**Specialization In: Heat Transfer & Thermodynamics**

Specialization in thermodynamic analysis of heat and mass transfer phenomena in industrial systems and in nature, for applications - including but not limited to - cooling/heating technologies, energy conversion systems, biomedical, and biotechnology.

### Fall Semester

<table>
<thead>
<tr>
<th><strong>Core Courses</strong></th>
<th><strong>Elective Courses</strong></th>
</tr>
</thead>
</table>
| ME 8341 Conduction | • ME 5103 - Thermal Environmental Engineering  
• ME 5344 Thermodynamics of Fluid Flow  
• ME 5446 - Introduction to Combustion  
• ME 5666 - Modern Thermodynamics  
• ME 8345 - Computational Heat Transfer and Fluid Flow  
• ME 8390 - Advanced Topics in the Thermal Sciences |

### Spring Semester

<table>
<thead>
<tr>
<th><strong>Core Courses</strong></th>
<th><strong>Elective Courses</strong></th>
</tr>
</thead>
</table>
| ME 8342 Convection | • ME 5101 - Vapor Cycle Systems  
• ME 5341 – Thermal Design/Case Studies  
• ME 5351 - Computational Heat Transfer  
• ME 8343 – Radiation  
• ME 8228 - Finite Elements in Multidisciplinary Flow/Thermal/Stress and Manufacturing Applications  
• ME 8253 - Computational Nanomechanics  
• AEM 8332 Adv. Fluid Dynamics  
• ME 8337 – Exp. Methods Thermal Sci.  
• ME 8446 – Adv. Combustion |

Fluid mechanics is an important topic in heat transfer and the students should also consider Fluid Mechanics Specialization core classes when making degree plans.

*Updated: 08/18/2017*
### Specialization in: Fluid Mechanics

The Fluid Mechanics specialization focuses on the theory and applications of fluid flows pertinent to mechanical engineering. The courses cover the physical phenomena, mathematical formulations, problem-solving skills, measurement techniques, and numerical methods applicable to fluid flows ranging from microscale to turbulent flows encountered in mechanical engineering practice.

#### Fall Semester

**Core Courses**
- ME 5332 Intermediate Fluid Mechanics (preferred)  
  OR  
- AEM 8201 Fluid Mechanics I

**Elective Courses**
- ME 5344 Thermodynamics of Fluid Flow with Applications  
- ME 8345 Computational Heat Transfer and Fluid Flow (Turbulence Modeling)  
- ME 8390 Advanced Topics in the Thermal Sciences (when the topic is on fluid mechanics)  
- ME 8462 Turbomachinery  
- AEM 5501 Continuum Mechanics  
- AEM 8211 Theory of Turbulence I  
- CHEN 8301 Physical Rate Processes I: Transport  
- MATH 5587 Elementary Partial Differential Equations I OR MATH 8401 Mathematical Modeling and Methods of Applied Mathematics

#### Spring Semester

**Core Courses**
- ME 8332 Advanced Fluid Dynamics in Mechanical Engineering (preferred)  
  OR  
- AEM 8202 Fluid Mechanics II

**Elective Courses**
- ME 5351 Computational Heat Transfer  
- ME 8337 Experimental Methods in the Thermal Sciences  
- ME 8342 Convection  
- ME 8390 Advanced Topics in the Thermal Sciences (when the topic is on fluid mechanics)  
- AEM 8207 Hydrodynamics Stability  
- AEM 8212 Theory of Turbulence II  
- CHEN 8102 Principles and Applications of Rheology  
- MATH 5588 Elementary Partial Differential Equations II OR MATH 8402 Mathematical Modeling and Methods of Applied Mathematics

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**Note:**
1. Some courses are not offered every year. Please check the class schedule and prerequisites.
2. It is highly recommended to seek advice from faculty advisors or potential faculty advisors.
### Specialization In: Control Systems and Mechatronics

The control systems specialization focuses on learning control system design techniques, theoretical analysis of the performance and robustness of feedback systems, state and parameter estimation techniques, and applications in robotics, automotive and fluid power systems.

#### Fall Semester

**Core Courses**
- ME 5281: Analog and Digital Control
- EE 5231: Linear Systems and Optimal Control

**Elective Courses**
- EE 5251/AEM 5451: Optimal Filtering & Estimation
- AEM 5401: Intermediate Dynamics
- ME 8283: Design of Mechatronic Products
- ME 8287: Design and Control of Automotive Powertrains
- AEM 8451: Syst Identification – Theory & Applications
- AEM 8423: Convex Optimization Methods in Control

#### Spring Semester

**Core Courses**
- ME 8281: Advanced Control System Design (Odd Years) OR
- ME 8285: Adv Control System Design, with Applications to Smart Vehicles (Even years)

**Elective Courses**
- ME 5248: Vibration Engineering
- ME 5286: Robotics
- ME 8287: Intermediate Robotics with Medical Appl’ns
- AEM 8421: Robust Multivariable Control Design
- AEM 8442: Navigation and Guidance Systems
- EE 8215: Nonlinear Systems

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Note: 1. Some courses are not offered every year. 2. Please check for needed prerequisites. 3. We highly recommend that you seek advice from faculty advisors or potential faculty advisors.
Specialization In: Design and Manufacturing

In the D&M specialization, courses are offered in materials selection, manufacturing processes (including nano and micro fabrication), computer aided design and computational methods. Applications include medical devices, multifunctional materials, and fluid power.

**Fall Semester**

**Core Courses**
- ME 5223 Materials in Design
- ME 5228 Intro to FEM
- ME 8221 New Product Design I

**Elective Courses**
- ME 5243 Advanced Mechanisms
- ME 8254 MEMs
- ME 8255 Intro. Nanotech
- AEM 5501 Continuum Mechanics
- BMEN 5001 Adv. Biomaterials
- CEGE 8402 Nonlinear Finite Element Analysis
- EE 5171/73 Microelec Fab

**Spring Semester**

**Core Courses**
- ME 5241 Computer Aided Engineering
- ME 8222 New Product Design II

**Elective Courses**
- ME 5221 Product Realization
- ME 5247 Stress Analysis
- ME 8228/8229 Finite Element Methods
- ME 8253 Comp Nano
- ME 82XX Advanced Materials
- AEM 4511 Composite Materials
- AEM 5503 Elasticity
- AEM 8531 Fracture Mechanics
- BMEN 5151 Intro BioMEMS/ Med devices

1: odd semester (ex F2017, S 2019)
2: even semester (ex F2018, S 2018)

Availability of courses outside of ME is based on 2017-2018 academic year catalog listing.
Specialization In: Reactive and Particulate Flows

Reactive and particulate flows deals with fluid systems that involve chemical reactions or particles that are involved in many processes, including combustion, HVAC, plasmas, material synthesis and filtration.

<table>
<thead>
<tr>
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<tbody>
<tr>
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<tr>
<td>• ME 5446 Intro. Combustion &amp;</td>
<td>1-2 Of:</td>
</tr>
<tr>
<td>• ME 8361 Molecular Gas Dynamics</td>
<td>• ME 8446 Adv. Combustion</td>
</tr>
<tr>
<td></td>
<td>• ME 8362 Intro. Plasma Technol.</td>
</tr>
<tr>
<td><strong>Elective Courses</strong></td>
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</tr>
<tr>
<td>• ME 5103 Thermal Env. Eng.</td>
<td>• ME 5133 Aerosol Laboratory</td>
</tr>
<tr>
<td>• ME 5113 Aerosol Eng.</td>
<td>• ME 5461 Combustion Engines</td>
</tr>
<tr>
<td>• ME 5332. Int. Fluid Mechanics</td>
<td>• ME 5462 - Gas Turbines</td>
</tr>
<tr>
<td>• ME 8255 Intro. Nanotech.</td>
<td>• ME 8253 Computational Nanomechanics</td>
</tr>
<tr>
<td>• ME 8337 – Exp. Methods Therm. Sci.</td>
<td>• ME 8342. Convection</td>
</tr>
<tr>
<td>• ME 8345 Comput. Heat Transfer</td>
<td>• AEM 8202. Fluid Mechanics II</td>
</tr>
<tr>
<td>• CHEN 5771. Colloids &amp; Dispersions</td>
<td>• AEM 8232 Phys. Gas Dynamics</td>
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<tr>
<td>• AEM 8202. Fluid Mechanics I</td>
<td>• CHEN 8102 Principles and Applications of Rheology</td>
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