Advanced Manufacturing

Program Offered

- Minor in Advanced Manufacturing

Minor and ASI in Advanced Manufacturing

The interdisciplinary Advanced Manufacturing program will prepare undergraduates to meet the challenges of careers in advanced manufacturing. Undergraduate students have the following degree options:

- Area of Special Interest (12 credit hours)
  - Requirements: MEGN483 and 9 credit hours of electives (see Table 2)
- Minor (18 credit hours)
  - Requirements: MEGN483 and one other core course to be determined and 12 credit hours of electives (see Table 2)

The Advanced Manufacturing program will be anchored by four signature core courses (three of which will be new to the next catalog) and will offer a diverse array of electives drawn from an approved list of existing courses within the Mechanical Engineering, Metallurgical and Materials Engineering, Electrical Engineering, Computer Science, Physics and Applied Math and Statistics departments. The electives in Table 2 are categorized based on the program’s specialty areas:

- Additive Manufacturing of Structural Materials
- Data-Driven Materials Manufacturing

The four core courses in the Advanced Manufacturing program will explore the emerging technology of additive manufacturing; the existing structural materials used in additive manufacturing and the physical models for processing them; how to design parts specifically for additive manufacturing processes; and the foundational principles of statistical modeling and machine learning for the purpose of optimizing materials for manufacturing processes and optimizing manufacturing processes for specific parts.

Table 1: Advanced Manufacturing core course list

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>MEGN483</td>
<td>ADDITIVE MANUFACTURING</td>
<td>3.0</td>
</tr>
<tr>
<td>MEGNXXX</td>
<td>Additional Core Courses to Be Determined</td>
<td>3.0</td>
</tr>
</tbody>
</table>

Table 2: Undergraduate elective courses, listed by specialty area

Additive Manufacturing of Structural Materials

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>MEGN381</td>
<td>MANUFACTURING PROCESSES</td>
<td>3.0</td>
</tr>
<tr>
<td>MEGN412</td>
<td>ADVANCED MECHANICS OF MATERIALS</td>
<td>3.0</td>
</tr>
<tr>
<td>MTGN348</td>
<td>MICROSTRUCTURAL DEVELOPMENT</td>
<td>3.0</td>
</tr>
<tr>
<td>MTGN414</td>
<td>ADVANCED PROCESSING AND SINTERING OF CERAMICS</td>
<td>3.0</td>
</tr>
<tr>
<td>MTGN442</td>
<td>ENGINEERING ALLOYS</td>
<td>3.0</td>
</tr>
<tr>
<td>MTGN445</td>
<td>MECHANICAL PROPERTIES OF MATERIALS</td>
<td>3.0</td>
</tr>
<tr>
<td>MTGN445L</td>
<td>MECHANICAL PROPERTIES OF MATERIALS LABORATORY</td>
<td>1.0</td>
</tr>
</tbody>
</table>

MTGN464 | FORGING AND FORMING | 2.0 |
MTGN464L | FORGING AND FORMING LABORATORY | 1.0 |
MTGN465 | MECHANICAL PROPERTIES OF CERAMICS | 3.0 |
MTGN475 | METALLURGY OF WELDING | 2.0 |
MTGN475L | METALLURGY OF WELDING LABORATORY | 1.0 |
PHGN300 | PHYSICS III-MODERN PHYSICS I | 3.0 |
PHGN320 | MODERN PHYSICS II: BASICS OF QUANTUM MECHANICS | 4.0 |
PHGN462 | ELECTROMAGNETIC WAVES AND OPTICAL PHYSICS | 3.0 |
PHGN466 | MODERN OPTICAL ENGINEERING (Additive Manufacturing of Structural Materials) | 3.0 |
PHGN480 | LASER PHYSICS | 3.0 |

Data-Driven Materials Manufacturing

CSCI303 | INTRODUCTION TO DATA SCIENCE | 3.0 |
CSCI403 | DATA BASE MANAGEMENT | 3.0 |
CSCI404 | ARTIFICIAL INTELLIGENCE | 3.0 |
CSCI406 | ALGORITHMS | 3.0 |
CSCI437 | INTRODUCTION TO COMPUTER VISION | 3.0 |
CSCI470 | INTRODUCTION TO MACHINE LEARNING | 3.0 |
EENG307 | INTRODUCTION TO FEEDBACK CONTROL SYSTEMS | 3.0 |
EENG310 | INFORMATION SYSTEMS SCIENCE I | 4.0 |
EENG311 | INFORMATION SYSTEMS SCIENCE II | 3.0 |
EENG383 | MICROCOMPUTER ARCHITECTURE AND INTERFACING | 4.0 |
EENG411 | DIGITAL SIGNAL PROCESSING | 3.0 |
EENG417 | MODERN CONTROL DESIGN | 3.0 |
MATH334 | INTRODUCTION TO PROBABILITY | 3.0 |
MATH335 | INTRODUCTION TO MATHEMATICAL STATISTICS | 3.0 |
MATH424 | INTRODUCTION TO APPLIED STATISTICS | 3.0 |
MATH432 | SPATIAL STATISTICS | 3.0 |
MATH436 | ADVANCED STATISTICAL MODELING | 3.0 |
MEGN441 | INTRODUCTION TO ROBOTICS | 3.0 |
MEGN485 | MANUFACTURING OPTIMIZATION WITH NETWORK MODELS | 3.0 |
MEGN486 | LINEAR OPTIMIZATION | 3.0 |

Courses

AMFG401. ADDITIVE MANUFACTURING. 3.0 Semester Hrs.

(II) Additive Manufacturing (AM), also known as 3D Printing in the popular press, is an emerging manufacturing technology that will see widespread adoption across a wide range of industries during your career. Subtractive Manufacturing (SM) technologies (CNCs, drill presses, lathes, etc.) have been an industry mainstay for over 100 years. The transition from SM to AM technologies, the blending of SM and AM technologies, and other developments in the manufacturing world has direct impact on how we design and manufacture products. This course will prepare students for the new design and manufacturing environment that AM is unlocking. Prerequisites: MEGN200 and MEGN201 or equivalent project classes. 3 hours lecture; 3 semester hours.
AMFG421. DESIGN FOR ADDITIVE MANUFACTURING. 3.0 Semester Hrs.
(II) Design for Additive Manufacturing (DAM) introduces common considerations that must be addressed to successfully design or redesign parts for additive manufacturing methods. Industry-leading hardware and FEA software will be used to explore all phases of the DAM workflow, including topology optimization, additive process simulation, distortion compensation, and in-service performance. 3 hours lecture; 3 semester hours.

AMFG498. SPECIAL TOPICS IN ADVANCED MANUFACTURING. 1-6 Semester Hr.
(I, II) Pilot course or special topics course. Topics chosen from special interests of instructor(s) and student(s). Usually the course is offered only once. Prerequisite: none. Variable credit; 1 to 6 credit hours. Repeatable for credit under different titles.