

Engineering &
Computer Science
Syracuse University

A Guide to
**Graduate Studies in
Mechanical and Aerospace
Engineering**

Department of Mechanical and Aerospace Engineering
College of Engineering and Computer Science
Syracuse University

Graduate Office

263 Link Hall
Syracuse University
Syracuse, NY 13244

Graduate Secretary

Hind BenGabr
hbengabr@syr.edu
315-443-4367

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1. Graduate Programs

The Department of Mechanical and Aerospace Engineering offers graduate programs leading to the following degrees:

- Master of Science (M.S.) in Mechanical and Aerospace Engineering
- Doctor of Philosophy (Ph.D.) in Mechanical and Aerospace Engineering

It also oversees two interdisciplinary master programs leading to the following degrees:

- Master of Science (M.S.) in Engineering Management
- Master of Science (M.S.) in Energy Systems Engineering

a. Admission Requirements

Master of Science (M.S.) in Mechanical and Aerospace Engineering

Admission to the M.S. degree program is granted on the basis of undergraduate preparation and performance, GRE scores, and letters of recommendation documenting the recent technical proficiency of the applicant. A grade-point average (GPA) of 3.0 or higher on a 4.0 scale (or equivalent), and a GRE Quantitative Reasoning score of 700 or higher (155 or higher on the new scale) are normally expected.

Admission to this M.S. degree program requires a Bachelor's degree in Engineering, or an acceptable field of Science.

If a student's background is not particularly strong in mechanical or aerospace engineering, he/she may be required to take undergraduate courses (not counted towards the M.S. degree) as specified in the letter of admission.

Master of Science (M.S.) in Engineering Management

Admission to the M.S. degree program is granted on the basis of undergraduate preparation and performance, GRE scores, and letters of recommendation documenting the recent technical proficiency of the applicant. A grade-point average (GPA) of 3.0 or higher on a 4.0 scale (or equivalent), and a GRE Quantitative Reasoning score of 700 or higher (155 or higher on the new scale) are normally expected.

Admission to this M.S. degree program requires a Bachelor's degree in Engineering, or an acceptable field of Science.

Master of Science (M.S.) in Energy Systems Engineering

Admission to the M.S. degree program is granted on the basis of undergraduate preparation and performance, GRE scores, and letters of recommendation documenting the recent technical proficiency of the applicant. A grade-point average (GPA) of 3.0 or higher on a 4.0 scale (or equivalent), and a GRE Quantitative Reasoning score of 700 or higher (155 or higher on the new scale) are normally expected.

Admission to this M.S. degree program requires a Bachelor's degree in Engineering, or an acceptable field of Science.

If a student's undergraduate background is not particularly strong in the basic sciences required for a successful pursuit of this degree (e.g., university-level chemistry; university-level-calculus-based physics; three (3) semesters of university-level mathematics, including calculus, linear algebra and differential equations; thermodynamics), s/he may be required to take undergraduate courses (not counted towards the M.S. degree) as specified in the letter of admission.

Doctor of Philosophy (Ph.D.) in Mechanical and Aerospace Engineering

Admission to the Ph.D. program will be considered if three conditions are met. First, a sufficient level of academic and professional achievement must be documented by transcripts of the student's prior academic performance (a GPA of 3.33 or higher on a 4.0 scale is expected), a GRE Quantitative Reasoning score of 700 or higher (155 or higher on the new scale) and an acceptable GRE Verbal Reasoning score, and letters of recommendation and other supporting information. Second, the focus of the student's research interest in one area of specialization should be clear from the student's transcript and statement of purpose. Third, a faculty adviser must be willing to supervise research in the student's area of specialization. Completion of an M.S. degree and/or an M.S. thesis may be required by individual faculty advisers.

b. Application Procedure

Online application is the preferred method of applying to graduate programs at Syracuse University. Applications submitted online can be processed faster and more efficiently than those filed on paper. The online application can be accessed from <https://apply.embark.com/grad/syracuse/37/>.

You will receive an e-mail or postcard from Syracuse University when your application has been received and processed. More information on the application process can be found from <http://lcs.syr.edu/apply/graduate-application-process/>.

2. Master of Science in Mechanical and Aerospace Engineering

a. Course requirements

Graduate courses can be found in the Course Catalog (<http://coursecatalog.syr.edu>), using the search engine.

M.S. students must complete 30 credits, including a capstone project (MAE 994: 0 credits; graded as Pass/Fail), and must attend at least two (2) semesters of the MAE graduate seminars (MAE 995: 0 credits; graded as A-F, based on attendance)¹. Out of the required 30 credits, students cannot take more than 9 credits at the 500-level. The MS degree in MAE offers both "general" and "concentration" options. A minimum GPA of 3.0 for coursework included in the Program of Study for the degree along with a minimum GPA of 2.8 for all credits earned must be achieved to graduate. Students are not allowed to take more than 3-credits of Independent Study.

Students selecting the "general" option must take three (3) required courses (MAE675, MAE643, and MAE635) and four (4) elective courses from the MAE department. The remaining three (3) elective courses (9 credits), if taken outside of the College of Engineering and Computer Science, must be approved by the student's advisor prior to registration.

Students selecting a "concentration" option must take MAE675 Methods of Analysis in ME, four (4) courses from a chosen concentration. Available concentrations and their concentration core(s) are:

- i) Thermal/Fluids
 - MAE 643: Fluid Dynamics
 - 3 elective courses in Thermal/Fluids
- ii) Solids/Structure
 - MAE 635: Advanced Mechanics of Materials
 - 3 elective courses in Solids/Structure
- iii) Design/Manufacturing
 - MFE 639: CAD/CAM Systems &
 - ECS 526: Statistics for Engineers
 - 2 elective courses in Design/Manufacturing

Acceptable elective courses for each concentration² include but not limited to:

- i) Thermal/Fluids
 - MAE 545: Applications of Fluid Mechanics
 - MAE 551: Energy Conversion
 - MAE 552: Building Environmental Measurements and Controls

¹ Part-time M.S. students may petition the Graduate Affairs Committee for partial exemption from seminar attendance.

² The list of acceptable elective courses for each concentration is regularly reviewed and may be revised by the faculty.

- MAE 553: HVAC Systems Analysis and Design
- MAE 554: Principles of Refrigeration
- MAE 571: Computational Fluid Dynamics
- MAE 585: Principles of Turbomachines
- MAE 587: Design of Solar Energy System
- MAE 588: Principles of Wind Turbines
- MAE 645: Fluid Dynamics Measurements
- MAE 647: Gas Dynamics
- MAE 651: Advanced Thermodynamics
- MAE 655: Advanced Heat Transfer
- MAE 657: Convective Heat and Mass Transfer
- MAE 658: Building Environmental Modeling and Simulations
- MAE 659: Building Materials and Envelope
- MAE 686: Advanced Fuel Cell Science and Technology
- MAE 741: Fundamentals of Turbulence
- MAE 765: Combustion Phenomena in Engineering
- MAE 771: Computational Fluid Mechanics
- MAE 746: Viscous Fluids
- ii) Solids/Structure
 - MAE 536: Composite Materials
 - MAE 573: Application of Finite Element Analysis
 - MAE 600: Computational Solid Mechanics
 - MAE 621: Failure Analysis of Composite Materials
 - MAE 625: Fracture Mechanics
 - MAE 626: Vibration of Mechanical Systems
 - MAE 721: Theory of Elasticity
 - MAE 785: Continuum Mechanics
 - MEE 725: Advanced Engineering Dynamics
- iii) Design/Manufacturing
 - ECS 511: Sustainable Manufacturing
 - MAE 555: Fundamentals of Nano-Science & Nano-Engineering
 - ECS 629: Modeling and Optimization Techniques
 - ECS 630: Simulation and Data Analytics
 - MAE 548: Engineering Economics and Technology Valuation
 - MEE 571: Computer Aided Design
 - MFE 636: Materials and Processing in Manufacturing
 - MFE 634: Productivity and Quality Engineering
 - MFE 654: Production System Design and Control
 - MFE 692: Design for Manufacturing

Two (2) additional elective courses must be taken from the MAE department. The remaining three (3) elective courses (9 credits), if taken outside of the College of Engineering and Computer

Science, must be approved by the student's advisor prior to registration. Of the 30 credits of course work, a maximum of 3 credits can be MAE 990 Independent Study, and a maximum of 6 credits can be MEE 996 Special Projects.

Students intending to pursue a Ph.D. degree after the M.S. degree should plan to meet the Ph.D. admission requirements and Ph.D. qualifying examination requirements, and select M.S. level courses accordingly.

b. Graduation requirements

The exit requirement for the M.S. degree is MAE 994 (Capstone Project). The student should register for MAE 994 in his/her last semester. The student will review papers or reports in the technical literature related to the student's field of interest. Specific requirements will be communicated to the student at the time of registration for MAE 994. The student will prepare an oral presentation summarizing the technical content of the documents reviewed, and present his/her findings before a faculty committee. The specific format of the PowerPoint presentation can be obtained from the graduate secretary. A hard copy of the presentation, signed by the student's adviser, must be submitted to the MAE Graduate Office. The student will then make their oral presentation to a committee of MAE faculty who will determine whether the student has passed or failed.

3. Master of Science in Engineering Management

a. Program requirements

The Master of Science in Engineering Management (MS EM) is a 33 credit-hour program (11 courses), plus a zero-credit exit paper. At least 18 credit-hours (6 courses) must be taken at the 600-level or higher. The program consists of a set of 5 required core courses (15 credits), a set of 4 courses (12 credits) in engineering management specialization (three of the four courses must be from the same track), and 2 elective courses (6 credits) in engineering and computer science. To remain in good academic standing, a GPA of 3.0 must be maintained. A minimum GPA of 3.0 for coursework included in the Program of Study for the degree along with a minimum GPA of 2.8 for all credits earned must be achieved to graduate. Full-time standing requires that a minimum of 9 credit hours be taken and passed in each of the fall and spring semesters. Registration for more than three (3) courses may be allowed, but requires permission of the program director. All other requirements of the graduate school also apply to this program.

b. Courses

Graduate courses can be found in the Course Catalog (<http://coursecatalog.syr.edu>), using the search engine.

The program is composed of three sections. The specific requirements of each are listed below:

(i) Required Core (15 Credits)

The following courses are required in this core:

- ECS 526: Statistics for Engineers
- MAE 548: Engineering Economics and Technology Valuation
- ECS 630: Simulation and Data Analytics
- SCM 656: Project Management
- EEE 620: Foundations of Entrepreneurship

(ii) Management Specialization Tracks (12 Credits)

Student has to select 3 courses (9 credits) from one of the following 4 tracks, plus 1 course (3 credits) from any of the 4 tracks.

Track 1: Operations

CIE601:	Construction Engineering and Project Management
MFE634:	Productivity and Quality Engineering
MFE654:	Production System Design and Control
SCM721:	Supply Chain Systems

SCM755: Lean Six Sigma

Track 2: Entrepreneurship

ECS511: Sustainable Manufacturing

EEE621: Corporate Entrepreneurship

EEE625: Venture Capital

LAW726: Intellectual Property

MBC603/604: Creating Customer Value / Managing the Marketing Mix

Track 3: Informatics

CIS787: Analytical Data Mining

CSE581: Introduction to Database Management

CSE682: Software Engineering

ECS629: Modeling & Optimization Techniques

SCM651: Business Analytics

Track 4: Sustainability

ECS636: Sustainable Development and Infrastructure Management

CIE663: Introduction to Sustainable Engineering

ECS511: Sustainable Manufacturing

ECS650: Managing Sustainability: Purpose, Principles, and Practice

ECS651: Strategic Management and the Natural Environment

(iii) ECS Electives (6 Credits)

Two elective courses (6 credits) in engineering and computer science need to be taken. Specific courses are determined during a meeting with a technical adviser.

c. Exit Paper

An exit capstone paper is required for graduation. The paper must address issues of engineering management. The paper can be an original paper or a critical review of a journal article. If the critical review option is selected, a copy of the paper being reviewed must be included with the capstone paper. The paper has a minimum length requirement of five pages and is completed during the last semester of study. A hard copy must be submitted along with an electronic version.

4. Master of Science in Energy Systems Engineering (MSESE) – degree program suspended 9/2016

a. Program Requirements

The course of study requires a minimum of 30 credit hours (10 courses) at the graduate level, no more than 12 (4 courses) of which can be at the 500 level. A minimum GPA of 3.0 for coursework included in the Program of Study for the degree along with a minimum GPA of 2.8 for all credits earned must be achieved to graduate. Full-time standing requires a minimum of 9 credit hours be taken and passed in each of the fall and spring semesters. All other requirements of the graduate school also apply to this program.

b. Courses

Graduate courses can be found in the Course Catalog (<http://coursecatalog.syr.edu>), using the search engine.

The course of study toward an MSESE consists of three components, subject to the restriction on the number of 500 level courses. The specific requirements of each are listed below:

(i) Required Core Courses (12 Credits)

The following courses are required in this core:

- MAE 548: Engineering Economics and Technology Valuation (3)
- MAE 551: Energy Conversion (3)
- ECS 629: Modeling & Optimization Techniques (3),
or MAE 671 Numerical Methods in Mechanical Engineering (3),
or MAE 675 Methods of Analysis in Mechanical Engineering (3),
or CEN 671 Chemical Engineering Methods I (3)
- ECS 650: Managing Sustainability (3)

(ii) Energy Track Courses (9 Credits)

The student must select 3 courses (9 credits) from one of the following three tracks: Thermal Energy, Alternative Energy, or Electric Energy. Courses comprising each of these tracks include:

Thermal Energy Track (select 3 of the following courses)

- MAE 553, MAE 554, MAE 585, CEN 542, MAE 651 or CEN 651, MAE 643, MAE 655 or MAE 657, MAE 658, MAE 659, MAE 757, MAE 765, and others to be announced.

Alternative Energy Track (select 3 of the following courses)

- *NUC/MAE 510, NUC 520, MAE 587, MAE 588, BEN/CEN 662 (Biofuels), MAE 686 (Fuel Cells), and others to be announced.*

Electric Energy Track (select 3 of the following courses)

- *ELE 514, ELE 530, ELE 691, and others to be announced.*

(iii) Program Customization Courses (9 Credits)

Select 2 courses (6 credits) from any of the above tracks plus 1 course (3 credits) from Business/Management, Social Sciences, or a Technical Elective.

c. Other Requirements

The student is required to complete an energy-focused, zero-credit capstone project report (MAE 994) approved by the adviser, as well as attend three (3) semesters of graduate seminars, e.g., MAE 995 (0 credits). The capstone project must address issues of energy sources, conversion and utilization, or the environmental and economic impacts of energy. The project can be based on original work or a critical review of a recent paper published in an archival journal. If the critical review option is selected, a copy of the paper being reviewed must be included with the capstone report.

5. Ph.D. in Mechanical and Aerospace Engineering

a. Program

A program of study is individually designed by each student in consultation with his or her adviser. A student entering the Ph.D. program with a master's degree or an equivalent degree (approved by the Graduate Affairs Committee) is expected to complete 18 credits of 600 or above level of course work and a Ph.D. dissertation (of 0 credits). Students wishing to proceed directly to the Ph.D. degree from a bachelor's degree must complete a program of 48-credit course work (with no more than 9 credits of courses at 500 level)³ and a Ph.D. dissertation (of 0 credits). Of the 18 credits of course work beyond the MS degree, 3 credits can be MAE 990 Independent Study. Under special circumstances, a student may petition for an additional 3 credits of MAE 990 Independent Study. Students interested in MAE 990 Independent Study must work with the Faculty Sponsor to fill out form "Proposal for Independent Study Course", and this form must be approved by the Department Chair. A GPA of 3.33 or higher is expected for a Ph.D. student. Full-time Ph.D. students must also attend the MAE graduate seminars every semester (MAE 995: 0 credits; graded as A-F, based on attendance). Graduate courses can be found in the Course Catalog (<http://coursecatalog.syr.edu>), using the search engine.

b. Ph.D. Qualifying Examination⁴

The MAE Department requires that each Ph.D. student pass a qualifying examination. The qualifying examination will have both written and oral components. The objective of the qualifying examination is to test the student's knowledge of fundamentals and preparedness to conduct dissertation research. Students who enter the MAE graduate program with a B.S. degree must take the written component of the qualifying examination at or before the completion of the fourth semester of their graduate study. Students who enter the Ph.D. program with an M.S. degree (or an equivalent degree) must take the written component of the qualifying examination at or before the completion of two semesters of their first registration in the program. The oral component of the qualifying examination must be taken no later than three (3) semesters after the first attempt at the written component of the qualifying examination. As a pre-requisite to the oral component of the qualifying examination, students who enter the MAE graduate program with a B.S. degree must complete a minimum of 30 credits after B.S. at the time of taking the oral component of the qualifying exam.

The written component of the qualifying examination will test the student's fundamental knowledge needed for doctoral study, in Mathematics, plus any two of the following topics: Fluid Dynamics, Solid Mechanics, Heat Transfer, Thermodynamics, Design, Manufacturing, Dynamics and Control, and Special Topics in a selected area. If a student selects Special Topics, s/he must

³ Of the 48-credit course work, 30 credits should be equivalent to the M.S. in Mechanical and Aerospace Engineering degree requirements.

⁴ The current rule approved by the MAE Faculty on April 18, 2014, applies to students who enter the Ph.D. program in Fall 2014 and after.

inform the MAE Graduate Affairs Committee in writing of the special area in which s/he wants to be examined.

The written part of the Ph.D. qualifying examination will be given twice a year: one at the end of the fall semester and the other at the end of the spring semester. In consultation with the adviser, an eligible Ph.D. student must formally apply to take the qualifying examination by notifying the chair of the Graduate Affairs Committee on or before September 30 if the student wishes to take the written examination in the Fall Semester of the same year, and on or before January 31 if the student wishes to take the written examination in the Spring Semester of the same year. In the notification letter, the student should specify his/her field of study/interest, the topics in which s/he wishes to be examined, and include a copy of his/her transcript showing the current GPA. The notification letter must be approved by the adviser.

The Graduate Affairs Committee informs the student after the qualifying examination has been completed whether s/he has passed. In the event of failure, the student must petition the Graduate Affairs Committee within two weeks of failure notification to retake the written examinations once more in the following semester. If approved, the student can retake the failed topics in the second attempt, but is not allowed to change her/his topics from the first attempt. No student will be allowed to retake the written and oral components of the qualifying examination more than once. Failure to pass the examination in a timely fashion will result in dismissal from the Ph.D. program. If you wish to review your exam results or appeal the grade decision, you must do so within two weeks from the date you received your results by informing the Graduate Secretary.

The student's adviser in consultation with the student will suggest a committee of oral examination for the Graduate Affairs Committee's approval. The oral examination committee should consist of 3 to 5 members with a majority of its members from the MAE Department, including the adviser. The student must provide a proposal for dissertation research to the members of the oral examination committee at least two weeks before the scheduled date of examination. The examination will typically take 2 hours to complete, in which the student will first make a 35-minute presentation of the research proposal followed by questions from each individual members of the committee. Based on the quality of dissertation proposal, presentation, and answers to the questions, the committee will deliberate and inform the student of the outcome of the examination, and report the outcome to the MAE Graduate Affairs Committee in writing.

c. Residency Requirement

The residence requirement is set by Academic Rules and Regulations of the Graduate School.

d. Dissertation

Each student is required to prepare a dissertation of high quality in terms of substance, originality and relevance, on a topic chosen in consultation with the dissertation adviser. The dissertation defense shall be conducted according to the rules of the Graduate School. In preparing the dissertation, the student should comply with accepted standards of style and format. The examination committee may refuse to hold the examination until such standards are met.

e. Evaluation of Ph.D. Student's Progress

In the spring semester, the status of every Ph.D. student will be reviewed by the MAE faculty. The review will include a brief summary by the adviser of the progress made by the student and any current or potential problems. If the progress is unsatisfactory, the student will be given six months to address issues of concern. If the situation has not improved, the student will not be allowed to continue in the program and will be so informed in writing.