Department of Mechanical Engineering

Mechanical engineering is the most versatile engineering program. Mechanical engineers pursue careers in a wide variety of industries, research laboratories, educational activities and government agencies. Mechanical engineering graduates can become involved in research, design and management in industries such as aerospace, automotive, energy conservation, precision engineering, railroad, heavy machinery, manufacturing, food/forest products, textiles, paper, consumer appliances, robotics, nuclear and fossil power plants, electronics, computer automation, agriculture, heating and air-conditioning, construction, transportation and mining. A significant number of mechanical engineering graduates use mechanical engineering as the foundation for careers in business administration, law, medicine and other professions. Many graduates are also accepted for advanced study in mechanical engineering, biomedical engineering, medicine, law, business administration and dentistry.

Program Objectives

The University of Alabama Department of Mechanical Engineering has adopted the following objectives to ensure our graduates are equipped to meet known and anticipated technical challenges of our profession. Out of a commitment to continuously improve the undergraduate curriculum for the mechanical engineering program, the Department of Mechanical Engineering’s faculty has adopted several educational objectives. The following objectives define the early-career accomplishments that the mechanical engineering program is designed to prepare graduates to pursue:

- Our graduates will be expected to follow one of two career paths: technical or management. We expect them to have sufficient career and professional accomplishments within 5-10 years of graduation to be considered as either an engineering expert or a leader/manager.
- Our graduates will continue to grow in expertise and knowledge by participating in activities that enhance professional development in their career path.
- Our graduates will contribute to the profession in ways that benefit society.

Student Educational Outcomes

The mechanical engineering program at The University of Alabama will demonstrate that its graduates have:

- an ability to apply knowledge of mathematics, science, and engineering
- an ability to design and conduct experiments, as well as to analyze and interpret data
- an ability to model, analyze, design, and realize a system, component, or process to meet ethical, health and safety, manufacturability and sustainability
- an ability to function on multidisciplinary teams
- an ability to identify, formulate and solve engineering problems
- an understanding of professional and ethical responsibility
- an ability to communicate effectively
- the broad education necessary to understand the impact of engineering solutions in a global economic, environmental and societal context
- a recognition of the need for, and an ability to engage in, life-long learning
- a knowledge of contemporary issues
- an ability to use the techniques, skills and modern engineering tools necessary for engineering practice
- an ability to apply advanced mathematics in both thermal and mechanical systems areas
- the ability to work professionally in both thermal and mechanical systems areas

Mechanical Engineering Curriculum

<table>
<thead>
<tr>
<th>Freshman</th>
<th>Fall Hours</th>
<th>Spring Hours</th>
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</thead>
<tbody>
<tr>
<td>CH 101</td>
<td>4 MATH 126</td>
<td>4</td>
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<tr>
<td>MATH 125</td>
<td>4 PHY 105</td>
<td>4</td>
</tr>
<tr>
<td>Humanities (HU), Literature (L), or Fine Arts, (FA) elective or history (HI) and/or Social and Behavioral Sciences (SB) elective...</td>
<td>3 ENGR 161</td>
<td>1</td>
</tr>
<tr>
<td>ME 121</td>
<td>1 ENGR 103</td>
<td>3</td>
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<tr>
<td>EN 101</td>
<td>3 ENGR 102</td>
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<tr>
<th>Sophomore</th>
<th>Fall Hours</th>
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<tbody>
<tr>
<td>AEM 201</td>
<td>3 AEM 264</td>
<td>3</td>
</tr>
<tr>
<td>MATH 227</td>
<td>4 AEM 311</td>
<td>3</td>
</tr>
<tr>
<td>ME 215</td>
<td>3 MATH 238</td>
<td>3</td>
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<tr>
<td>PH 106</td>
<td>4 ME 305</td>
<td>3</td>
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</tbody>
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Approved science elective

<table>
<thead>
<tr>
<th>Junior</th>
<th>Fall Hours</th>
<th>Spring Hours</th>
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<tbody>
<tr>
<td>AEM 250</td>
<td>3 ME 350</td>
<td>3</td>
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<tr>
<td>AEM 251</td>
<td>1 ME 560</td>
<td>3</td>
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<tr>
<td>ECE 320</td>
<td>3 ME 372</td>
<td>3</td>
</tr>
<tr>
<td>ME 309</td>
<td>3 ME 383</td>
<td>3</td>
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<tr>
<td>ME 349</td>
<td>3 Approved mechanical engineering elective</td>
<td>3</td>
</tr>
<tr>
<td>Humanities (HU), Literature (L), or Fine Arts, (FA) elective or history (HI) and/or Social and Behavioral Sciences (SB) elective</td>
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</table>

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<thead>
<tr>
<th>Senior</th>
<th>Fall Hours</th>
<th>Spring Hours</th>
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</thead>
<tbody>
<tr>
<td>ME 450</td>
<td>3 ME 490</td>
<td>3</td>
</tr>
<tr>
<td>ME 460</td>
<td>4 Approved mechanical engineering or technical elective</td>
<td>4</td>
</tr>
<tr>
<td>ME 489</td>
<td>3 Approved mechanical engineering elective</td>
<td>3</td>
</tr>
<tr>
<td>Humanities (HU), Literature (L), or Fine Arts, (FA) elective or history (HI) and/or Social and Behavioral Sciences (SB) elective</td>
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</tbody>
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Total Hours: 126

1 All engineering students are required to take 9 hours of humanities and 9 hours of social and behavioral sciences. At least 6 hours must be from a single program.
2 Approved science electives are taken from an approved list available from the department.
3 Mechanical engineering electives are offered on a regular schedule, but not necessarily every year. The student may select any two mechanical engineering electives to complete the requirements for the BS degree. A list of mechanical engineering electives is available from the department.
4 The technical elective requirement may be fulfilled with a mechanical engineering elective course or an engineering, math, or science course from the approved list or with advanced petition to the mechanical engineering department. The approved list is available from the department.

Interim Term Courses

Humanities and social science courses taken during the Interim term may be counted toward the requirements for a BS degree in mechanical engineering. However, Interim courses can be used to fulfill mechanical engineering or technical elective requirements only if the specific courses have been approved in advance of registration by the Department of Mechanical Engineering.

Special Programs

Mechanical Engineering Program

The Mechanical Engineering Honors Program is part of the College of Engineering Honors Programs and is designed to provide an enhanced academic experience for highly-motivated, high-achieving students. The program develops problem-solving, critical-thinking and communication skills through a mentored experience-based activity. Research is particularly encouraged. Students completing the ME Honors Program will be awarded a certificate and recognized at the Honors Day ceremony in the student’s senior year. Details can be found online at me.eng.ua.edu under the undergraduate program link.

University Scholars Program

The department participates in the University Scholars Program where a student who meets qualifications as an honors student can apply to graduate school after the junior year and pursue the BS and MS simultaneously.

Undergraduate Research Program

The Supplemental Undergraduate Research Experience (SURE) program provides our students with an enhanced educational experience. This is achieved by teaming the student with a faculty mentor who will work with and guide the student as he/she completes a structured research project. Participation in the SURE Program will:

- sharpen the student’s critical thinking skills
- enhance the student’s ability to apply engineering analysis techniques
- improve the student’s ability to communicate technical information
- increase the student’s confidence in his or her engineering skills
• provide exposure to the graduate-level research environment
Details can be found online at me.eng.ua.edu under the undergraduate program link.

Cooperative Education
Many mechanical engineering students participate in the cooperative education program. This is an academic program where students alternate work terms in an engineering environment in industry with full-time terms of course work. Co-op can greatly enhance your academic experience and employment opportunities.

Faculty
Interim Department Head and Director, Center for Advanced Vehicle Technology
Midkiff, Jr., K. Clark
Professor and Robert F. Barfield Endowed Chair
Agrawal, Ajay K.

Professors
Balasubramanian, Bharat, Executive Director, Center for Advanced Vehicle Technology
Chou, Y. Kevin
Guo, Yuebin
Shepard, Steve
Taylor, Robert P.
Woodbury, Keith A.

Associate Professors
Ashford, Marcus
Fonseca, Daniel
Puzinauskas, Paul
Schreiber, Will
Todd, Beth A.
Williams, Keith

Assistant Professor
Fisher, Brian
Jordon, Brian
Mahmoodi, Seyed Nima
O’Neil, Zheng
Shen, Xiangrong
Volkov, Alexey
Yoon, Hwan-Sik

Professors Emeriti
Barfield, Robert F.
Parker, Joey K.
Harrisberger, Lee
Doughty, Julian O.
Evces, Charles R.
Kavanaugh, Steve

Courses
ME 121. INTRODUCTION TO MECHANICAL ENGINEERING. 1 sem. hr.
An introduction to the discipline of mechanical engineering and the role of the mechanical engineer, including both mechanical and thermal/fluid stems. Focus is on learning about the discipline through a series of student hands-on activities. Credit will not be given for this course for students who have passed ME 215.
Prerequisite(s): Math 112 or Math 113 or Math 115 or Math 125 or Math 126 or Math 145 or Math 146 or Math 227 or Math 238.

ME 215. Thermodynamics I. 3 sem. hrs.
Properties of matter; processes in fluids; zeroth; first and second laws; irreversibility.
Prerequisite(s): Math 126 or Math 146 or Math 132.

ME 216. Thermal Engineering Survey. 3 sem. hrs.
Survey of thermal engineering topics for engineers outside mechanical engineering. To include an overview of subjects typically covered in courses about fluid mechanics, thermo-dynamics I and II, and heat transfer. An emphasis is placed on qualitative concepts of transport and conservation as they relate to thermal-fluids in order to increase the understanding of thermal engineering applications.
Prerequisite(s): Math 126 or Math 146.

ME 305. Thermodynamics II. 3 sem. hrs.
Thermodynamic cycle analysis; thermodynamics of non-reacting and reacting mixtures; and chemical equilibrium.
Prerequisite(s): ME 215, Math 227 or Math 247.

ME 308. Propulsion Systems. 3 sem. hrs.
Basic propulsion dynamics, thermodynamics of fluid flow, combustion kinetics, air-breathing engines, rockets, design criteria, performance and advanced propulsion systems.
Prerequisite(s): ME 305.

ME 309. Heat Transfer. 3 sem. hrs.
Steady and unsteady conduction, convection and radiation heat transfer.
Prerequisite(s): Math 238 and ME 215 and AEM 311.

ME 349. Engineering Analysis. 3 sem. hrs.
Elements of statistics, matrix algebra, numerical analysis, and partial differential equations applied to engineering problems; includes extensive computer applications. Computing proficiency is required for a passing grade in this course.
Prerequisite(s): Math 238 and MES 122 or ENGR 141 or ENGR 103.

ME 350. Static Machine Components. 4 sem. hrs.
The analysis of stresses of machine elements and the topics of fatigue strength, wear and failure criteria. Also includes the design of fasteners covering both bolted and welded joints, as well as an introduction to finite element analysis.
Prerequisite(s): AEM 250 and AEM 251 and DR 125 or ART 131 or ENGR 161.

ME 360. Ctrl Instrumnt Components. 3 sem. hrs.
Introduction to selection and use of electrical, pneumatic, and other components of mechanical system instrumentation and control. Specific components include modern electrical measurement devices, signal conditioning, force and torque measurement, proximity sensors, AC and DC motors, etc. Writing proficiency is required for a passing grade in this course.
Prerequisite(s): AEM 250; and ECE 320 or ECE 225.

ME 364. Vehicle Dynamics. 3 sem. hrs.
Dynamics of four-wheeled vehicles, including acceleration and braking performance, road loads, ride comfort, steady-state cornering, suspensions, steering systems, and rollover. Vehicle dynamics system modeling programs are introduced and used for detailed investigations of the effect of system design parameters on performance.
Prerequisite(s): AEM 264.

ME 372. Dynamic Systems. 3 sem. hrs.
An introduction to the modeling, analysis and control of dynamic systems. The course takes the student from initial modeling through analysis of the system response and finally into the control of the system. Specific systems include mechanical devices, electrical circuits, and electromechanical systems. Computing proficiency is required for a passing grade in this course.
Prerequisite(s): Math 238 and AEM 264 and ME 349; and ECE 320 or ECE 225.

ME 377. Noise Control. 3 sem. hrs.
Physical properties of noise; hearing and noise criteria measurement techniques; and noise-control fundamentals applied to practical problems.
Prerequisite(s): Math 238 and PH 106.

ME 383. Modern Manufacturng Processes. 3 sem. hrs.
A survey of classical and modern manufacturing processes. Emphasis is on technical fundamentals and practical applications. Components include geometric and service attributes of manufactured products, metal casting processes, forming processes, machine processes and joining processes. Practical project experience included.
Prerequisite(s): AEM 250 and AEM 251 and DR 125 or ART 131 or ENGR 161.

ME 406. Thermal Power Systems. 3 sem. hrs.
Study of thermal systems emphasizing large power generation systems. Topics include Rankine and gas turbine cycles, fossil fuels combustion, boiler characteristics, cogeneration, combined cycle plants, environmental effects of power generation, and alternative energy concepts.
Prerequisite(s): ME 305.

ME 407. Heatg Ventilat Air-Condg. 3 sem. hrs.
Fundamentals and practice associated with heating, ventilating and air conditioning; study of heat and moisture flow in structures, energy consumption, human comfort and health; and design of practical systems.
Prerequisite(s): ME 309 and ME 305.
Analysis of energy systems, including fossil fuels, steam, cogeneration, waste heat recovery, heating, ventilation, air-conditioning, control and energy-management systems. Topics include conservation in electrical load, lighting, building envelope, and insulation; alternative energy sources; economic analysis; energy auditing; and fuel sources and supplies.
Prerequisite(s): ME 309 and ME 305 and ECE 320 or ECE 225.

ME 417. Sustainable Energy. 3 sem. hrs.
Contemporary issues surrounding the challenge of providing energy for societal and economic development are examined. Depletion of fossil fuel resources and the impact of fossil fuel use on the environment and climate are considered. Alternative sustainable sources of energy production are explored.
Prerequisite(s): ME 215.

ME 418. Combustion Engines. 3 sem. hrs.
Theory, design, and performance of combustion engines; fuels, oxidants, and propellants; and combustion, dissociation, ionization, and engine emissions.
Prerequisite(s): ME 305.

ME 421. Reliability Maint & TPM. 3 sem. hrs.
Measures and methods of reliability engineering, maintainability engineering and total productive maintenance, as used in the system design process.
Prerequisite(s): GES 255 or GES 500.

ME 430. Fuzzy Set Theory & Application. 3 sem. hrs.
This course introduces fuzzy set theory and its engineering applications to upper-class undergraduate students.
Prerequisite(s): GES 400 or GES 500.

ME 450. Dynamic Machine Components. 3 sem. hrs.
This course covers the selection and application of machine elements in dynamic systems. Specific components covered include transmission elements (gears and pulleys), mechanisms (linkages and cams), shafting, bearing systems and prime movers.
Prerequisite(s): AEM 264 and ME 350.

Selection and use of basic thermal systems measurement instrumentation. Techniques of analysis and design of thermal systems, including piping networks, heat exchangers, and pumping systems. Hands on experience with these systems. Statistical design of experiments. Writing proficiency is required for a passing grade in this course.
Prerequisite(s): ME 305, ME 309 & ME 360 - each must have a minimum grade of C-

ME 470. Mechanical Vibrations. 3 sem. hrs.
Free and forced vibrations, both undamped and damped, and systems with many degrees of freedom formulated and analyzed by matrix methods. Experimental techniques of vibration measurement are introduced.
Prerequisite(s): ME 372 and AEM 250.

ME 471. Fundamentals of Acoustics. 3 sem. hrs.
Fundamental physical principles underlying wave propagation and resonance in mechanical systems. Introduces applications and provides experience in acoustic and audio measurements, and the associated instrumentation.
Prerequisite(s): MATH 238 and PH 106 and ECE 225 or ECE 320.

ME 475. Control Systems Analysis. 3 sem. hrs.
Classical and modern feedback-control system analysis; block diagrams, state variables, stability, root locus and computerized analysis. Includes an introduction to modern control techniques.
Prerequisite(s): ME 349 and ME 372.

ME 483. Computer-Aided Manufacturing. 3 sem. hrs.
Introduction and application of several technologies used in computer-aided design/manufacturing; computer-aided design, solid modeling, rapid prototyping, geometric dimensioning and tolerancing, machining process optimization, NC programming CNC machines, software-based product, and process design in machining.
Prerequisite(s): ME 383.

ME 485. Intro to Computer-Aided Design. 3 sem. hrs.
Basics of computer-aided design, including solid modeling, model assembly, structural and thermal analysis, mechanism simulation and parametric/optimization study. Interactive computer programs are used to design and analyze mechanical components/devices.
Prerequisite(s): ENGR 161, AEM 250 and ME 309.

ME 489. Mechanical Engineering I. 3 sem. hrs.
Introduction to concepts and techniques of engineering design with supporting mathematical material. Guest lecturers present professional aspects of engineering. The Capstone Design Project is begun and carried on through ME 490 (ME 489 and ME 490 are taken in consecutive semesters).
Prerequisite(s): ME 350 and ME 309.

ME 490. Mechanical Engg Design II. 3 sem. hrs.
In this semester-long internship experience, three-student teams serve as consultants to an industrial client. Emphasis is on conducting a professional design study and preparing written and oral presentations of the project.
Prerequisite(s): ME 489.

ME 491. Special Problems. 1-6 sem. hr.
This is a special topics lecture class or an assigned problem class. Credit is based on the amount of work undertaken.

ME 497. Mechanical Engineering Project. 1-3 sem. hr.
An individual analytical, experimental or design project. Research on an assigned problem culminates in a required report.