Master of Science in Engineering Management

The Master of Science in Engineering Management (MSEM) degree program combines advanced course work in highly-specialized technical fields with a professional education in contemporary business, entrepreneurship, and management practices. Graduates of the program will be provided with the educational background to pursue professional management roles in industry.

Facilities

The MSEM program has a dedicated seminar room housed in Whitehead 105. Students are able to study, conduct research and build prototypes within this space.

Graduate Requirements

Please consult directly with the MSEM program director or MSEM academic advisor to confirm the below requirements; changes may have occurred since annual publication.

Students in the MSEM program will take ten courses to fulfill degree requirements, with the following guidelines:

• Five advanced courses in the engineering/technical concentration
• 3 full-fall semester management courses, a full spring semester MSEM Seminar courses and 6 half-semester courses.
• No grade lower than C may be applied to the program
• Courses must be at the 400-level or higher
• Departments sponsoring technical concentrations may impose stricter requirements for course work within the concentration

At the discretion of the student’s advisors, an MSEM student may be permitted to double-count up to two JHU courses (one for the technical concentration and one for the management concentration) or apply undergraduate or graduate courses taken at JHU or elsewhere but not applied to a degree, in accordance with conditions in the WSE Policy on Double-Counting Courses.

Advising

MSEM students will receive advising on the engineering/technical concentration from a designated faculty member affiliated with that concentration. MSEM students will be advised regarding the management concentration by members of the Center for Leadership Education faculty.

Faculty

Faculty members teaching the technical concentration courses are listed in their respective engineering departments elsewhere in this catalog. Faculty members teaching the management concentration courses are listed in the Center for Leadership Education section of this catalog.

Management Concentration

The Center for Leadership Education has constructed a five-course program tailored to the needs of future engineering managers. MSEM students will participate in a cohort program, which begins each fall, where all students in an entering class will take the following five management courses together:

- EN.662.611 Strategies: Accounting & Finance (fall)
- EN.662.651 Marketing Communication and Strategy (spring)
- EN.662.642 Management and Leadership (spring)
- EN.662.692 Strategies for Innovation & Growth (fall)
- EN.662.632 Business Law and Intellectual Property

In addition, all MSEM students are required to attend the MSEM Seminar (EN.662.811 M.S. in Engineering Management Seminar/EN.662.812 M.S. in Engineering Management (MSEM) Seminar) course while enrolled in the program. This will meet weekly and addresses three important content areas: Innovation and design thinking; personal skills and development especially in the communication arena; and talks with practicing engineering managers. The Engineering Management program reserves the right to change the list of eligible courses at its discretion.

MSEM Course # EN.662.802: Engineering Management Internship Assessment

This course involves the assessment of a student’s internship experience via a report and oral presentation. The questions and general format of the report and presentation will be provided by the instructor (http://memp.pratt.duke.edu/sites/memp.pratt.duke.edu/files/EGRMGMT_551_External.doc). The report and presentation will be evaluated by the instructor and both must be approved to obtain credit for this course. One full course counting toward graduation. Smedick (Summer semester)

Technical Concentrations

In addition to fulfilling the management concentration requirements, MSEM students must complete the requirements for one of fifteen technical concentrations. These are:

• Biomaterials
• Chemical & Biomolecular Engineering (pending finalized MHEC recognition- please contact Angela Ruddle for more information regarding concentration requirements and status)
• Civil Engineering
• Communications Science
• Computer Science
• Fluid Mechanics
• Materials Science and Engineering
• Mechanical Engineering
• Mechanics and Materials
• Nano-Biotechnology
• Nanomaterials and Nanotechnology
• Operations Research
• Probability and Statistics
• Smart Product and Device Design
• Environmental Systems Analysis, Economics and Public Policy
Biomaterials
(Sponsored by the Department of Materials Science & Engineering (http://e-catalog.jhu.edu/departments-program-requirements-and-courses/engineering/materials-science-engineering))

Prerequisites
• UG calculus, chemistry, biology, physics and introductory biomaterials course equivalent to EN.510.316 Biomaterials I

Required Courses (3)
EN.510.606  Polymer Chemistry & Biology
EN.510.607  Biomaterials II: Host response and biomaterials applications
EN.510.621  Biomolecular Materials I - Soluble Proteins and Amphiphiles

Substitutions for required courses can be made at the advisor’s discretion.

Electives (2)
• Electives should be related to Materials Science and Engineering and must be approved by the DMSE graduate committee
• See list of pre-approved elective courses or courses off list by petition

List of Pre-approved Electives
EN.510.400  Introduction to Ceramics
EN.510.403  Materials Characterization
EN.510.405  Materials Science of Energy Technologies
EN.510.422  Micro and Nano Structured Materials & Devices
EN.510.426  Biomolecular Materials I - Soluble Proteins and Amphiphiles
EN.510.428  Material Science Laboratory I
EN.510.429  Materials Science Laboratory II
EN.510.430  Biomaterials Lab
EN.510.456  Introduction to Surface Science
EN.510.604  Mechanical Properties of Materials
EN.510.605  Electrical, Optical and Magnetic Properties of Materials
EN.510.606  Polymer Chemistry & Biology
EN.510.607  Biomaterials II: Host response and biomaterials applications
EN.510.608  Electrochemistry
EN.510.611  Solid State Physics
EN.510.612  Solid State Physics
EN.510.619  Biopolymers Synthesis
EN.510.624  X-Ray Scattering, Diffraction and Imaging
EN.510.657  Materials Science of Thin Films

Courses not on this list can be used at the advisor’s discretion.

Civil Engineering
(Sponsored by the Department of Civil Engineering (http://e-catalog.jhu.edu/departments-program-requirements-and-courses/engineering/civil-engineering))

The Civil Engineering concentration for the Master of Science in Engineering Management consists of five courses, with the following guidelines:

Required Courses
EN.560.730  Finite Element Methods

Substitutions for required courses can be made at the advisor’s discretion.

Elective Courses
• Any two courses from 560.6xx or above, or 565.6xx or above (excluding seminar)

Communications Science
(Sponsored by the Department of Electrical & Computer Engineering (http://e-catalog.jhu.edu/departments-program-requirements-and-courses/engineering/electrical-computer-engineering))

Students may select any combination of 5 courses in communications and related fields from the list below.

EN.520.401  Basic Communication
EN.520.410  Fiber Optics & Devices
EN.520.435  Digital Signal Processing
EN.520.447  Information Theory
EN.520.465  Digital Communications I
EN.520.646  Wavelets & Filter Banks
EN.520.651  Random Signal Analysis
EN.520.652  Extraction of Signals from Noise
EN.520.666  Information Extraction
EN.520.735  Sensory Information Processing

Substitutions for required courses can be made at the advisor’s discretion.

Computer Science
(Sponsored by the Department of Computer Science (http://e-catalog.jhu.edu/departments-program-requirements-and-courses/engineering/computer-science))

Curricular Requirements
• Any five regular graduate courses approved by the advisor, 400-level or higher, from the Department of Computer Science, not including the senior thesis. Three 1-credit graduate courses may be combined to constitute one regular graduate course.

Fluid Mechanics
(Sponsored by the Department of Mechanical Engineering (http://e-catalog.jhu.edu/departments-program-requirements-and-courses/engineering/mechanical-engineering))

Any five courses in Fluid Mechanics or closely related discipline, at the 400-level or higher, as approved by the Faculty advisor. At least two of the required technical courses must be at the 600-level or higher.

Materials Science & Engineering
(Sponsored by the Department of Materials Science & Engineering (http://e-catalog.jhu.edu/departments-program-requirements-and-courses/engineering/materials-science-engineering))
Prerequisites
• UG calculus, chemistry and physics; biology is recommended

Required Courses (1)
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
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</thead>
<tbody>
<tr>
<td>EN.510.601</td>
<td>Structure of Materials</td>
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</tbody>
</table>

Substitutions for required courses can be made at the advisor's discretion.

Electives (4)
• See list of pre-approved elective courses or courses off list by petition

Recommended Structure

Elective Courses
Any two (2) of the following courses, approved by the faculty advisor:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
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</thead>
<tbody>
<tr>
<td>EN.510.403</td>
<td>Materials Characterization</td>
</tr>
<tr>
<td>EN.510.428</td>
<td>Material Science Laboratory I</td>
</tr>
<tr>
<td>EN.530.405</td>
<td>Mechanics of Advanced Engineering Structures</td>
</tr>
<tr>
<td>EN.530.414</td>
<td>Computer-Aided Design</td>
</tr>
<tr>
<td>EN.530.416</td>
<td>Advanced Mechanical Design</td>
</tr>
<tr>
<td>EN.530.418</td>
<td>Aerospace Structures &amp; Materials</td>
</tr>
<tr>
<td>EN.530.454</td>
<td>Manufacturing Engineering</td>
</tr>
<tr>
<td>EN.510.602</td>
<td>Thermodynamics of Materials</td>
</tr>
<tr>
<td>EN.510.603</td>
<td>Phase Transformations of Materials</td>
</tr>
<tr>
<td>EN.530.612</td>
<td>Computational Solid Mechanics</td>
</tr>
</tbody>
</table>

Alternative selections can be made at the advisor's discretion.

Mechanical Engineering
(Sponsored by the Department of Mechanical Engineering (http://e-catalog.jhu.edu/departments-program-requirements-and-courses/engineering/mechanical-engineering))

Required Courses
Any five courses in Mechanical Engineering or closely related discipline at the 400-level or higher, as approved by the Faculty advisor. At least two of the required technical courses must be at the 600-level or higher.

Alternative selections can be made at the advisor's discretion.

Electives (2)
• Electives should be related to Materials Science and Engineering and must be approved by the DMSE graduate committee
• See list of pre-approved elective courses or courses off list by petition

Recommended Structure

Fall | Credits | Spring | Credits |
<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td>EN.510.422</td>
<td>Micro and Nano Structured Materials &amp; Devices</td>
<td>3</td>
<td>EN.510.607</td>
</tr>
</tbody>
</table>
Electives: suggest one | Electives: suggest one
---|---
3 | 0

Total Credits: 3

**List of Pre-approved Electives**

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<th>Course Code</th>
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<td>EN.510.657</td>
<td>Materials Science of Thin Films</td>
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</tbody>
</table>

Alternative selections can be made at the advisor’s discretion.

**Nanomaterials and Nanotechnology**

(*Sponsored by the Department of Materials Science & Engineering* ([http://e-catalog.jhu.edu/departments-program-requirements-and-courses/engineering/materials-science-engineering](http://e-catalog.jhu.edu/departments-program-requirements-and-courses/engineering/materials-science-engineering))

**Prerequisites**

- UG calculus, chemistry, and physics

**Required Courses (2)**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
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</thead>
<tbody>
<tr>
<td>EN.510.422</td>
<td>Micro and Nano Structured Materials &amp; Devices</td>
</tr>
<tr>
<td>EN.670.619</td>
<td>Fundamental Physics and Chemistry of Nanomaterials</td>
</tr>
</tbody>
</table>

Substitutions for required courses can be made at the advisor’s discretion.

**Electives (3)**

- Electives should be related to Materials Science and Engineering and must be approved by the DMSE graduate committee
- See list of pre-approved elective courses or courses off list by petition

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**Recommended Structure**

<table>
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<tbody>
<tr>
<td>EN.510.422</td>
<td>Micro and Nano Structured Materials &amp; Devices (Required)</td>
</tr>
<tr>
<td>EN.670.619</td>
<td>Fundamental Physics and Chemistry of Nanomaterials</td>
</tr>
</tbody>
</table>

Electives in Spring: suggest two

See list of pre-approved elective courses or courses off list by petition

Total Credits: 3

**List of Pre-approved Electives**

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<td>Solid State Physics</td>
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</tbody>
</table>

**Operations Research**

(*Sponsored by the Department of Applied Mathematics & Statistics* ([http://e-catalog.jhu.edu/departments-program-requirements-and-courses/engineering/applied-mathematics-statistics])

**Prerequisites**

Calculus-based background in Probability and Statistics. Students wishing to strengthen their background in this area may enroll in EN.550.420 Introduction to Probability and/or EN.550.430 Introduction to Statistics, but these courses may not be used in fulfillment of this concentration’s requirements.

**Required Courses (3)**

<table>
<thead>
<tr>
<th>Course Code</th>
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</tr>
</thead>
<tbody>
<tr>
<td>EN.570.495</td>
<td>Optimization Foundations for Environmental Engineering and Policy Design</td>
</tr>
</tbody>
</table>
or EN.550.661 Foundations of Optimization
EN.570.497 Risk and Decision Analysis 3
EN.570.608 Data Analytics for Engineering, Policy Analysis and Management
or EN.550.400 Mathematical Modeling and Consulting

Substitutions for required courses can be made at the advisor’s discretion.

**Elective Courses (2)**

Any two courses from the following list, or a substitution as approved by the student’s concentration advisor. As course offerings vary over time, an updated list of acceptable courses will be maintained on the MSEM program website.

EN.570.493 Economic Foundations for Environmental Engineering and Policy Design
EN.570.496 Urban and Environmental Systems
EN.550.662 Optimization Algorithms
EN.550.426 Introduction to Stochastic Processes
EN.550.427 Stochastic Processes and Applications to Finance
EN.550.433 Monte Carlo Methods
EN.550.463 Network Models in Operations Research

Alternative selections can be made at the advisor’s discretion.

**Probability and Statistics**

(Sponsored by the Department of Applied Mathematics & Statistics ([http://e-catalog.jhu.edu/departments-program-requirements-and-courses/engineering/applied-mathematics-statistics](http://e-catalog.jhu.edu/departments-program-requirements-and-courses/engineering/applied-mathematics-statistics))

**Admissions Requirements**

- One upper-division undergraduate course in probability (equivalent to EN.550.420 Introduction to Probability)
- One upper-division undergraduate course in mathematical statistics (equivalent to EN.550.430 Introduction to Statistics)

**Curricular Requirements**

Any five (5) of the following courses, approved by the faculty advisor:

EN.550.413 Applied Statistics and Data Analysis
EN.550.426 Introduction to Stochastic Processes
EN.550.433 Monte Carlo Methods
EN.550.434 Nonparametric Statistics
EN.550.436 Data Mining
EN.550.439 Time Series Analysis
EN.550.620 Probability Theory I
EN.550.630 Statistical Theory
EN.550.631 Statistical Theory II
EN.550.635 Topics in Bioinformatics
EN.550.730 Topics In Statistics

**Additional Requirements**

- An overall GPA of 3.0 must be maintained in courses used to meet the program’s technical requirements. At most two course grades of C or C+ are allowed to be used, and the rest of the course grades must be B- or better.

- Students must satisfy the department’s graduate student computing requirement.
- With advisor’s approval, one non-departmental course containing appropriate mathematical or statistical content can be counted to satisfy the five course requirement.

**Smart Product and Device Design**

(Sponsored jointly by the Department of Mechanical Engineering ([http://e-catalog.jhu.edu/departments-program-requirements-and-courses/engineering/mechanical-engineering](http://e-catalog.jhu.edu/departments-program-requirements-and-courses/engineering/mechanical-engineering)) and the Department of Electrical & Computer Engineering ([http://e-catalog.jhu.edu/departments-program-requirements-and-courses/engineering/electrical-computer-science](http://e-catalog.jhu.edu/departments-program-requirements-and-courses/engineering/electrical-computer-science))

**Required Courses**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
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</thead>
<tbody>
<tr>
<td>EN.530.646</td>
<td>Robot Devices, Kinematics, Dynamics, and Control</td>
</tr>
<tr>
<td>EN.530.414</td>
<td>Computer-Aided Design</td>
</tr>
<tr>
<td>EN.520.491</td>
<td>CAD Design of Digital VLSI Systems I (Seniors/Grads)</td>
</tr>
<tr>
<td>EN.530.421</td>
<td>Mechatronics</td>
</tr>
<tr>
<td>EN.520.448</td>
<td>Electronics Design Lab</td>
</tr>
</tbody>
</table>

Substitutions for required courses can be made at the advisor’s discretion.

**Elective Courses**

Any two (2) courses approved by the faculty advisor.

**Environmental Systems Analysis, Economics and Public Policy**

(Sponsored by the Department of Geography & Environmental Engineering ([http://e-catalog.jhu.edu/departments-program-requirements-and-courses/engineering/geography-environmental-engineering](http://e-catalog.jhu.edu/departments-program-requirements-and-courses/engineering/geography-environmental-engineering))

**Required Courses (3)**

At least one course from each of the three following groups:

- **Economics** (with calculus)—acceptable courses include EN.570.493 Economic Foundations for Environmental Engineering and Policy Design or equivalent. (This requirement may be waived if the student has already had an intermediate microeconomics course accepted by their advisor)
- **Mathematics of Decision Making**—acceptable courses include EN.570.495 Optimization Foundations for Environmental Engineering and Policy Design and EN.570.497 Risk and Decision Analysis
- **Policy**—acceptable courses include EN.570.659 Environmental Policy Analysis and EN.570.607 Energy Policy and Planning Models

Substitutions for required courses can be made at the advisor’s discretion.

**Elective Courses (2)**

Any of the courses listed in the Mandatory list (see Part A above)

<table>
<thead>
<tr>
<th>Course Code</th>
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</tr>
</thead>
<tbody>
<tr>
<td>EN.570.496</td>
<td>Urban and Environmental Systems</td>
</tr>
<tr>
<td>EN.570.618</td>
<td>Multiobject Programming and Planning</td>
</tr>
<tr>
<td>EN.570.676</td>
<td>Stochastic Programming</td>
</tr>
</tbody>
</table>
Other courses in environmental economics, systems, or policy, as approved by the advisor.

Additional Notes
- All courses must be approved by the student’s advisor.
- All course must be at the 400-level or above.
- Students with a background in quantitatively rigorous economics sufficient for the economics requirement to be waived must still take five (5) courses in this area of concentration.
- No more than one course in environmental engineering may be used to fulfill the area of concentration and only with careful consultation with the student’s advisor. Candidate courses in environmental engineering include:
  - EN.570.446 Biological Process of Wastewater Treatment, EN.570.490 Solid Waste Engineering and Management, EN.570.491 Hazardous Waste Engineering and Management, EN.570.647 Hydrologic Transport in the Environment, EN.570.657 Air Pollution, etc.
- No more than one C may be used toward the degree in this concentration.

For current faculty and contact information go to http://eng.jhu.edu/wse/cle/page/our_people

Faculty

Program Directors
Pamela Sheff
Director of the Master of Science in Engineering Management Program & Senior Lecturer: business and technical communication, marketing, public relations, science and scientific writing, oral presentations, entrepreneurship.

Senior Lecturer
Robert Graham
Annette Leps
Senior Lecturer: accounting, finance, management.

Julie Reiser
Eric Rice
William Smedick

For current course information and registration go to https://isis.jhu.edu/courses/

Courses

This course includes a review of financial accounting with an emphasis on the implications of GAAP selections and other managerial decisions on the financial statements. Historic financial performance is assessed using ratio analysis. Relevant cash flows are used in capital budgeting situations; projects are analyzed using discounted cash flow techniques as a measure of valuation. Managerial accounting topics of financial forecasting, cost accumulation, cost allocation, product costing, and variance analysis are used in decision making. For M.S. in Engineering Management only; graded (not P/F); no audits.
Instructor(s): A. Leps.

EN.662.620. Professional Presentations.
This course is designed to help scientists and engineers improve their oral presentation skills in a practice-intensive environment. Students will learn how to hone their message, to craft presentations that address both technical and non-technical audiences, and create clear, compelling PowerPoint presentations. All presentations will be recorded for self-evaluation, and students will receive extensive instructor and peer feedback. MSEM students only. This is a 7-week course and is not open to undergraduates. Suggested readings: The Art of Explanation by Lee Lever, Presentation Zen by Garr Reynolds
Instructor(s): J. Reiser.

Business Law and Intellectual Property introduces participants to the fundamental aspects of law associated with developing and bringing new products to the marketplace. Arranged in modules and taught largely through the case method, the course features the following topics: creating and forming businesses; contracts; intellectual property; principal-agent relations; and product liability. Not only will participants learn the principles associated with each topic, but also they will master the questions and concerns to use when working with legal counsel on these issues in the future. For M.S. in Engineering Management only; no audits.
Instructor(s): G. Galvez.

EN.662.642. Management and Leadership.
Management and Leadership is a case, experiential and research based course intended to introduce participants to issues and solutions related to growing and managing businesses with an emphasis on entrepreneurial enterprises. The course focuses on managerial decision-making and organization building through topics that include planning and managing strategic change; finding competitive advantage; making informed decisions; dealing with uncertainty; negotiating collaborative settlements; managing/leading projects, teams and professionals; networking and forming strategic alliances; valuing differences; creating and maintaining organizational cultures; and devising performance measures. Additionally, participants master aspects of management communication as they address course content. For M.S. in Engineering Management only; graded (not P/F); no audits.
Instructor(s): E. Rice.

EN.662.650. Marketing Communications.
Written and oral work focuses on communicating effectively with target audiences using integrated media and developing interpersonal skills essential for managers, including presenting to a hostile audience, running meetings, listening, and contributing to group decision-making. MSEM students only, no undergrads.
Instructor(s): R. Graham.

This course is designed to introduce students to key marketing, communications, and strategic issues surrounding the process of bringing new products to the marketplace. Through cases, readings, discussion and hands-on team projects, students develop a flexible approach to thinking about marketing problems, maximizing resources and creating strategic solutions. Written and oral work focuses on communicating effectively with target audiences using integrated media and developing interpersonal skills essential for managers, including presenting to a hostile audience, running meetings, listening, and contributing to group decision-making. For M.S. in Engineering Management only; graded (not P/F); no audits.
EN.662.692. Strategies for Innovation & Growth.  
This course requires participants to work in groups to address, design and plan a business solution for an engineering problem with social implications. More specifically, students will work on cross-disciplinary teams to develop a commercially viable new technology. They must select a problem amenable to an engineering solution, investigate the problem, research the issues and potential, develop a design for the technology, investigate the competitive advantage, and create and present a business plan for the idea. Course content will address many of the issues that will be encountered during the process of bringing an idea to fruition. For M.S. in Engineering Management only; graded (not P/F); no audits.  
Instructor(s): P. Sheff.

EN.662.802. Master of Science in Engineering Management Internship.  
This course involves the assessment of a student's internship experience via a report and oral presentation. The questions and general format of the report and presentation will be provided by the instructor. The report and presentation will be evaluated by the instructor and both must be approved to obtain credit for this course. Students must be enrolled simultaneously in the internship experience.  
Instructor(s): W. Smedick.

Professional development seminar for engineering management students featuring outside speakers with engineering management experience. For M.S. in Engineering Management only; P/F only; no audits.  
Instructor(s): S. Ozdemir.

Professional development seminar for engineering management students featuring outside speakers with engineering management experience. For M.S. in Engineering Management only; P/F only; no audits.  
Instructor(s): P. Sheff.

EN.662.815. CAD for MSEM.  
MSEM students only or permission of instructor.  
Instructor(s): M. Boyle.