Mechanical Engineering: Past, Present and Future

A World-Class Education
The Department of Mechanical Engineering (ME) at The University of Texas at Austin (UT) is one of the premier mechanical engineering departments in the country, and the university is among the top research institutions in the world. The Times of London ranked UT Austin 15th internationally and second in the United States among all research universities. Our graduates enjoy leadership roles in engineering, business, medicine, space, government and education. The department embraces the university’s core values—learning, discovery, freedom, leadership, individual opportunity, and responsibility.

Research Overview
The undergraduate core curriculum has stayed relatively consistent since the department’s inception, but the research and careers of current graduates and faculty has changed dramatically. The main research areas (also known as Thrusts) are Clean Energy, Advanced Manufacturing, Nano- and Micro-Scale Engineering and Mechanical Systems Intelligence. Many of our faculty members are world-renowned research scientists, whose leadership provides students an unparalleled opportunity to learn and contribute on the frontier of science and technology.

History of the Department
Engineering was established as a discipline on campus in 1895, and the School of Mechanical Engineering (now a department) was founded in 1913. Today the department is home to approximately 1,000 undergraduate students, 340 graduate students, 69 faculty members and 30+ staff members. ME is housed in a 10-story, 137,000-square-foot building on Dean Keeton Street. Additional research facilities are located at the Pickle Research Campus in North Austin.

The Future of the Profession
These are exciting times in the field of mechanical engineering, and they present great opportunities for the next generation of engineers to make a difference in the lives of millions worldwide. Mechanical engineering is now about developing solutions to everyday problems and promoting sustainability. Our current graduates will have careers that are quite different from those of their predecessors, but they share with our alumni the rich tradition of a classical engineering education, tailored to their time.

Below: Graduate and undergraduate students on the UT Austin Challenge X team, supervised by Professor Ron Matthews, participated in a hybrid car design contest sponsored by GM. They doubled the standard Equinox’s mileage in their final design presented at the 2008 competition.
Below: Thermodynamics students find themselves back in 1824 when Sadi Carnot (aka Professor Phil Schmidt) makes a guest appearance to explain his discovery of the second law of thermodynamics. Carnot has been delivering the famous lecture for over 20 years. Dr. Schmidt is the recipient of the Chancellors Teaching Award, honoring a senior faculty member. It is one of the highest awards presented at UT for outstanding commitment and dedication to teaching excellence.
Department Rankings and Research

UT ME engineers are working on energy issues from many different angles, including solar and nuclear energy, lithium-ion battery design and production, fuel-efficient engines and wind turbine design. UT ME researchers are also working and studying in other areas such as bio-medical laser surgery and turning oil from algae into an environmentally safe biofuel.

Statistics and Rankings
Each year our department graduates approximately 200 undergraduate students, 70 master’s students and 30 Ph.D. students. According to U.S. News and World Report, UT ME is the highest ranked ME department in the southwest and south central United States, and is ranked tenth nationally. In 2008-09, our undergraduates were admitted from the top 7 percent of their high school graduating classes. The annual fall career fair, hosted by the Cockrell School of Engineering, attracted more than 160 companies expressing interest in hiring our ME students.

Research Efforts (Thrusts)
The research being developed in Mechanical Engineering is as promising as it is fascinating. We organize our research efforts into four general areas called Thrusts. For detailed information on these efforts, please refer to the links from the department’s faculty directory pages. The directory provides an in-depth biographical sketch on each faculty member with links to their own research Web sites. Advanced Manufacturing is the study of scientific and mathematical methodology to improve the speed and quality of the manufacturing process. The Nano- and Micro-scale Engineering Thrust (NMSET) is a multidisciplinary group that investigates fundamental mechanical science and engineering at the micro and nano scales and includes nanomanufacturing. The Mechanical Systems Intelligence (MSI) Thrust is focused on the scientific development of intelligent machines (e.g., robots) to create a new wave of technology building on the success of the last wave associated with computers. The Clean Energy Thrust (CET) is extremely broad, but includes the efficient conversion of nuclear, solar or liquid fuels into electricity or motive power; conversion of solar resources into next-generation biofuels (e.g., algae); end-use efficiency of devices; and systems modeling and energy infrastructure requirements. The CET group also focuses on fuel cells; rechargeable batteries; electrochemical supercapacitors; solar energy with an emphasis on the development of new materials and advanced nuclear fuel cycles; efficient manufacturing processes; system integration and control; analysis, testing and design of components at both the microscale and system levels; and analysis of off-design and transient behavior.

PROCEED
The Project-Centered Education (PROCEED) program in Mechanical Engineering is a department-wide curriculum development effort aimed at tying all elements of the ME undergraduate experience to real-world engineering. Through the generous support of several large corporate donors, and the involvement of 30 faculty members, we now offer 14 project-centered courses from the freshman to senior year. We have developed two online student portfolio databases and require a Senior Design Project class in which students work for an engineering sponsor on a project of the sponsor’s choice. Students gain hands-on work experience and the sponsors retain the rights to the projects the students develop.
Below: Assistant Professor Carolyn Seepersad (right) and graduate student Lia Kashdan use a process originally developed at UT called selective laser sintering to design custom products and prototypes. The technique uses a high-power laser to fuse particles into a three-dimensional object. On the table are designs by Seepersad’s research group and classes for deployable airplane wings, a customized backrest and bicycle pedals, a clock and tailored honeycomb mesostructures.
American Engineering Education Is Lagging Behind

In Thomas Friedman’s book, *The World is Flat*, he speaks of a marked decrease in the number of American students studying science and engineering. **Today only 5 percent of Americans graduate with an engineering degree, compared with 25 percent in Russia and 46 percent in China.* This will have an adverse effect on American business and the U.S. economy, as it is technical entrepreneurship that has propelled America to world dominance for the past 200 years. This situation makes your support of UT ME even more critical.

UT ME’s Economic Impact

The economic impact of the Department of Mechanical Engineering on Texas is enormous. A community’s economic base is directly determined by its proximity to a major engineering institution, and UT ME is the only top 10 department within a 900-mile radius of Austin. For this reason, it makes sound economic sense for corporations to financially nurture the programs that breed their future employees and grow the regional economy.

State Funding Is Not Enough

The Cockrell School of Engineering reports it receives approximately 50 percent of its operating budget via research funding. It cannot be adequately funded without corporate and donor support. Funding comes in the form of cash, in-kind donations, research grants or support of start-up companies spun off of university research efforts. Donations are used for capital improvements to structures and equipment, research-related salaries, endowments, scholarships and research. The department’s goals include endowing the Chair, building an Energy Institute, hiring more faculty, attracting the best possible students, funding more graduate work, offering more paid undergraduate research positions and renovating our research labs at the Pickle Research Campus.


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U.S. map: Elite ME departments usually enhance their regional economies. Orange states have a top 15 ME department. The top 15 ME departments are shown in red. The dark blue cities have the most jobs per capita of the 50 largest metropolitan areas. A strong job market often correlates to proximity to a top-tier ME program. Austin ranks 4th, as of July 2009. **Sources:** [Indeed.com](https://www.Indeed.com) and [U.S. News and World Report](https://www.usnews.com/).
Below: ME graduate student Shilpa Gulati, who specializes in artificial intelligence, worked as the software engineer for an Antarctic expedition to map the topography of an underground lake. She is standing in front of the submarine robot at a testing site. The robot went under the ice in Lake Bonney, Antarctica. The NASA funded research will enable exploration and discovery of life forms on other planets and satellites.
Changing the Way We Live through Research

Current Mechanical Engineering research is state-of-the-art, exciting and has the potential to make a tremendous difference in the lives of millions of people.

Green Algae as a Biofuel
Assistant Professor Halil Berberoglu and his research team are developing innovative technologies to provide society with sustainable and environmentally-friendly energy supplies. Dr. Berberoglu is an expert on algae systems. Algae are microorganisms that use sunlight and consume CO₂ to grow and produce the raw materials for biofuel. Algae-based biofuels offer a more energy-efficient and economically-sustainable alternative to agricultural-based biofuels. Through innovative system design and analysis, as well as fundamental biological research, Dr. Berberoglu’s team is developing efficient and economical algae-based biofuel production processes.

Longer-Lasting Energy Storage
Professor Rodney Ruoff and his research team have achieved a breakthrough in the use of a one-atom-thick structure called “graphene” as a new carbon-based material for storing electrical charge in ultracapacitor devices. This technology has the promise of improving the efficiency and performance of electric and hybrid cars, buses, trains and trams, as well as solar and wind turbine production. Everyday devices such as office copiers and cell phones benefit from the improved power delivery and long lifetimes of ultracapacitors. Electrical energy storage becomes a critical component when very large quantities of renewable electrical energy are being generated. This technology could pave the way toward shifting worldwide energy production to completely renewable energy sources, since adequate energy storage methodology is currently a limiting factor.

Biomechanics of Human Locomotion
Associate Professor Richard Neptune’s research group uses rapid prototyping techniques to optimize orthotic and prosthetic components and quickly produce prototypes to be tested in patients. His team’s research is also directed at improving sports performance by integrating models of the musculoskeletal and neuromuscular systems and design optimization techniques to improve equipment and identify optimal muscle coordination patterns. Current research involves the study of impaired muscle coordination in patients with post-stroke hemiparesis and rehabilitation methods including identifying optimal wheelchair propulsion techniques. Dr. Neptune received a CAREER Award from the National Science Foundation for his work to design prosthetic ankle-foot components to improve the walking ability of those with lower-limb amputations.

Associate Professor Richard Neptune and his team design devices to improve the walking ability of individuals with post-stroke hemiparesis and lower-limb amputations.
Below: Assistant Professor Halil Berberoglu and his team at The Solar Energy and Biofuels Laboratory (SEBL) are studying algae as a possible source for biofuels because it offers a more energy-efficient and economically-sustainable alternative to agricultural-based biofuels.
Insure Economic Sustainability by Supporting UT ME

Giving Back to UT ME
Volunteering your time to work with students or student organizations is one avenue of service. Alumni volunteers provide hands-on technical expertise to student organizations, while building close personal ties to enthusiastic student leaders. Recruitment of female and minority students also offers another service opportunity. For example, The Women in Engineering Program hosts several yearly events for prospective students, and professional engineers often mentor the participants.

In-kind donations of equipment and supplies are always greatly appreciated, both for the department and for student group use. Examples of needed or requested in-kind donations include: solar panels, airline tickets, computers, software, networking and wireless equipment, generators, shipping containers, engines and automotive components.

The Mechanical Engineering Advisory Board
Alumni may also serve by selection to the Mechanical Engineering Advisory Board (EAC) that actively supports the objectives and goals of the department. The EAC provides UT ME with valuable input concerning current and future trends in industry, resources for research and development, industry interfaces and exchanges, recruitment opportunities and departmental promotion. The EAC provides a means for the faculty to learn more about the technical, business and professional needs of industry and government.

Collaboration
Other ways you can participate include collaborating with faculty to develop application-based problems for use in PROCEED courses, hiring a summer intern, a coop student or a graduate of the department, participating in Career Fairs held twice annually, donating to the CSE Capital Campaign, attending or sponsoring a departmental event such as the Back-to-School Bash, being a guest lecturer at a student organization function or collaborating on research.

Getting Started
If you’re interested in giving back to UT ME, please contact Danielle Fournier, our Executive Assistant and External Affairs Coordinator, by e-mail at danielle.fournier@me.utexas.edu or by phone at (512) 471-2969. To read more about giving to the Cockrell School of Engineering or the Department of Mechanical Engineering, see http://www.engr.utexas.edu/campaignfortexas/gift/. We look forward to developing a long-term relationship with you. Together we’ll strive to achieve our educational goals and serve the people of Texas and the engineering community at large.

UT ME offers both for-credit classes and financial support to student organizations, enabling students to gain hands-on experience in real-world situations. Adventurous undergrads are working with an indigenous tribe in a remote region of Panama to upgrade their inadequate water system. They surveyed, tested water, mapped the communities and studied existing infrastructure. The location was only accessible by small aircraft and canoe, as shown below.
About the Photos:

Cover: Astronaut Dr. Karen Nyberg pictured aboard the Space Shuttle Discovery, received her Ph.D. from UT ME in 1996. Photo courtesy of NASA.

Above: “Clock Knot,” a sculpture by Mark di Suvero, was recently installed outside the ETC building.