MAE 1000: Introduction to Mechanical Engineering
Introduction to the mechanical engineering profession, the Mechanical and Aerospace Engineering Department and curriculum, and the core disciplines of mechanical engineering. Introduction to engineering problem solving, ethics, and design.
Credit Hour: 1
Prerequisites: Restricted to engineering students only

MAE 2100: Programming and Software Tools
Introduction to the use of computers, programming, and software. Topics include MATLAB syntax and programming techniques, algorithm design, and programming with Excel spreadsheets.
Credit Hours: 2
Prerequisites: grade of C- or better in MATH 1700. Restricted to Mechanical Aerospace Engineering students only

MAE 2300: Thermodynamics
(same as ENGINR 2300). Fluid properties, work and heat, first law, second law, entropy, applications to vapor and ideal gas processes.
Credit Hours: 3
Prerequisites: grade of C- or better in PHYSCS 2750

MAE 2600: Dynamics
Basic fundamentals of particle and rigid body dynamics; energy and momentum methods.
Credit Hours: 3
Prerequisites: grade of C- or better in ENGINR 1200. Restricted to Mechanical and Aerospace Engineering students only

MAE 3100: Computational Methods for Engineering Design
Introduction to numerical methods for linear system analysis, curve-fitting, integration and differentiation, and optimization. The numerical methods are demonstrated through computer implementation and application to engineering design problems.
Credit Hours: 4
Prerequisites or Corequisites: MATH 4100 grade of C- or better
Prerequisites: Grade of C- or better in MAE 2100; Restricted to Mechanical and Aerospace Engineering students only

MAE 3200: Engineering Materials
The nature of the structure of engineering materials. The relationship of material structure to physical properties. Mechanical behavior of engineering materials.
Credit Hours: 4
Prerequisites: Grade of C- or better in ENGINR 2200 and CHEM 1320. Restricted to Mechanical and Aerospace Engineering students only

MAE 3200W: Engineering Materials - Writing Intensive
The nature of the structure of engineering materials. The relationship of material structure to physical properties. Mechanical behavior of engineering materials.
Credit Hours: 4
Prerequisites: Grade of C- or better in ENGINR 2200 and CHEM 1320. Restricted to Mechanical and Aerospace Engineering students only

MAE 3300: Fluid Mechanics
A basic course in fluid mechanics. Topics include: fluid properties, hydrostatics, conservation laws, infinitesimal and finite control volume analysis, Navier-Stokes equations, dimensional analysis, internal and external flows.
Credit Hours: 3
Prerequisites or Corequisites: MAE 2300 grade of C- or better
Prerequisites: Grade of C- or better in MAE 2600; Restricted to Mechanical and Aerospace Engineering students only

MAE 3600: Dynamic Systems and Control
Modeling and analysis of dynamic systems and introduction to feedback control. Topics include dynamic modeling and response of mechanical, electrical, fluid, and thermal systems; and feedback control systems analysis.
Credit Hours: 3
Prerequisites or Corequisites: ENGINR 2100 grade of C- or better
Prerequisites: Grade of C- or better in MAE 2600 and MAE 3100 and MATH 4100. Restricted to Mechanical and Aerospace Engineering students only

MAE 3600H: Dynamic Systems and Control - Honors
Modeling and analysis of dynamic systems and introduction to feedback control. Topics include dynamic modeling and response of mechanical, electrical, fluid, and thermal systems; and feedback control systems analysis.
Credit Hours: 3
Prerequisites or Corequisites: ENGINR 2100 grade of C- or better
Prerequisites: Grade of C- or better in MAE 2600 and MAE 3100 and MATH 4100. Restricted to Mechanical and Aerospace Engineering students only. Honors eligibility required

MAE 3800: Instrumentation and Measurements Laboratory
Design and reporting of experimental investigations. Topics include instrument design equations, sources of error, and calibration. Survey of instruments to measure: voltage, resistance, current, time, frequency, displacement, velocity, acceleration, strain, force, and torque.
Credit Hours: 3
Prerequisites or Corequisites: MAE 3600 grade of C- or better
Prerequisites: Grade of C- or better in ENGINR 2100 and ENGINR 2200 and Physics 2760; Restricted to Mechanical and Aerospace Engineering students only

MAE 3900: Mechanism Design
Analysis of kinematics and dynamics of machinery. Topics include design and selection of various mechanisms. Graded on A-F basis only.
Credit Hours: 3
Mechanical And Aerospace Engineering (MAE) 2

Prerequisites: Grade of C- or better in MAE 2600 and MAE 3100. Restricted to Mechanical and Aerospace Engineering students only

MAE 4001: Topics in Mechanical and Aerospace Engineering
Current and new technical developments in mechanical and aerospace engineering. Enrollment limited to Mechanical and Aerospace Engineering students only.

Credit Hours: 3
Prerequisites: instructor's consent

MAE 4085: Problems in Mechanical and Aerospace Engineering
Special design, experimental and analytical problems in mechanical and aerospace engineering.

Credit Hours: 1-99
Prerequisites: Instructor's consent

MAE 4210: Aerospace Structures
(cross-leveled with MAE 7210). Fundamentals of the mechanics and design issues of aerospace structures. Analysis of thin skins with stiffeners for external surfaces, bulkheads and frames for shape support, and fasteners for holding components together. Graded on A-F basis only.

Credit Hours: 3
Prerequisites: C- or better in ENGINR 2200

MAE 4220: Materials Selection
(cross-leveled with MAE 7220). Study of the physical and mechanical metallurgy of alloy systems of interest in engineering applications.

Credit Hours: 3
Prerequisites: C- or better in MAE 3200; Restricted to Mechanical and Aerospace Engineering students only

MAE 4230: Nanomaterials
(cross-leveled with MAE 7230). The primary goal of this course is to introduce students into the new field of nanostructured materials. The emphasis of the course is to introduce the students into synthesis and characterization of nanomaterials, the behavior of such materials with nanoscale structures, and their technological applications.

Credit Hours: 3
Prerequisites: C- or better in MAE 3200 or equivalent

MAE 4230W: Nanomaterials - Writing Intensive
(cross-leveled with MAE 7230). The primary goal of this course is to introduce students into the new field of nanostructured materials. The emphasis of the course is to introduce the students into synthesis and characterization of nanomaterials, the behavior of such materials with nanoscale structures, and their technological applications.

Credit Hours: 3
Prerequisites: C- or better in MAE 3200 or equivalent

MAE 4231: Transport Phenomena in Materials Processing
(same as BIOL_EN 4231; cross-leveled with BIOL_EN 7231, MAE 7231). Applications of fluid flow, heat transfer, and mass transfer in steady-state and unsteady-state materials processing with applications to metals, polymers, and ceramics. Graded on A-F basis only.

Credit Hours: 3
Prerequisites: Grade of C- or better in MAE 2300 and MAE 3400. Restricted to Mechanical and Aerospace Engineering students only

MAE 4001: Topics in Mechanical and Aerospace Engineering
Current and new technical developments in mechanical and aerospace engineering. Enrollment limited to Mechanical and Aerospace Engineering students only.

Credit Hours: 3
Prerequisites or Corequisites: MAE 4300
Prerequisites: C- or better in Math 4100

MAE 4232: Ceramic Materials and Processing
(cross-leveled with MAE 7232). Treatment of ceramics materials, structure, and ceramic processing with hands-on demonstration/labs. Graded on A-F basis only.

Credit Hours: 3
Prerequisites: C- or better in MAE 3200

MAE 4250: Composite Materials
(cross-leveled with MAE 7250). A survey of composite materials used in engineering emphasizing fiber-reinforced composites but including laminate and particulate composites.

Credit Hours: 3
Prerequisites: C- or better in MAE 3200. Restricted to Mechanical and Aerospace Engineering students only

MAE 4270: Nondestructive Evaluation of Materials
(cross-leveled with MAE 7270). The role of nondestructive evaluation (NDE) in engineering is explored. Ultrasonic NDE is studied in detail. Labs are used to support the study of ultrasonic NDE. Other NDE techniques are surveyed.

Credit Hours: 3
Prerequisites: C- or better in MAE 3200, Mechanical and Aerospace Engineering students only

MAE 4280: Introduction to Finite Element Methods
(cross-leveled with MAE 7280). The application of matrix operations, energy concepts and structural mechanics to the development of the finite element method. Application of finite element method to beams, frames and trusses.

Credit Hours: 3
Prerequisites: C- or better in ENGINR 2200, MAE 3100, MAE students only

MAE 4290: Welding Engineering
(cross-leveled with MAE 7290). Welding is the most common method of joining similar as well as dissimilar materials. This course thus introduces the basic science and engineering aspects of commonly used fusion and non-fusion welding processes. Stress analysis and failure to welded joints is also introduced to develop safe and durable welded structures.

Credit Hours: 3
Prerequisites: senior standing in Mechanical and Aerospace Engineering

MAE 4300: Heat Transfer

Credit Hours: 3
Prerequisites: Grade of C- or better in MAE 2300 and MAE 3400. Restricted to Mechanical and Aerospace Engineering students only
MAE 4310: Intermediate Heat Transfer  
(cross-leveled with MAE 7310). Advanced topics in conduction, convection, and radiation. Heat exchanges and their applications will also be analyzed.  
Credit Hours: 3  
Prerequisites: C- or better in MAE 4300 and Mechanical Engineering students only

MAE 4320: Design of Thermal Systems  
(cross-leveled with MAE 7320). Thermal systems are simulated by mathematical models (often on a digital computer), followed by optimization. Supporting topics include: economics, heat transfer, thermodynamics, and optimization.  
Credit Hours: 3  
Prerequisites: C- or better in MAE 4300

MAE 4320W: Design of Thermal Systems - Writing Intensive  
Thermal systems are simulated by mathematical models (often on a digital computer), followed by optimization. Supporting topics include: economics, heat transfer, thermodynamics, and optimization.  
Credit Hours: 3  
Recommended: MAE 4300

MAE 4325: Nanoscale Energy Transport  
(cross-leveled with MAE 7325). This course examines non-equilibrium energy processes from the vantage point of fundamental energy carriers. Topics include foundational solid state physics, statistical energy carrier distributions, density of states, and dispersion relationships. Energy transport will be discussed in terms of kinetic theory, the Landauer Formalism, and the Boltzmann Transport Equation. Graded on A-F basis only.  
Credit Hours: 3  
Prerequisites: Senior standing in MAE

MAE 4340: Heating and Air Conditioning  
(cross-leveled with MAE 7340). General principles of thermal science applied to the design of environmental control systems. Topics covered include heating and cooling load calculations, annual operating and life cycle cost estimating, duct and pipe sizing, and equipment selection.  
Credit Hours: 3  
Prerequisites: C- or better in MAE 4300 and MAE students only

MAE 4350: Industrial Energy Analysis  
Credit Hours: 3  
Prerequisites: MAE 4300

MAE 4380: Intermediate Thermodynamics  
(cross-leveled with MAE 7380). Topics from classical and statistical thermodynamics.  
Credit Hours: 3  
Prerequisites: C- or better in MAE 2300

MAE 4390: Aerospace Propulsion  
(cross-leveled with MAE 7390). Analysis of aircraft engines and spacecraft propulsion systems.  
Credit Hours: 3  
Prerequisites: C- or better in MAE 3400 and Junior standing in Mechanical and Aerospace Engineering

MAE 4420: Intermediate Fluid Mechanics  
(cross-leveled with MAE 7420). Topics in potential and viscous flow theory, and computational fluid dynamics.  
Credit Hours: 3  
Prerequisites: C- or better in MAE 3400

MAE 4430: Introduction to Computational Fluid Dynamics and Heat Transfer  
(cross-leveled with MAE 7430). Introduction to the principles and development of the finite difference approximations to the governing differential equations of viscous and inviscid fluid flow, as well as heat transfer. Introduction to discretization methods and the calculation of flow fields, convection, diffusion and conduction.  
Credit Hours: 3  
Prerequisites: C- or better in MAE 3400

MAE 4440: Aerodynamics  
(cross-leveled with MAE 7440). Presents fundamentals of wing and airfoil theory for incompressible flow, including fluid kinematics and dynamics, potential flow, flow about a body, thin-airfoil theory, and finite wing.  
Credit Hours: 3  
Prerequisites: C- or better in MAE 3400

MAE 4450: Gas Dynamics  
(cross-leveled with MAE 7450). One dimensional compressible flow with and without friction and heat transfer. Isentropic flow and shock phenomenon in nozzles and diffusers.  
Credit Hours: 3  
Prerequisites: C- or better in MAE 3400

MAE 4460: Microfluidics  
(cross-leveled with MAE 7460). This course focuses on liquid transport in micro/nano fluidic devices and related electrohydrodynamics. Graded on A-F basis only.  
Credit Hours: 3  
Recommended: MAE 3400

MAE 4500: Manufacturing Methods  
Introduction to manufacturing processes with emphasis on those aspects most relevant to methods, problems in force analysis, and practicum and experimentation in machine tool applications.  
Credit Hours: 3  
Prerequisites: Grade of C- or better in ENGINR 1110 and MAE 3200. Restricted to Mechanical and Aerospace Engineering students only
MAE 4600: Advanced Mechanics of Materials
(same as CV_ENG 4600; cross-leveled with MAE 7600 and CV_ENG 7600). Analysis of more complicated problems in stresses, strains.

Credit Hours: 3
Prerequisites: C- or better in ENGR 2200, MAE 3200 and Junior standing in MAE

MAE 4620: Aircraft Flight Performance
(cross-leveled with MAE 7620). Analysis of aircraft flight and aircraft performance metrics. Topics include airplane aerodynamics and propulsion, steady flight, range, endurance, take-off and landing, and aircraft maneuvers. Graded on A-F basis only.

Credit Hours: 3
Prerequisites: C- or better in MAE 2600, MAE 3100, MAE 3400, and Junior standing in Mechanical and Aerospace Engineering

MAE 4630: Space Flight Mechanics
(cross-leveled with MAE 7630). Analysis of spacecraft orbits and trajectories. Topics include orbital mechanics, orbital maneuvers, interplanetary missions, and entry flight mechanics.

Credit Hours: 3
Prerequisites: C- or better in MAE 2600, MAE 3100, and Junior standing in Mechanical and Aerospace Engineering

MAE 4660: Vibration Analysis
(same as CV_ENG 4660; cross-leveled with MAE 7660, CV_ENG 7660). Vibration theory and its application to mechanical systems. Topics include free and forced vibration analysis of single- and multi-degree of freedom systems.

Credit Hours: 3
Prerequisites: C- or better in MATH 4100 and MAE 2600

MAE 4680: Introduction to MEMS
(cross-leveled with MAE 7680). The course will start with a survey of the widespread applications of MEMS sensors and actuators. Micro fabrication methods used in conventional semiconductor industry will be introduced. MEMS-specific process will be emphasized. Fundamental principles in electric circuits and mechanics will be reviewed. Special attention is on mechanical issues encountered in MEMS design and fabrication.

Credit Hours: 3
Prerequisites: C- or better in MAE 3600 and Junior standing in Mechanical and Aerospace Engineering

MAE 4710: Hydraulic Control System
(cross-leveled with MAE 7710). Analysis of hydraulic control components and systems. Topics include pumps, valves, actuators, and industrial and mobile control systems. May be repeated for credit. Graded on A-F basis only.

Credit Hours: 3
Prerequisites: C- or better in MAE 3400, MAE 3600, and Junior standing in Mechanical and Aerospace Engineering

MAE 4720: Modern Control
(cross-leveled with MAE 7720). Analysis and design of control systems using state-space methods. Topics include controllability and observability, feedback control using pole-placement, state observers, optimal linear-quadratic feedback control, and optimal estimation. Graded on A-F basis only.

Credit Hours: 3
Prerequisites: C- or better in MAE 3600 and Junior standing in Mechanical and Aerospace Engineering

MAE 4730: Mechatronics
(cross-leveled with MAE 7730). Design of systems which require the integration of mechanical and electronic components. Topics include microcontrollers, sensors, actuators, mechanical systems, real-time control system programming, and modeling of electronic and mechanical systems.

Credit Hours: 3
Prerequisites: C- or better in MAE 3600 and Junior standing in Mechanical and Aerospace Engineering

MAE 4740: Digital Control
(cross-leveled with MAE 7740). Design and analysis of control systems using discrete-time methods. Topics include z-transforms, sampling and reconstruction, stability analysis, and digital controller design.

Credit Hours: 3
Prerequisites: C- or better in MAE 3600 and Junior standing in Mechanical and Aerospace Engineering

MAE 4750: Classical Control
(same as BIOL_EN 4310, ECE 4310; cross-leveled with MAE 7750, BIOL_EN 7310, ECE 7310). Study of feedback control design based on classical continuous-time methods. Topics include performance specifications, stability analysis, root locus compensator design, and frequency domain analysis and compensator design.

Credit Hours: 3
Prerequisites: C- or better in MATH 4100

MAE 4800: Applied Thermal/Fluids Laboratory
Applied thermal and fluid systems, such as HVAC and psychometrics, will be introduced. Experiments conducted on thermal/fluid hardware components will be used to reinforce concepts.

Credit Hours: 4
Prerequisites: Grade of C- or better in MAE 4300. Restricted to Mechanical and Aerospace Engineering students only

MAE 4800W: Applied Thermal/Fluids Laboratory - Writing Intensive
Applied thermal and fluid systems, such as HVAC and psychometrics, will be introduced. Experiments conducted on thermal/fluid hardware components will be used to reinforce concepts.

Credit Hours: 4
Prerequisites: Grade of C- or better in MAE 4300. Restricted to Mechanical and Aerospace Engineering students only
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Description</th>
<th>Credit Hours</th>
<th>Prerequisites</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAE 4900</td>
<td>Machine Element Design</td>
<td>Application of stress and fatigue analyses to the design of machine elements such as fasteners, springs, shafts, and gears. Topics include selection of appropriate materials and machine elements.</td>
<td>3</td>
<td>Grade of C- or better in MAE 3200. Restricted to Mechanical and Aerospace Engineering students only</td>
</tr>
<tr>
<td>MAE 4930</td>
<td>Applied Mechanical Optimization</td>
<td>(cross-leveled with MAE 7930). Introduction to mathematical programming techniques and applications to the design of mechanical systems and components.</td>
<td>3</td>
<td>C- or better in MAE 3100, Mechanical and Aerospace Engineering students only</td>
</tr>
<tr>
<td>MAE 4940</td>
<td>Aircraft Design</td>
<td>(cross-leveled with MAE 7940). Conceptual design of aircraft, from initial sizing and design layout to design analysis, optimization and trade studies. Fundamental theories for aircraft design including sizing, aerodynamic forces, airfoil selection, wing loading, configuration layout payloads, propulsion systems, landing gear, aerospace structures, and cost analysis. Graded on A-F basis only.</td>
<td>3</td>
<td>C- or better in ENGR 2200, MAE 3400, MAE 3600, and Junior standing in MAE</td>
</tr>
<tr>
<td>MAE 4980</td>
<td>Senior Capstone Design</td>
<td>Senior design experience. Topics include reliability, safety, manufacturability, economic, and environmental constraints; design case studies; and industrial design projects.</td>
<td>3</td>
<td>Grade of C- or greater in MAE 3600, MAE 3900, MAE 4500, MAE 4900 and STAT 4710 or IMSE 2110; Restricted to Mechanical and Aerospace Engineering students only</td>
</tr>
<tr>
<td>MAE 4980W</td>
<td>Senior Capstone Design - Writing Intensive</td>
<td>Senior design experience. Topics include reliability, safety, manufacturability, economic, and environmental constraints; design case studies; and industrial design projects.</td>
<td>3</td>
<td>Grade of C- or greater in MAE 3600, MAE 3900, MAE 4500, MAE 4900 and STAT 4710 or IMSE 2110; Restricted to Mechanical and Aerospace Engineering students only</td>
</tr>
<tr>
<td>MAE 4990</td>
<td>Undergraduate Research in Mechanical and Aerospace Engineering</td>
<td>Independent investigation or project in Mechanical Engineering. Enrollment limited to senior Mechanical and Aerospace Engineering students only.</td>
<td>0-6</td>
<td>instructor's consent</td>
</tr>
<tr>
<td>MAE 4995</td>
<td>Undergraduate Honors Research Mechanical &amp; Aerospace Engineering</td>
<td>Independent investigation to be presented as an undergraduate honors thesis. Enrollment limited to Honors Mechanical and Aerospace Engineering students only. Prerequisites: Consent required</td>
<td>1-99</td>
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</tr>
<tr>
<td>MAE 4995W</td>
<td>Undergraduate Honors Research Mechanical &amp; Aerospace Engineering - Writing Intensive</td>
<td>Independent investigation to be presented as an undergraduate honors thesis. Enrollment limited to Honors Mechanical and Aerospace Engineering students only. Prerequisites: Consent required</td>
<td>1-99</td>
<td></td>
</tr>
<tr>
<td>MAE 7001</td>
<td>Topics in Mechanical and Aerospace Engineering</td>
<td>Current and new technical developments in mechanical and aerospace engineering.</td>
<td>3</td>
<td>instructor's consent</td>
</tr>
<tr>
<td>MAE 7210</td>
<td>Aerospace Structures</td>
<td>Fundamentals of the mechanics and design issues of aerospace structures. Analysis of thin skins with stiffeners for external surfaces, bulkheads and frames for shape support, and fasteners for holding components together. Graded on A-F basis only.</td>
<td>3</td>
<td>Grade of C or better in ENGINR 2200</td>
</tr>
<tr>
<td>MAE 7230</td>
<td>Nanomaterials</td>
<td>The primary goal of this course is to introduce students into the new field of nanostructured materials. The emphasis of the course is to introduce the students into synthesis and characterization of nanomaterials, the behavior of such materials with nanoscale structures, and their technological applications.</td>
<td>3</td>
<td>MAE 3200 or equivalent</td>
</tr>
<tr>
<td>MAE 7231</td>
<td>Transport Phenomena in Materials Processing</td>
<td>(same as BIOL_EN 7231) Applications of fluid flow, heat transfer, and mass transfer in steady-state and unsteady-state materials processing with applications to metals, polymers, and ceramics. Graded A-F basis only.</td>
<td>3</td>
<td>MAE 3200, MAE 3400, MAE 4300 (or equivalent courses) and MATH 4100</td>
</tr>
<tr>
<td>MAE 7232</td>
<td>Ceramic Materials and Processing</td>
<td>(cross-leveled with MAE 4232). Treatment of ceramics materials, structure, and ceramic processing with hands-on demonstration/labs. Graded on A-F basis only.</td>
<td>3</td>
<td>MAE 3200 or equivalent course</td>
</tr>
<tr>
<td>Course Code</td>
<td>Course Title</td>
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<tr>
<td>MAE 7250</td>
<td>Composite Materials</td>
<td>A survey of composite materials used in engineering emphasizing fiber-reinforced composites but including laminate and particulate composites.</td>
<td>3</td>
<td>MAE 3200</td>
</tr>
<tr>
<td>MAE 7270</td>
<td>Nondestructive Evaluation of Materials</td>
<td>The role of nondestructive evaluation (NDE) in engineering is explored. Ultrasonic NDE is studied in detail. Labs are used to support the study of ultrasonic NDE. Other NDE techniques are surveyed.</td>
<td>3</td>
<td>MAE 3200</td>
</tr>
<tr>
<td>MAE 7280</td>
<td>Introduction to Finite Element Methods</td>
<td>(cross-leveled with MAE 4280). The application of matrix operations, energy concepts and structural mechanics to the development of the finite element method. Application of finite element method to beams, frames and trusses. Prerequisites: ENGINR 2200, MAE 3100, MAE students only.</td>
<td>3</td>
<td>MAE 3200</td>
</tr>
<tr>
<td>MAE 7290</td>
<td>Welding Engineering</td>
<td>Welding is the most common method of joining similar as well as dissimilar materials. This course thus introduces the basic science and engineering aspects of commonly used fusion and non-fusion welding processes. Stress analysis and failure to welded joints is also introduced to develop safe and durable welded structures.</td>
<td>3</td>
<td>senior standing or graduate level</td>
</tr>
<tr>
<td>MAE 7310</td>
<td>Intermediate Heat Transfer</td>
<td>Advanced topics in conduction, convection, and radiation. Heat exchanges and their applications will also be analyzed.</td>
<td>3</td>
<td>MAE 4300</td>
</tr>
<tr>
<td>MAE 7320</td>
<td>Design of Thermal Systems</td>
<td>Thermal systems are simulated by mathematical models (often on a digital computer), followed by optimization. Supporting topics include: economics, heat transfer, thermodynamics, and optimization.</td>
<td>3</td>
<td>MAE 4300</td>
</tr>
<tr>
<td>MAE 7340</td>
<td>Heating and Air Conditioning</td>
<td>General principles of thermal science applied to the design of environmental control systems. Topics covered include heating and cooling load calculations, annual operating and life cycle cost estimating, duct and pipe sizing, and equipment selection.</td>
<td>3</td>
<td>MAE 4300</td>
</tr>
<tr>
<td>MAE 7355</td>
<td>Industrial Energy Analysis</td>
<td>Energy use in industrial systems: furnaces, boilers, compressors, motors, lighting, etc. Insulation in building envelopes. Renewable energy sources. Energy auditing and economic analysis. Graded on A-F basis only.</td>
<td>3</td>
<td>MAE 4300 or instructor's consent</td>
</tr>
<tr>
<td>MAE 7380</td>
<td>Intermediate Thermodynamics</td>
<td>Topics from classical and statistical thermodynamics.</td>
<td>3</td>
<td>ENGINR 2300</td>
</tr>
<tr>
<td>MAE 7390</td>
<td>Aerospace Propulsion</td>
<td>Analysis of aircraft engines and spacecraft propulsion systems.</td>
<td>3</td>
<td>MAE 3400</td>
</tr>
<tr>
<td>MAE 7420</td>
<td>Intermediate Fluid Mechanics</td>
<td>Topics in potential and viscous flow theory, and computational fluid dynamics.</td>
<td>3</td>
<td>MAE 3400</td>
</tr>
<tr>
<td>MAE 7430</td>
<td>Introduction to Computational Fluid Dynamics and Heat Transfer</td>
<td>Introduction to the principles and development of the finite difference approximations to the governing differential equations of viscous and inviscid fluid flow, as well as heat transfer. Introduction to discretization methods and the calculation of flow fields, convection, diffusion and conduction.</td>
<td>3</td>
<td>MAE 3400, MAE 4300 and MAE 4420</td>
</tr>
<tr>
<td>MAE 7440</td>
<td>Aerodynamics</td>
<td>Presents fundamentals of wing and airfoil theory for incompressible flow, including fluid kinematics and dynamics, potential flow, flow about a body, thin-airfoil theory, and finite wing.</td>
<td>3</td>
<td>MAE 3400</td>
</tr>
<tr>
<td>MAE 7450</td>
<td>Gas Dynamics</td>
<td>One-dimensional compressible flow with and without friction and heat transfer. Isentropic flow and shock phenomenon in nozzles and diffusers.</td>
<td>3</td>
<td>MAE 3100 and MAE 3400</td>
</tr>
<tr>
<td>MAE 7460</td>
<td>Microfluidics</td>
<td>(cross-leveled with MAE 4460). This course focuses on liquid transport in micro/nano fluidic devices and related electrohydrodynamics. Graded on A-F basis only.</td>
<td>3</td>
<td>MAE 3400</td>
</tr>
</tbody>
</table>
MAE 7600: Advanced Mechanics of Materials
(same as CV_ENG 7600; cross-leveled with MAE 4600 and CV_ENG 4600). Analysis of more complicated problems in stresses, strains.
Credit Hours: 3
Prerequisites: C- or better in ENGR 2200, MAE 3200 and Junior standing in MAE

MAE 7620: Aircraft Flight Performance
(cross-leveled with MAE 4620). Analysis of aircraft flight dynamics and aircraft performance. Topics include airplane aerodynamics and propulsion, steady flight, flight performance, aircraft maneuvers, aircraft stability, and an introduction to flight controls. Graded on A-F basis only.
Credit Hours: 3
Prerequisites: MAE 3600

MAE 7630: Space Flight Mechanics
(cross-leveled with MAE 4630). Analysis of spacecraft motion. Topics include orbital dynamics, spacecraft attitude dynamics, satellite trajectory design, and spacecraft control system design.
Credit Hours: 3
Prerequisites: MAE 3600

MAE 7660: Vibration Analysis
(same as CV_ENG 7660). Vibration theory and its application to Mechanical systems. Topics include free and forced vibration analysis of single and multi-degree of freedom systems.
Credit Hours: 3
Prerequisites: C- or better in MATH 4100 and MAE 2600

MAE 7680: Introduction to MEMS
The course will start with a survey of the widespread applications of MEMS sensors and actuators. Micro fabrication methods used in conventional semiconductor industry will be introduced. MEMS-specific processes will be emphasized. Fundamental principles in electric circuits and mechanics will be reviewed. Special attention is on mechanical issues encountered in MEMS design and fabrication. Graded on A-F basis only.
Credit Hours: 3
Prerequisites: MAE 3400, MAE 3600, MAE 3600

MAE 7710: Hydraulic Control Systems
Analysis of hydraulic control components and systems. Topics include pumps, valves, actuators, and industrial and mobile control systems.
Credit Hour: 1-3
Prerequisites: MAE 3400 and MAE 3600

MAE 7720: Modern Control
Analysis and design of control systems using state-space methods. Topics include controllability and observability, feedback control using pole-placement, state observers, optimal linear-quadratic feedback control, and optimal estimation. Graded on A-F basis only.
Credit Hours: 3
Prerequisites: MAE 3600

MAE 7730: Mechatronics
Design of systems which require the integration of mechanical and electronic components. Topics include microcontrollers, sensors, actuators, mechanical systems, real time control system programming, and modeling of electronic and mechanical systems.
Credit Hours: 3
Prerequisites: MAE 3600

MAE 7750: Classical Control
(same as ECE 7310, BIOL_ENG 7310; cross-leveled with MAE 4750, ECE 4310, BIOL_ENG 4310). Study of feedback control design based on classical continuous-time methods. Topics include performance specifications, stability analysis, root locus compensator design, and frequency domain analysis and compensator design.
Credit Hours: 3
Prerequisites: MAE 3600

MAE 7930: Applied Mechanical Optimization
Introduction to mathematical programming techniques and applications to the design of mechanical systems and components.
Credit Hours: 3
Prerequisites: MAE 3100

MAE 7940: Aircraft Design
(cross-leveled with MAE 4940). Conceptual design of aircraft, from initial sizing and design layout to design analysis, optimization, and trade studies. Fundamental theories for aircraft design, including sizing, aerodynamic forces, airfoil selection, wing loading, configuration layout, payloads, propulsion systems, landing gear, aerospace structures, and cost analysis. Graded A-F basis only.
Credit Hours: 3
Prerequisites: MAE 3400, MAE 3600, MAE 3600

MAE 8001: Advanced Topics in Mechanical and Aerospace Engineering
Advanced Topics in Mechanical and Aerospace Engineering.
Credit Hours: 3
Prerequisites: MAE 3400, MAE 3600, MAE 3600

MAE 8085: Problems in Mechanical and Aerospace Engineering
Supervised investigation in mechanical and aerospace engineering to be presented in the form of a report.
Credit Hour: 1-99
Prerequisites: MAE 3400, MAE 3600, MAE 3600

MAE 8087: Graduate Seminar in Mechanical and Aerospace Engineering
Reviews recent investigations, projects of major importance in mechanical and aerospace engineering. Graded on S/U basis only.
Credit Hour: 1
Prerequisites: MAE 3400, MAE 3600, MAE 3600

MAE 8240: Mechanical Behavior of Materials
This course will cover the mechanical behavior of metallic, ceramic, polymeric, and composite materials and their relationships to the underlying microstructures. Graded on A-F basis only.
Credit Hours: 3
Prerequisites: MAE 3600
Prerequisites: MAE 3200 and graduate standing in engineering, or instructor's consent

MAE 8280: Finite Element Methods
(same as CV_ENG 8208). The concepts and fundamentals of the finite element method with applications to problems in solid and fluid mechanics.
Credit Hours: 3
Prerequisites: MAE 4280

MAE 8300: Microscale Heat Transfer
Review of existing models. Concept of thermal lagging and the second-law admissibility. Applications to low temperatures, thermal processing of thin-film devices; amorphous materials; advanced composites.
Credit Hours: 3
Prerequisites: MAE 4300

MAE 8311: Heat Transfer-Convection
Principles of heat transfer by convection, review of boundary layer theory, laminar and turbulent heat transfer, temperature-dependent fluid properties, high velocity heat transfer and an introduction to mass transfer.
Credit Hours: 3
Prerequisites: MAE 4300

MAE 8313: Heat Transfer-Conduction
Distribution of temperature and temperature history within solids by the four essential methods of evaluation of these temperature fields.
Credit Hours: 3
Prerequisites: MAE 4300

MAE 8315: Multiphase Heat Transfer
Fundamentals and application of heat and mass transfer and fluid flow with phase change; melting and solidification, sublimation and vapor deposition, condensation, evaporation, nucleate and film boiling, two-phase flow. Graded on A-F basis only.
Credit Hours: 3
Prerequisites: MAE 4300

MAE 8320: Continuum Mechanics
(same as CV_ENG 8320). Introductory course in the mechanics of continuous media. Basic concepts of stress, strain, constitutive relationships; conservation laws are treated using Cartesian tensor notation. Examples from both solid and fluid mechanics investigated.
Credit Hours: 3
Prerequisites: MAE 3400, MATH 4100, ENGINR 2200

MAE 8330: Theory of Elasticity
Credit Hours: 3

MAE 8332: Thermal Stresses
General equations of thermoelasticity. Constitutive equations of thermoelastoplasticity: Analytical and numerical analyses of thermal stresses in bars, beams, 3D media, 2D plane stress and strain media, cylinders, and spheres. Graded on A-F basis only.
Credit Hours: 3
Prerequisites: MAE 4300, or instructor's consent
Recommended: MAE 8330

MAE 8360: Theory of Plasticity
Credit Hours: 3
Prerequisites: MAE 8330 or instructor's consent

MAE 8380: Advanced Thermodynamics
Advanced topics from classical thermodynamics.
Credit Hours: 3
Prerequisites: MAE 4380

MAE 8420: Computational Heat Transfer and Fluid Dynamics
Introduction to numeric analysis techniques applied to heat transfer and fluid dynamics problems. Coverage will include, the development of discretization equations for the control volume approach and solution strategies of those equations. Results from numeric simulations will be compared with close form analytic solutions and commercial numeric code output.
Credit Hours: 3

MAE 8430: Introduction to Two Phase Flow
An introduction to the analysis of the mechanics and transport processes in two phase flows.
Credit Hours: 3
Prerequisites: MAE 3400

MAE 8450: Introduction to Turbulence
An introduction to the physical phenomena of turbulence, supported by mathematical and statistical descriptions. Especially appropriate for engineers involved in research of momentum, heat, and mass transport.
Credit Hours: 3
Prerequisites: MAE 4420

MAE 8510: Manufacturing Design
Design for manufacture methods, their capabilities and applications. Design of intelligent manufacturing systems using sensory systems and artificial intelligence techniques.
Credit Hours: 3
Prerequisites: MAE 3100 and MAE 4500

MAE 8620: Advanced Dynamics
(same as CV_ENG 8620). Fundamental principles of advanced rigid body dynamics with applications. Special mathematical techniques including Lagrangian and Hamiltonian methods.
Credit Hours: 3  
Prerequisites: MAE 2600

**MAE 8740: Robust Control**
Definition of the robust performance problem with the goal of achieving specified signal levels in the face of plant uncertainty; uncertainty and robustness, stabilization, design constraints, loopshaping, model matching and design for robust performance.

Credit Hours: 3  
Prerequisites: MAE 4750, and MAE 8780 or instructor's consent

**MAE 8750: Nonlinear Control**
Nonlinear systems analysis techniques including phase plane analysis, Lyapunov theory. Control design including feedback linearization, sliding control, and adaptive control.

Credit Hours: 3  
Prerequisites: MAE 4750 and MAE 8780

**MAE 8760: Optimal Control**
The course will study optimization under dynamic constraints and optimal control theory. Topics include calculus of variation, Pontryagin's minimum principle, dynamic programming, and linear quadratic optimal control. Graded on A-F basis only.

Credit Hours: 3

**MAE 8910: Modular Machine Tool Design**
This course introduces necessary concepts and tools for modular machine tool design. Students will learn how to apply mechanical design knowledge and commercially available subassemblies and parts to design modular machine tools for mass production application.

Credit Hours: 3  
Prerequisites: MAE 4980 or instructor's consent

**MAE 8930: Advanced Mechanical System Modeling and Optimization**
Calculus of variations is introduced as a basic tool. Hamilton's Principle is used for system modeling. Numerical solution methods are used for dynamic simulation. Genetic algorithm and other algorithms are applied for system optimization. Graded on A-F basis only.

Credit Hours: 3  
Prerequisites: MAE 3600 and MAE 4980. Seniors will require consent

**MAE 8990: Research-Masters Thesis in Mechanical and Aerospace Engineering**
Independent investigation in field of mechanical and aerospace engineering to be presented as a thesis. Graded on a S/U basis only.

Credit Hour: 1-99

**MAE 9990: Research-Doctoral Dissertation Mechanical & Aerospace Engineering**
Independent investigation in field of mechanical and aerospace engineering to be presented as a thesis. Graded on a S/U basis only.

Credit Hour: 1-99