graduation.

Course may be repeated once. Enrollment requires Ingram School Director’s approval. Prerequisite: At least one academic year (or two long semesters) of enrollment in MS Engineering, a valid offer of engineering-related internship from industry, and a written internship plan approved by the Director of Ingram School of Engineering

1 Credit Hour. 0 Lecture Contact Hours. 1 Lab Contact Hours.

**Course Attribute(s):** Exclude from 3-peat Processing

**Grade Mode:** Credit/No Credit
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
1 Credit Hour. 1 Lecture Contact Hour. 0 Lab Contact Hours.
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
1 Credit Hour. 1 Lecture Contact Hour. 0 Lab Contact Hours.
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
2 Credit Hours. 2 Lecture Contact Hours. 0 Lab Contact Hours.
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
2 Credit Hours. 2 Lecture Contact Hours. 0 Lab Contact Hours.
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
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Course Attribute(s): Graduate Assistantship Exclude from Graduate GPA
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
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Standard Letter

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
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
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
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 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
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
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Credit/No Credit

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
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
3 Credit Hours. 3 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
5 Credit Hours. 5 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Credit/No Credit

ENGR 5599B. 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
5 Credit Hours. 5 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Credit/No Credit
**Electrical Engineering (EE)**

**EE 5320. Advanced Computer Architecture and Arithmetic.**
This course teaches design and analysis of high-performance computer systems, focusing on quantitative analysis of the latest processors and compilers. Current processor architectures are surveyed for system design. Topics include instruction sets, parallelizing architectures, pipelining, I/O, memory and cache organization, parallel/vector processing, fast arithmetic units design, and implementation using HDL. Prerequisites: EE 3420 and CS 3339 or equivalent, or approval of instructor. Restricted to students enrolled in the MS Engineering program

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<thead>
<tr>
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<th>Lab Contact Hours</th>
<th>Grade Mode</th>
<th>Credit/No Credit</th>
</tr>
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<tbody>
<tr>
<td>3</td>
<td>3</td>
<td>0</td>
<td>Standard Letter</td>
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</tbody>
</table>

**EE 5323. Digital Image Processing.**
This course provides the necessary fundamental techniques to analyze and process digital images. It covers principles, concepts, and techniques of digital image processing and computer vision. Prerequisites: ED 3420, CS 2308, or approval of instructor. Restricted to students enrolled in the MS Engineering program

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**EE 5330. Embedded and Real-Time Computing.**
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

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**EE 5340. Smart Grid: an Application Development Platform.**
In this course, students will learn how to develop real applications for the smart grid and model its performance with simulations and stochastic models. Topics include energy informatics, smart metering, home energy management, demand response, load disaggregation and APIs/OpenData. The mathematical tools used include: Optimization/Control, Machine Learning and Stochastic Processes. Prerequisite: EE 3370, EE 4340 or approval of instructor

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**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

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**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

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**EE 5356. 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

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**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

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**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

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EE 5375. Smart Grid: an Application Development Platform.
In this course, students will learn how to develop real applications for the smart grid and model its performance with simulations and stochastic models. Topics include energy informatics, smart metering, home energy management, demand response, load disaggregation and APIs/OpenData. The mathematical tools used include: Optimization/Control, Machine Learning and Stochastic Processes. Prerequisites: EE 3370, EE 4340 or approval of instructor
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
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
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Standard Letter

EE 5398A. Antenna Theory, Design and Applications.
This course covers the basic theory, design and applications of antennas. The topics include antenna radiation, fundamental parameters of antennas, linear wire antennas, loop antennas, antenna arrays, long-periodic antennas, horn antennas, microstrip antennas and modern nano-antennas. Restricted to students enrolled in the MS Engineering program. Prerequisite: EE 3340 or EE 3370 (or an equivalent) with a grade of C or higher, or Instructor's approval
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Course Attribute(s): Exclude from 3-peat Processing|Topics
Grade Mode: Standard Letter

EE 5398B. Electronic Materials and Beyond for Sustainable Energy.
This course covers the basic science and technology for sustainable energy from the view of materials, where electronic materials are highly emphasized. The topics include solar cells, thermoelectrics, batteries, supercapacitors, artificial photosynthesis, fuel cells, biomass and nuclear energy. Restricted to students enrolled in MS Engineering program. Prerequisite: EE 3355 or equivalent, with a grade of "B" or higher
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Course Attribute(s): Exclude from 3-peat Processing|Topics
Grade Mode: Standard Letter

EE 5398C. Multimedia Signal Processing.
This course covers theory and applications of digital signal processing to multimedia signals, including speech, audio, image, and video. Key concepts and algorithms are discussed first, followed by a review of relevant industry standards. Hardware architectures and real-time implementation concepts appropriate for multimedia signals are also included. Restricted to students enrolled in MS Engineering program. Prerequisites: EE 3370 (or equivalent) and EE 4377 or EE 4323 (or an equivalent), or Instructor’s approval
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Course Attribute(s): Exclude from 3-peat Processing|Topics
Grade Mode: Standard Letter

EE 5398D. Electroceramics.
This course covers binary and ternary phase diagrams, non-centrosymmetric crystal structures and symmetry groups, nonlinear dielectrics (ferroelectricity, piezoelectricity, pyroelectricity), nonlinear magnetics, oxide wideband gap semiconductors, detectors and sensors, introduction to MEMS, radhard electronics, and spintronics technology. Labs and additional research-oriented instruction are related to materials processing, characterization, fabrication, and testing. Restricted to students enrolled in the MS Engineering program. Prerequisite: EE 3355 with a grade of B or higher, or Instructor’s Approval
3 Credit Hours. 3 Lecture Contact Hours. 3 Lab Contact Hours.
Course Attribute(s): Exclude from 3-peat Processing|Topics
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
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 MFGE 4396; or 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

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

IE 5398A. Healthcare Systems Engineering.
This course provides an introduction into healthcare delivery with particular attention to the application of systems engineering techniques. Topics include the organization of healthcare systems, characteristics of US healthcare, decision-making in the healthcare environment, health informatics, and performance measurement tools. Student project involves integration and application of systems engineering methodologies. Restricted to students enrolled in the MS Engineering program. Prerequisite: IE 5340 or instructor's approval.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Course Attribute(s): Exclude from 3-peat Processing|Topics
Grade Mode: Standard Letter

IE 5398B. Response Surface Methodologies.
This course continues the examination of the design and analysis of controlled experiments, demonstrating how design of experiments (DOE) and response surface methodologies (RSM) are used in product optimization and process improvement. Topics include factorial and fractional factorial designs, steepest ascent, fitting response surfaces, variance-optimal design, and mixture experiments. Restricted to students enrolled in MS Engineering, MS Computer Science, MS Mathematics, MS Physics or MS Technology Management. Prerequisite: IE 5310 or Instructor’s approval.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Course Attribute(s): Exclude from 3-peat Processing|Topics
Grade Mode: Standard Letter

IE 5398C. Data-Intensive Analysis and Simulation for Engineers.
This course covers foundational topics in data science, including data-intensive analysis and simulation. Specific topics include data science, data extracting and preprocessing, data visualization, and design of simulation experiments. Prerequisite: IE 5310 or Instructor’s Approval.
3 Credit Hours. 3 Lecture Contact Hours. 1 Lab Contact Hour.
Course Attribute(s): Exclude from 3-peat Processing|Topics
Grade Mode: Standard Letter

Mechanical and 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. Additive Manufacturing.
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. 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

MFGE 5398A. Multiscale Manufacturing.
This course covers multiscale manufacturing processes, techniques, and applications. Topics include micro and nano-manufacturing, polymer and semiconductor fabrication, thin film technologies, bulk and surface micromachining, physics of multiscale manufacturing, microelectromechanical (MEMS) devices, and design issues for fabrication of micro and nano-systems. Restricted to students enrolled in MS Engineering, MS Computer Science, MS Mathematics, MS Physics, or MS Technology Management. Instructor’s approval required
3 Credit Hours. 3 Lecture Contact Hours. 1 Lab Contact Hour.
Course Attribute(s): Exclude from 3-peat Processing
Grade Mode: Standard Letter

MFGE 5398B. Advanced Composite Materials.
This course examines various aspects of fiber-reinforced polymeric composites. The topics covered include constituent materials (fibers and matrices), mechanics, performance, manufacturing, and introduction to nanocomposites. This course also provides introductory treatments concerning ceramic matrix composites, metal matrix composites, and carbon/carbon composites. Restricted to students enrolled in MS Engineering program
3 Credit Hours. 3 Lecture Contact Hours. 1 Lab Contact Hour.
Course Attribute(s): Exclude from 3-peat Processing
Grade Mode: Standard Letter