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*

**Introductory courses**  MAE 210A,B,C  Fluid Mechanics I, II, III

**Advanced courses**
- MAE 212  Introductory Compressible Flow
- MAE 214A  Introduction to Turbulence and Turbulent Mixing
- MAE 216  Ocean Turbulence and Mixing
- MAE 215  Hydrodynamic Stability
- MAE 223  Computational Fluid Dynamics
- MAE 224A, B  Environmental Fluid Dynamics

**Specialization: Biomechanics**

*Research Areas: Biomechanics*

**Introductory courses**  MAE 209 / BENG 209  Continuum Mechanics Applied to Medicine/Biology

**Advanced courses**
- MAE 261  Cardiovascular Fluid Mechanics
- MAE 262  Fluid Mechanics of the Cell
- MAE 263  Experimental Methods in Cell Mechanics
- MAE 266/MATS 252  Biomaterials and Medical Devices

**Specialization: Combustion**

*Research Areas: Thermal Sciences, Engineering Physics*

**Introductory courses**  MAE 211  Introduction to Combustion
- MAE 212  Introductory Compressible Flow

**Advanced courses**
- MAE 213  Mechanics of Propulsion
- MAE 220A,B,C  Physics of Gases; Physical Gasdynamics; Nonequilibrium Gasdynamics
- MAE 221AB  Heat Transfer; Mass Transfer
- MAE 256  Radiative Transfer for Energy Applications

**Specialization: Solid Mechanics**

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

**Introductory courses**  MAE 231A,B  Foundations of Solid Mechanics; Elasticity

**Advanced courses**
- MAE 231C  Anelasticity
- or
- SE 273  Theory of Plasticity and Viscoelasticity
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
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 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/MAE 265 Structure & Properties of Electronic, Magnetic, Photonic Materials
MATS 252/MAE 266 Biomaterials and Medical Devices
MAE 253/MAE 267 Nanomaterials and Properties

Specialization: Applied Plasma Physics
Research Areas: Thermal Sciences, Engineering Physics
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 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.

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