## Graduate Course Structure for PhD and MS Students

### Specialization areas and their corresponding courses

Note: if you want to use a course not on this list, get approval from your faculty advisor.

### Specialization: Fluid Mechanics

**Research Areas: Fluid Mechanics**

<table>
<thead>
<tr>
<th>Introductory courses</th>
<th>MAE 210A, B, C</th>
<th>Fluid Mechanics I, II, III</th>
</tr>
</thead>
<tbody>
<tr>
<td>Advanced courses</td>
<td>MAE 212</td>
<td>Introductory Compressible Flow</td>
</tr>
<tr>
<td></td>
<td>MAE 214A</td>
<td>Introduction to Turbulence and Turbulent Mixing</td>
</tr>
<tr>
<td></td>
<td>MAE 216</td>
<td>Ocean Turbulence and Mixing</td>
</tr>
<tr>
<td></td>
<td>MAE 215</td>
<td>Hydrodynamic Stability</td>
</tr>
<tr>
<td></td>
<td>MAE 223</td>
<td>Computational Fluid Dynamics</td>
</tr>
<tr>
<td></td>
<td>MAE 224A, B</td>
<td>Environmental Fluid Dynamics</td>
</tr>
</tbody>
</table>

### Specialization: Biomechanics

**Research Areas: Biomechanics**

<table>
<thead>
<tr>
<th>Introductory courses</th>
<th>MAE 209 / BENG 209</th>
<th>Continuum Mechanics Applied to Medicine/Biology</th>
</tr>
</thead>
<tbody>
<tr>
<td>Advanced courses</td>
<td>MAE 261</td>
<td>Cardiovascular Fluid Mechanics</td>
</tr>
<tr>
<td></td>
<td>MAE 262</td>
<td>Fluid Mechanics of the Cell</td>
</tr>
<tr>
<td></td>
<td>MAE 263</td>
<td>Experimental Methods in Cell Mechanics</td>
</tr>
<tr>
<td></td>
<td>MAE 266/MATS 252</td>
<td>Biomaterials and Medical Devices</td>
</tr>
</tbody>
</table>

### Specialization: Combustion

**Research Areas: Thermal Sciences, Engineering Physics, Energy**

<table>
<thead>
<tr>
<th>Introductory courses</th>
<th>MAE 211</th>
<th>Introduction to Combustion</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>MAE 212</td>
<td>Introductory Compressible Flow</td>
</tr>
<tr>
<td>Advanced courses</td>
<td>MAE 213</td>
<td>Mechanics of Propulsion</td>
</tr>
<tr>
<td></td>
<td>MAE 220A,B,C</td>
<td>Physics of Gases; Physical Gasdynamics; Nonequilibrium Gasdynamics</td>
</tr>
<tr>
<td></td>
<td>MAE 221A, B</td>
<td>Heat Transfer; Mass Transfer</td>
</tr>
<tr>
<td></td>
<td>MAE 256</td>
<td>Radiative Transfer for Energy Applications</td>
</tr>
</tbody>
</table>

### Specialization: Solid Mechanics

**Research Areas: Materials Sciences, Applied and Solid Mechanics**

<table>
<thead>
<tr>
<th>Introductory courses</th>
<th>MAE 231A,B</th>
<th>Foundations of Solid Mechanics; Elasticity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Advanced courses</td>
<td>MAE 231C</td>
<td>Anelasticity</td>
</tr>
<tr>
<td>or</td>
<td>SE 273</td>
<td>Theory of Plasticity and Viscoelasticity</td>
</tr>
</tbody>
</table>
MAE 233A, B  Fracture Mechanics; Micromechanics
MAE 235  Computational Techniques in Finite Elements
MAE 238  Stress Waves in Solids
MAE 267/MATS 253  Nanomaterials and Properties

Specialization: Environmental Engineering
Research Areas: Environmental Engineering, Energy
Introductory courses  MAE 210B  Fluid Mechanics II
Advanced courses  MAE 214A  Introduction to Turbulence and Turbulent Mixing
MAE 216  Ocean Turbulence and Mixing
MAE 221A, B  Heat Transfer; Mass Transfer;
MAE 224A, B  Environmental Fluid Dynamics
MAE 254/MATS 256  Energy Materials & Application
MAE 255  Boundary Layer/Renew Energy Meteorology
MAE 256  Radiative Transfer for Energy Applications
SIO 217A, B, C  Atmospheric and Climate Sciences I, II, III

Specialization: Applied Atmospheric Sciences
Research Area: Environmental Engineering
SIO 217A, B, C  Atmospheric and Climate Sciences I, II, III
SIO 218  Cloud Dynamics and Climate
SIO 236  Satellite Remote Sensing

Specialization: Design
Research Areas: Design
Introductory courses  MAE 291  Design and Mechanics in Computer technology
MAE 292  Computer-Aided Design and Analysis

Specialization: Linear and Optimal Control
Research Areas: Dynamics Systems and Control
Introductory courses  MAE 280A, B  Linear Systems Theory; Linear Control Design
Advanced courses  MAE 284  Robust and Multi-Variable Control
MAE 287  Control of Distributed Parameter Systems
MAE 288A  Optimal Control
MAE 288B  Optimal Estimation
MAE 289  Functional Analysis with Applications
MAE 290A, B  Efficient Numerical Methods for Simulation, Optimization and Control; Numerical Methods for Differential Equations

Specialization: Adaptive Systems and Dynamic Modeling
Research Areas: Dynamics Systems and Control
### Introductory courses
- **MAE 242** Robot Motion Planning
- **MAE 247** Cooperative Control of Multi-Agent Systems
- **MAE 281A, B** Nonlinear Systems; Nonlinear Control

### Advanced courses
- **MAE 282** Adaptive Control
- **MAE 283A** Parametric Identification, Theory & Methods
- **MAE 283B** Approximate Identification & Control
- **MAE 286** Hybrid Systems
- **MAE 222** Flow Control

### Specialization: Materials Sciences
#### Research Areas: Materials Sciences, Applied and Solid Mechanics

**Introductory courses**
- **MATS 201A/MAE 271A** Thermodynamics of Solids
- **MATS 201B/MAE 271B** Solid State Diffusion & Reaction Kinetics

**Advanced courses**
- **MATS 201C/MAE 271C** Phase Transformations
- **MATS 205A/MAE 272** Imperfections in Solids
- **MATS 211/MAE 229A** Mechanical Properties
- **MATS 218/MAE 250** Fatigue, Fracture, and Failure
- **MATS 227/MAE 251** Structure and Bonding of Solids
- **MATS 213A,B** Dynamic Behavior of Materials I & II
- **MATS 233A./MAE 252A,B** Processing & Synthesis of Advanced Materials
- **MATS 236/MAE 253** Ceramic & Glass Technology
- **MATS 251/MAE265** Structure & Properties of Electronic, Magnetic, Photonic Materials
- **MATS 252/MAE 266** Biomaterials and Medical Devices
- **MATS 253/MAE 267** Nanomaterials and Properties
- **MATS 254/MATS 256** Energy Materials & Application
- **MATS 257** Polymer Science and Engineering

### Specialization: Applied Plasma Physics
#### Research Areas: Thermal Sciences, Engineering Physics, Energy

**Introductory courses**
- **MAE 217A** Introduction to Gas Discharge Plasma Physics
- **MAE 217B** Intro to Non-magnetized Plasma Physics
- **MAE 217C** Intro to Magnetized Plasma Physics
- **MAE 218A** Intro to High Energy Density Physics (MHD and Pinches)
- **MAE 218B** Intro to High Energy Density Physics (Laser-Plasma Interactions)

**Advanced courses**
- **MAE 227A** Fundamentals of Modern Plasma Physics (Magnetized Plasma)
- **MAE 227B** Fundamentals of Modern Plasma Physics (Laser-Plasma Interactions)
- **MAE 228** Selected Topics in Plasma Physics
- **PHYS 218A,B,C** Plasma Physics
- **PHYS 228** High Energy Astrophysics and Compact Objects
- **PHYS 235** Nonlinear Plasma Theory
- **ECE 240A** Laser and Optics

### Specialization: Mathematics
Research Areas: Applied and Solid Mechanics, Material Sciences, Fluid Mechanics, Thermal Sciences, Engineering Physics, Dynamics Systems and Controls, Environmental Engineering, Biomechanics, Design

MAE 208 Mathematics for Engineers
MAE 289 Functional Analysis and Applications
MAE 294A,B,C Methods in Applied Mechanics I, II, III
MAE 290A,B Efficient Numerical Methods for Simulation, Optimization and Control; Numerical Methods for Differential Equations
MATH 210A,B,C Mathematical Methods in Physics and Engineering
MATH 211 Fourier Analysis on Finite Groups
MATH 212A Introduction to the Mathematics of Systems and Control
MATH 220A,B,C Complex Analysis
MATH 221A,B,C Topics in Several Complex Variables
MATH 227A,B,C Topics In Complex Analysis
MATH 231A,B,C Partial Differential Equations
MATH 233 Singular Perturbation Theory for Differential Equations
MATH 240A,B,C Real Analysis
MATH 241A,B,C Functional Analysis
MATH 247A Topics in Real Analysis
MATH 250A,B,C Differential Geometry
MATH 270A,B,C Numerical Mathematics
MATH 271A,B,C Numerical Optimization
MATH 272A,B,C Numerical Partial Differential Equations
MATH 273A,B,C Scientific Computation
MATH 274A Topics in Real Analysis
MATH 280A,B,C Probability Theory
MATH 285A, B Stochastic Processes
MATH 286 Stochastic Differential Equations
MATH 287A,B,C Time Series Analysis; Multivariate Analysis; Nonparametric Analysis
MATH 290A,B,C Topology

Specialization: Basic Science
Research Areas: Applied and Solid Mechanics, Material Sciences, Fluid Mechanics, Thermal Sciences, Engineering Physics, Dynamics Systems and Controls, Environmental Engineering, Biomechanics, Design

CHEM 213 Chemistry of Macromolecules
CHEM 214 Molecular and Cellular Biochemistry
ECE 220 Space Plasma Physics
ECE 222 Applied Electromagnetic Theory
ECE 253A Digital Image Analysis
ECE 270A, B Neurocomputing
PHYS 200A,B Theoretical Mechanics
PHYS 201 Mathematical Physics
PHYS 203A,B Advanced Classical Electrodynamics
PHYS 211A,B Solid-State Physics
SIO 203A,B,C Methods of Applied Analysis

Not all courses will be offered every year. Consult the course offerings for the current year.

If you want to use a course not on this list, get approval from your faculty advisor.
A Note About MAE 207’s:

MAE 207, Topics in Engineering Science, is often used to develop new courses before an actual course number is assigned. You may use 207’s as many as two times. The topics must be different from one another. If you want to use more, please consult with your faculty advisor or the MAE Graduate Advisor.

Updated August 2017