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 (Odd Fall)
- ME 8284: Intermediate Robotics with Medical Appl’ns (Even Fall)
- ME 8287: Design and Control of Auto’tive Powertrains (Odd Fall)
- AEM 8442: Navigation and Guidance Systems

**Spring Semester**

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

**Elective Courses**
- ME 5248: Vibration Engineering
- ME 5286: Robotics
- AEM 8421: Robust Multivariable Control Design
- CSCI 5552: Sensing and Estimation in Robotics
- EE 8215: Nonlinear Systems
- AEM 8423: Convex Optimizat’n Methods in Control (Occasional)
- AEM 8451: Syst Identification – Theory & Appl’ns (Occasional)
- ME 8287: Passivity and Control of Mech Systems (Occasional)

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 Finite Element Methods
- AEM 5510: Continuum Mechanics

**Elective Courses**
- ME 5243 Advanced Mechanisms
- ME 8221 New Product Design I
- ME 8254 MEMs
- ME 8255 Intro. Nanotech
- AEM 4502 Comp. Structural Analysis
- ME 8243 Topic: Adv. Fluid Power
- ME 8283 Design of Mechatronic Products
- AEM 5501 Continuum Mechanics
- BMEN 5001 Adv. Biomaterials
- EE 5171/73 Microelec Fab

**Spring Semester**

**Core Courses**
- ME 5241 Computer Aided Engineering

**Elective Courses**
- ME 5221 Product Realization
- ME 5229/8229 Transient Finite Element Methods
- ME 5247 Stress Analysis
- ME 5248 Vibration Engineering
- ME 8222 New Product Design II
- ME 8228 Finite Element Methods: Flow/Thermal/Stress
- ME 8253 Comp Nanomechanics
- ME 8243 Topic: Adv. Materials
- AEM 4511 Composite Materials
- AEM 5503 Theory of Elasticity
- AEM 8531 Fracture Mechanics
- BMEN 5151 Intro BioMEMS/Med devices

1: odd semester (i.e. F2017, S 2019)
2: even semester (i.e. F2018, S 2018)

Availability of courses outside of ME is based on 2017-2018 academic year catalog listing.
# 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: 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 engineering, and biotechnology.

### 2018 Fall Semester

**Core Courses**
- ME 8341 Conduction

**Elective Courses**
- ME 5332 - Intermediate Fluid Mechanics
- ME 5312 - Solar Thermal Technologies
- ME 5446 - Introduction to Combustion
- ME 5462 - Gas Turbines
- ME 8462 - Turbomachinery
- AEM 5253 - Computational Fluids Bio/Med
- CHEN 8301 - Transport
- ME 5344 – Thermo. Fluid Flow
- ME 5666 – Modern Thermo.
- ME 8345 – Comput. Heat Transfer
- ME 8361 -- Molecular Gas Dynamics
- ME 8390 - Advanced Topics Thermal Sciences

### 2019 Spring Semester

**Core Courses**
- ME 8342 Convection

**Elective Courses**
- ME 5351 - Computational Heat Transfer
- ME 5461 - Internal Combustion Engines
- ME 8350 - Heat Transfer Physics
- ME 8332 - Advanced Fluid Dynamics
- ME 8381 -- Bioheat Transfer
- AEM 8253 – Comput. Fluid Mech
- BMEN 5311 – Adv Biomed Transport
- ME 5101 - Vapor Cycle Systems
- ME 5341 – Thermal Design/Case Studies
- ME 8343 – Radiation
- ME 8228 - Finite Elements in Flow/Thermal/Stress
- ME 8253 – Comput. Nanomechanics
- ME 8337 - Experimental Methods Thermal Sciences
- ME 8446 - Advanced Combustion

In the “Elective Courses” list above, the courses listed in **bold/black** are ME courses offered in 2018F & 2019S semesters. **Bold/gray** courses are those offered by other departments in or close to HT&T areas. If you have questions, please contact Prof. Chris Hogan hogan108@umn.edu (DGS) or Prof. Alptekin Aksan (HT&T Teaching Group Chair) aaksan@umn.edu. Updated on: Updated: 05/10/2018
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.

**Fall Semester**

**Core Courses**
- ME 5446 Intro. Combustion
- ME 8361 Molecular Gas Dynamics

**Elective Courses**
- ME 5103 Thermal Env. Eng.
- ME 5133 Aerosol Laboratory
- ME 5332. Int. Fluid Mechanics
- ME 5344 Therm. Fluid Flow
- ME 8345 Comput. Heat Transfer
- CHEN 5771. Colloids & Dispersions
- AEM 8202. Fluid Mechanics I
- CHEN 8301. Physical Rate Processes I.

**Spring Semester**

**Core Courses**
- ME 8363 Intro. Reactive Flows
- 1-2 Of:
  - ME 8446 Adv. Combustion
  - ME 8362 Intro. Plasma Technol.

**Elective Courses**
- ME 5461 Combustion Engines
- ME 5462 - Gas Turbines
- ME 8253 Computational Nanomechanics
- ME 8342. Convection
- AEM 8202. Fluid Mechanics II
- AEM 8232 Phys. Gas Dynamics
- CHEN 8102 Principles and Applications of Rheology

**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.
General Mechanical Engineering

MSME students interested in a well-rounded degree in mechanical engineering are encouraged to follow guidelines noted below. Students following this schedule are expected to graduate in three semesters if completing the degree as full-time student (two Fall semesters and one Spring Semester). Students submitting degree plans composed of 30 credits chosen exactly from this list will satisfy MSME Plan C requirements and have their degree plans automatically approved. Others will need to provide written justification for when submitting their degree plan if entering Fall 2018 or later.

**Fall Semester**

**Core Courses**
- ME 5281: Analog and Digital Controls
- ME 5332: Intermediate Fluid Mechanics
- AEM 5510: Continuum Mechanics

**Two of the following:**
- ME 5103: Thermal Environmental Engineering
- ME 5223: Materials in Design
- ME 5228: Finite Element Methods
- ME 5243: Advanced Mechanism Design
- ME 5344: Thermodynamics of Fluid Flow With Applications
- ME 5351: Computational Heat Transfer
- ME 5446: Introduction to Combustion
- ME 8341: Conduction
- ME 8343: Radiation
- EE 5231: Linear Systems and Optimal Control
- AEM 5401: Intermediate Dynamics

**Spring Semester**

**Core Courses**
- ME 5241: Computer Aided Engineering

**Two of the following:**
- ME 5101: Vapor Power Cycles
- ME 5221: Product Realization
- ME 5247: Stress Analysis
- ME 5248: Vibration Engineering
- ME 5286: Robotics
- AEM 4511: Composite Materials
- AEM 5503: Elasticity
- ME 8342: Convection
- ME 8332: Advanced Fluid Dynamics in Mechanical Engineering