

Department of Mechanical and Aerospace Engineering
USU Departmental Teaching Excellence Award
Pre-proposal 2010

Besides responding to the award criteria, a major objective for the Mechanical and Aerospace Engineering Portfolio of Learning Excellence will be to show how a department with a relatively high student to faculty ratio has successfully established and maintained a quality educational learning environment for both faculty and students while building its research enterprise. Research and education are not mutually exclusive but are different aspects of a single learning paradigm.

Mechanical and Aerospace Engineering Department - Overview

The Mechanical and Aerospace Engineering (MAE) Department offers curricula for BS, MS, ME and PhD degrees in Mechanical Engineering with an emphasis on Mechanical, Aerospace, Computational, or Manufacturing Engineering. An additional MS degree in Aerospace Engineering was approved by the Board of Regents in August 2009. Fall 2009 department demographics included 601 undergraduate students, 77 MS and 26 PhD students, 20 FTE faculty and five staff members. MAE graduates are competitive; they consistently finish in the top 10% in intercollegiate national student design competitions, pursue PhD degrees at prestigious institutions, and are well received by industry.

MAE has experienced dramatic growth over the past five years, including the following areas:

- Student enrollment has increased 25%.
- Faculty research productivity as measured by research publications, winning research grants, patent applications, and students involved in research has more than doubled.
- Two thirds of the 18 MAE tenured/tenure track professors have been hired since 2001.
- The new engineering building is an exceptional student centered teaching facility.

This growth has provided new opportunities to strengthen MAE's commitment to excellence and forward vision for student learning outcomes through classroom and research lab instruction.

MAE Teaching/Learning Mission

MAE's BS curriculum is built upon a foundation of program educational objectives and program outcomes. Program Educational Objectives are broad statements that describe the career and professional accomplishments that the program is preparing graduates to achieve. MAE's Program Educational Objectives are the following:

- 1) Graduates will succeed in entry-level engineering positions in regional, national, or international industries, and with government agencies.
- 2) Graduates will succeed in the pursuit of advanced degrees in engineering or other fields requiring a solid foundation in mathematics, science, and engineering fundamentals.
- 3) Graduates will be able to synthesize mathematics, science, engineering fundamentals, and laboratory and work-based experiences to formulate and solve engineering problems in both thermal and mechanical systems areas.
- 4) Graduates will have proficiency in computer-based engineering, including modern numerical methods, software design and development, and the use of computational tools.
- 5) Graduates will be prepared to communicate and work effectively on team-based projects.
- 6) Graduates will recognize the importance of and have the skills for life-long learning.

Program Outcomes describe the specific knowledge or skills students are expected to acquire from the program. The MAE faculty has identified 12 explicit Program Outcomes that it believes are essential for the students to achieve the Program Educational Objectives following graduation. All courses in the MAE BS curriculum map into one or more of the Program Outcomes. These Program Outcomes were derived from nationally based norms guided by the National Academy of Engineering and ABET, Inc., the national accrediting body for engineering programs within the United States.

Maintaining an attitude of strong rigor in each class is an important feature of the MAE program. The MAE Faculty has determined that the long term interests of the graduates are best served via a curriculum that emphasizes engineering fundamentals as opposed to engineering technology applications.

MAE Commitment to Learning Excellence

As evidenced by course development, committee service, mentoring, advising activities, national teaching awards, textbook writing, and pedagogical research, the MAE faculty has maintained student learning outcomes as a top priority, as illustrated by the following examples:

- 1) About half of our 75 BS graduates participate in national design competitions under the direction of a faculty member who voluntarily sponsors the team; e.g., NASA Student Rocket Launch Initiative (1st place 2009 & 2008), NASA Great Moonbuggy Race (1st place 2005), SAE Zero Emissions Snowmobile Challenge (1st place 2006), SAE Baja Competition, AIAA Design Build and Fly Competition (4th place 2005).
- 2) The Faculty has adjusted the BS Curriculum to include a two semester capstone design experience beginning spring 2010, which includes design, build, and test phases.
- 3) The MAE Faculty makes extensive use of course web pages and Blackboard Vista.
- 4) Two MAE Faculty members have received national teaching awards in their discipline.
- 5) MAE Faculty members received the College of Engineering 2009 Outstanding Teaching, Advisor, and Researcher awards, and the 2009 College of Engineering Valedictorian was an MAE student.
- 6) All MAE required courses have about 100 students. To better communicate with students a number of our faculty use a tablet PC as a whiteboard so that the actual lecture can be recorded and archived for download via Wimba or Adobe Acrobat Connect.
- 7) In 2006, the Department initiated a highly successful tutor program that hires its academically gifted students to maintain a walk- in tutorial service for any MAE course.
- 8) The majority of our graders and lab assistants are undergraduate students. These experiences contribute significantly to the learning outcomes of these students.
- 9) About 30% of our graduates have worked with an MAE faculty member as a research assistant on a sponsored research project. This number increases to about 60% if their employment at SDL is counted. This is *hands on learning* at its best.
- 10) Many of our undergraduates attend and present papers at national conferences.
- 11) MAE has received four NSF pedagogical grants that have added significantly to its teaching/learning mission: a) computational engineering emphasis was an outcome; b) summer research experiences for a total of 24 students over a three year period; c) 50 scholarships to improve retention and diversity; and d) enhanced understanding of K-12 students interested in engineering careers, especially female students.

- 12) MAE has received a three year (2009-2012) faculty development grant and a scholarship grant for 18 students at \$10,000 each from the Nuclear Regulatory Commission.
- 13) Professional society student chapters for ASME, AIAA, and SAE provide leadership development, service activities, and connections with local and national practicing professionals. Each unit has a faculty mentor.

Assessment for Achievement and for Continual Improvement

The BS program is accredited on a six year cycle by ABET, Inc. The program must demonstrate and measure how well each of nine criteria is met. Moreover, a continuous improvement process must be demonstrated. MAE's latest program review was during 2008. In August 2009, ABET's final report gave the MAE program *a statement of compliance*, which means that it has satisfied the nine criteria with no concerns or weaknesses that need to be addressed. (This is the evaluation each program strives to achieve.)

The MAE Department has a well established continual improvement process. Data are collected and evaluated from a wide range of sources to determine how well our students are meeting the Program Outcomes and Program Educational Objectives. Annual internal data include instructor course evaluations, student ratings, graduating senior survey and interviews, internship reports, advisory board feedback, and an alumni survey. Annual external data include employer feedback, National Fundamentals of Engineering (FE) exam results, scores at national competitions, Graduate Record Exam scores, and placement of MAE graduates for employment and advanced degrees.

The Fundamentals of Engineering (FE) Exam is a national exam required for professional licensure. Passing this exam is a graduation requirement for MAE students. The FE exam record provides a quantitative, objective view of our students' performance in the fundamentals of mechanical engineering in comparison to a large national sample.

The MAE ***Industrial Advisory Board*** is comprised of individuals that represent a spectrum of experience from senior management to recent graduates. The primary function of the Industrial Advisory Board is providing industry recommendations to:

- Improve the quality and effectiveness of the MAE BS, MS, and PhD degrees from USU.
- Evaluate and recommend continuous improvements in the MAE undergraduate curriculum as an essential element in maintaining ABET accreditation.

Each year this comprehensive database is used by the MAE faculty at its spring retreat to assess the effectiveness of the MAE curriculum. Changes to enhance student learning outcomes are a continuous process.

In summary, the Department of Mechanical and Aerospace Engineering is dedicated to a continuous assessment and improvement processes for enhancing the educational experience of our students. This is demonstrated by student learning and achievement outcomes in a variety of ways, such as continuing assessment practices, national student competitions, Fundamentals in Engineering national exam, internship and research opportunities, formal industry feedback, faculty, and student awards.

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