# Mechanical and Aerospace Engineering

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## Mechanical and Aerospace Programs

Aerospace Engineering is a diverse and rapidly changing field that consists of four fundamental technical disciplines: aerodynamics, structures and materials, propulsion, and flight mechanics and control. Aerospace engineers have traditionally applied their knowledge of these disciplines to the design and development of high performance flight systems such as aircraft, rotorcraft, spacecraft, missiles and rockets.

Mechanical Engineering applies the principles of physics and materials science for design, analysis and manufacturing of mechanical and thermal systems. Mechanical engineers use core concepts: mechanics, kinematics, thermodynamics, and fluid mechanics and tools: computer-aided design and modeling to design and build machines, weapons, medical devices, and robotics.

The department of Mechanical and Aerospace Engineering offers the following degree programs:

- Bachelor of Science in Aerospace Engineering (http://catalog.uah.edu/undergrad/colleges-departments/engineering/mechanical-aerospace-engineering/aerospace-engineering-bsae)
- Bachelor of Science in Mechanical Engineering (http://catalog.uah.edu/undergrad/colleges-departments/engineering/mechanical-aerospace-engineering/mechanical-engineering-bsme)

## Mission Statement

The mission of the Department of Mechanical and Aerospace Engineering is to provide undergraduate and graduate education, research, and public service in the mechanical and aerospace engineering disciplines and to support the mechanical and aerospace engineering needs of Huntsville, the State of Alabama, the region, our nation, and the international community.

## Program Educational Objectives

*Within a few years of graduation, Aerospace and Mechanical Engineering graduates will have:*

- attained successful careers and recognition as young leaders in industry and in the community;
- created innovative solutions through the application of their knowledge base and capacity for critical thinking;
- established collaborative working relationships wherein they communicate their ideas effectively; and
- pursued continuous professional development and advanced-study opportunities.

## Majors in Mechanical and Aerospace Engineering

- Aerospace Engineering, BSAE (http://catalog.uah.edu/undergrad/colleges-departments/engineering/mechanical-aerospace-engineering/aerospace-engineering-bsae)
- Mechanical Engineering, BSME (http://catalog.uah.edu/undergrad/colleges-departments/engineering/mechanical-aerospace-engineering/mechanical-engineering-bsme)

MAE 115 - INTRODUCTION TO MACHINING
Semester Hour: 1

Safety and familiarity with the machine shop environment, equipment, tools, and practices. Correlate student design with consquences of design choice. Basic turning, milling, welding, and sheet metal operations. Programming and operation of numerically controlled machines. Prerequisites: MAE 310 and MAE 198.

MAE 200 - PRINC AERONAUTICS & ASTRONAUTI
Semester Hours: 3

Fundamental concepts of aerospace engineering including the history of flight, standard atmosphere, fluid and flow properties, lift and drag, propulsion, and structures; elementary aircraft performance, stability and control; basic astronautics and space environment; and aerospace vehicle design. Prerequisites: PH 111, ENG 101, MA 172. Prerequisite with concurrency: MAE 211.

MAE 211 - INTRO COMPUTATIONAL TOOLS
Semester Hours: 2

Computer-aided design and solid modeling concepts including: model definition through constraints and dimensioning, and development of subassemblies and assemblies. Prerequisites: ENG 101 and MA 171.

MAE 271 - STATICS
Semester Hours: 3

Topics include: forces, resultant forces, moments, couples equivalent force systems, equilibrium, distributed loads, two force members, trusses, centroids, moments of inertia, shear and bending moment diagrams, static and kinematic friction. (Same as CE 271) Prerequisites: PH 111, MA 201 and ENG 101.

MAE 272 - DYNAMICS
Semester Hours: 3

Kinematics and kinetics of a particle and of systems of particles with applications to central force motion, impact, relative motion, vibrations, and variable mass systems. Dynamics of rigid body in plan motion, relative motion in rotating coordinates, and gyroscopic motion. (Same as CS 362) Prerequisites: (CE 271 or MAE 271) and MA 201.

MAE 284 - NUMERICAL METHODS
Semester Hours: 3

Use computational tools to solve mathematical problems of engineering interest. Discussion and application of root finding and optimization techniques. Other topics include curve fitting, Gauss Elimination, LA decomposition, and Cholesky decomposition, numerical integration and numerical differentiation. Solving initial and boundary value problems. Course includes a lab experience using modern computational tools. Prerequisites: MA 244, ENG 101, MAE 211 and MA 238.

MAE 284L - NUMERICAL METHODS LAB
Semester Hours: 0

MAE 310 - FLUID MECHANICS I
Semester Hours: 3

Fluid properties and fundamental principles governing fluid behavior. Fluid statics, basic equations in integral form and differential form, potential flow, dimensional analysis, and internal incompressible viscous flows. Prerequisites: (CE 271 or MAE 271) and MA 238.

MAE 311 - PRIN MEASUREMENT & INSTRUMEN
Semester Hours: 3

Instrumentation and techniques for measurement of mechanical phenomena. Calibration, standards, computerized data acquisition, error analysis, signal conditioning, dynamic response, and experimental design. Laboratory included. Prerequisites: EE 213 and MAE 284.

MAE 311L - PRINC MEASUREMENT & INSTR LAB
Semester Hours: 0

MAE 330 - FUNDAMENTALS AERODYNAMICS
Semester Hours: 4

Fundamentals of incompressible flow, conservation laws, potential flow, similarity, airfoil and finite wing lift and drag, thin airfoil and panel methods, introduction to viscous flows and boundary layers, and modern airfoil and wing design. Integrated lab sessions allow students to investigate aerodynamic principles through wind tunnel experiments. Prerequisites: MAE 200, MAE 272 and MA 238 (all with minimum grade of C-).

MAE 330L - LABORATORY
Semester Hours: 0

This lab is a 0 credit lab component of the 4 credit MAE 330 course.

MAE 341 - THERMODYNAMICS I
Semester Hours: 3

Basic laws of energy that apply in all branches of engineering and science. Properties of matter, state variables, reversible processes, first and second laws of thermodynamics with applications to closed and open systems. Availability of energy and irreversibility. Prerequisites: CH 121, PH 112, and MA 201.

MAE 342 - THERMODYNAMICS II
Semester Hours: 3

Continuation of MAE 341. Thermodynamic cycles, thermodynamic relations among properties, chemical reactions, and phase and chemical equilibrium. Prerequisites: MAE 341 and MA 238.

MAE 343 - COMPRESSIBLE AERODYNAMICS
Semester Hours: 3

Compressible flow including area change, friction, and heat transfer. Fundamentals of acoustic waves, 1- and 2-D shock and expansion waves, shock-expansion theory, and linearized flow with applications to inlets, nozzles, wind tunnels, and supersonic flow over aerodynamic bodies and wings. Prerequisites: MAE 200, MAE 341 and MA 238 (all with minimum grade of C-).

MAE 345 - HONORS THERMODYNAMICS COLQ
Semester Hour: 1

Students in this course will be expected to participate in assigned readings and discussions to develop an understanding of the context behind the fundamental concepts and principles of thermodynamics. Through reflections students will be encouraged to apply this knowledge to develop their own creative ideas. Prerequisites with concurrency: MAE 341 or CHE 344.

MAE 364 - KINEMATICS/DYNAM MACHINE
Semester Hours: 3

Kinematics and dynamics of planar machinery including principles of mechanisms, cam design, gears and epicycle gear trains, determination of velocity and acceleration in mechanisms. Inertia forces in machines, balancing of rotating masses and reciprocating masses, and vibration analysis. Prerequisites: MAE 211 and (MAE 272 or CE 272).

MAE 364L - KINEMATICS/DYN MACHINE LAB
Semester Hours: 0

MAE 370 - MECHANICS OF MATERIALS
Semester Hours: 4

Stress and strain, Hooke's law, stresses and deformations in bodies loaded by single and combined loads, and analysis of statically indeterminate systems. Laboratory includes experimental verification of lecture concepts, test procedures, instrumentation, and interpretation of results. (Same as CE 370). Prerequisites: (MAE 211 or CE 211) and (CE 271 or MAE 271), and MA 244.

MAE 370L - LABORATORY
Semester Hours: 0

MAE 371 - AEROSPACE STRUCTURES
Semester Hours: 3

Analysis and design of lightweight aerospace structures including sandwich structures, stiffened panels, and tubing stress and deflection analysis. Design of members in tension, torsion, and bending. Space structures. Prerequisites: MAE 200 and (MAE 370 or CE 370).

MAE 378 - MATERIALS & MFG PROCESS
Semester Hours: 3

Engineering properties of materials, sources of information for properties of materials, cost considerations for material selection, manufacturing processes, casting, forming, machining, cost considerations for machining operations. One or more field trips included. (Same as ISE 378). Prerequisites: MAE 370 or CE 370.

MAE 395 - SEL TOPICS:MECH & AEROSPACE EG
Semester Hours: 1-3

Special topics in Mechanical or Aerospace Engineering.

MAE 425 - DESIGN OF MACHINE ELEMENTS/A&M
Semester Hours: 3

MAE 440 - ROCKET PROPULSION I
Semester Hours: 3

Introduction to the operation, analysis, and design of liquid and solid rockets. Incorporates design and realization of a thermal system, in which students work in teams to design a rocket motor or component. Prerequisite: MAE 343.

MAE 441 - AIRBREATHING PROPULSION
Semester Hours: 3

Air breathing propulsion systems with emphasis on gas turbine engines for air-and rotor-craft. Includes thermodynamic power cycles, components design, and engine performance analysis. Incorporates a turbine engine design and realization team project. Prerequisite: MAE 343.

MAE 444 - INTRO TO ELECTRIC PROPULSION
Semester Hours: 3

Elements of electrically-driven rocket propulsion for applications from low earth orbit to the outer planets will be discussed. The physics of ionizing and heating gases and plasmas for electrothermal, electrostatic and electromagnetic acceleration will be studied. Characteristics of Resistojet, Arcjet, Magnetoplasmadynamic thrusters, Electrothermal, Pulsed plasma, Electrostatic, and Hall thrusters will be covered. Review thruster system performance, power requirements and selection for space missions. Overview of current research efforts, including thruster systems, physics, and performance. Prerequsite: MAE 420.

MAE 449 - AEROSPACE LABORATORY
Semester Hours: 2

Experimental investigation of aerospace structures, airfoils and bodies in subsonic flow, and performance of various aerospace propulsion systems. An experiment design project is included. Concurrent registration in MAE 449L is required.

MAE 450 - INTRO TO HEAT & MASS TRANSFER
Semester Hours: 4

Principles of heat and mass transfer; application of principles to problems in conductive, convective, and radioactive heat transfer and mass transfer; laminar and turbulent flow processes; boiling and condensation; heat exchangers. One credit hour laboratory included. Prerequisites: MAE 283, MAE 311, MAE 341 and (MAE 310 or MAE 330).

MAE 450L - INTRO HEAT & MASS TRANSFER LAB
Semester Hours: 0

MAE 455 - DESIGN OF THERMAL SYSTEMS
Semester Hours: 3

Heat transfer, thermodynamics, and fluid mechanics applied to analysis and design of systems for storage and transport, and exhange of thermal energy. Modeling of thermal equipment, simulation of system performance, optimization of system design, and comprehensive design of thermal systems. Prerequisites: MAE 342 and MAE 450.

MAE 461 - VIBRATIONS ELASTIC SYS
Semester Hours: 3

Formulation of the equations of motion of discrete and continuous systems, analytical and numerical methods of solution, eigenvalue problems and dynamic response. Prerequisite: MAE 488.

MAE 463 - INTERMEDIATE DYNAMICS
Semester Hours: 3

Kinematics and dynamics of particles, system of particles, and rigid-bodies. Variational principles and Langrangian mechanics. Prerequisites: MAE 272 and MAE 488.

MAE 466 - MECH & DSGN MACH ELEMENT
Semester Hours: 3

Detailed design and selection of machine elements such as gears, shafts, and bearings. Analysis of stresses and deformations under combined static and dynamic loads, stress concentrations, and fatigue. Prerequisites: MAE 364 and (MAE 370 or CE 370).

MAE 468 - ELEMENTS OF SPACECRAFT DESIGN
Semester Hours: 3

Fundamentals of spacecraft engineering and design. Topics include: orbital mechanics, space environment, attitude determination and control, communications, space structures, thermal control, propulsion and power, and systems and mission design. Prerequisites: MAE 371 and (MAE 272 or CE 272).

MAE 471 - ADV AEROSPACE STR & MTRLS
Semester Hours: 3

Composite materials and applications in aerospace structures including: material types and properties and fabrication techniques, micromechanics, constitutive behavior, and classical laminated plate theory. Introduction to failure concepts, sandwich panels and finite element modeling of 1-and 2-D aerospace structures. Prerequisites: MAE 311 and MAE 371.

MAE 474 - APP MECHANICS OF SOLIDS
Semester Hours: 3

Stresses and strains at a point, theories of failures, stress concentration factors, thick-walled cylinders, torsion of noncircular members, curved beams, unsymmetrical bending, and shear center. Prerequisites: MAE 370 or CE 370.

MAE 477 - EXP TECH SOLID MECHANICS
Semester Hours: 3

Experimental methods to determine stress, strain, displacement, velocity, and acceleration in various media. Theory and laboratory applications of electrical resistance strain gages, brittle coatings, and photo elasticity. Application of transducers and experimental analysis of engineering systems. Prerequisites: MAE 370 or CE 370.

MAE 480 - AIRCRAFT STABILITY & CONTROL
Semester Hours: 3

The stability and control of aerodynamic vehicles. The design of aircraft to obtain good flying characteristics. The complete governing equations and analog solutions of linearized equations. Prerequisites: MAE 430 and MAE 488.

MAE 488 - ANALY ENGINEERING SYSTEM
Semester Hours: 3

Development of mathematical engineering models of physical systems including: mechanical, electrical, and fluid systems and combined systems. Determination of the dynamic response of physical systems. Prerequisites: EE 213, MAE 284 and (MAE 272 or CE 272).

MAE 489 - COMPUTER AIDED ENGR
Semester Hours: 3

Analysis of design of structural, thermal, and dynamical systems using finite element and finite difference computer programs. Practical guidelines for discrete modeling; analysis of modeling errors. Comparison of exact and approximate solutions to boundary value problems. Prerequisites: MAE 370 or CE 370 and MAE 284 w/concurrency.

MAE 490 - SENIOR DESIGN I
Semester Hours: 3

Application of basic design principles including: design methodology, decision making, creativity, product liability, human factors, patents, ethics, and technical writing. Students will be assigned to a multi-disciplinary teams to develop design project requirements and initial concepts. Prerequisites: ISE 321, MAE 311, MAE 341 and (MAE 310, MAE 364 & MAE 371 or MAE 330, mAE 343 & MAE 371).

MAE 491 - SENIOR DESIGN II
Semester Hours: 3

Continuation of MAE 490. Students work on multi-disciplinary teams to design, fabricate, test and demonstrate the performance of various mechanisms, products and vehicles according to customer requirements. Oral presentations and written detailed documentation of the project must also be completed. Prerequisite: MAE 490.

MAE 492 - MISSION DESIGN & DEVELPMNT
Semester Hours: 3

Senior Capstone Course Option. Students work design teams to develop missions of interest to NASA, DoD and industry. Includes defining the mission architecture and associated vehicles and components required to meet the customer requirements. Prerequisites: MAE 490.

MAE 493 - ROCKET DESIGN
Semester Hours: 3

Senior Capstone Course Option. Design, build, test and fly a high-powered rocket with a payload to a specified altitude. Students work on multi-disciplinary teams to design payloads, avionics, recovery systems, structures and other sub-systems and then integrate them into the final vehicle. Prerequisites: MAE 490.

MAE 494 - AIRCRAFT DESIGN
Semester Hours: 3

Senior Capstone Course Option. Design, build, and test an unmanned aircraft to meet specified requirements. Students work on multi-disciplinary teams. Systems engineering aspects including simulation, fabrication, integration, scheduling and cost estimation are also emphasized.

MAE 495 - SEL TOPICS:MECH & AEROSPACE EG
Semester Hours: 1-4

MAE 496 - IND STUDY:MECH & AEROSPACE EG
Semester Hours: 1-4

Special independent project in a topic of Mechanical or Aerospace Engineering. Must work with a MAE faculty member with project approved by MAE department chair.

MAE 499 - UNDERGRADUATE THESIS
Semester Hours: 3

Required for students completing an Honors Program Bachelors Thesis. Senior standing and permission of thesis advisor required.