

## **Systematic Implementation of the Evaluation Results in Continuous Improvement**

The MAE department undergraduate curriculum committee is composed of four full-time faculty members that evaluate the ABET committee's recommendations and make proposals for the full faculty to consider. A majority positive vote of the faculty is needed to make any changes to the curriculum. It is primarily the fall and spring MAE faculty retreats that have been utilized to consider the motions of the undergraduate curriculum committee, although motions may be brought forth at any time during the academic year.

Since 2008 the department has made many minor adjustments to improve the program and several major changes. In an effort to continuously improve the program, the following changes have been completed in the past six years. The changes listed are in chronological order of implementation into the curriculum or program.

### **1) Addition of Professionalism and Ethics Course.**

Results of Evaluation Process: During the 2008-2009 academic year, the undergraduate curriculum committee reviewed the ABET criteria for professionalism and ethics in engineering. These topics had been covered in lectures embedded in the senior design course. The committee deemed the coverage of these topics in senior design to be insufficient to meet the ABET criteria. Specifically, the faculty review determined that students were not receiving formalized training in professionalism and ethics and were not required to complete assignments to demonstrate their proficiency.

Program Improvement Plans: A new 1 credit course was added in the junior year called Professionalism and Ethics. The official course syllabus includes assignments and exams in professionalism and ethics. The change was made effective beginning with the Fall 2009 semester.

### **2) Creation of a new Capstone Design courses with 6 credits instead of 5 credits for Senior Design.**

Results of Evaluation Process: Senior exit interviews have consistently reflected a lack of design instruction. The industrial advisory board also expressed concern that the senior design process lacked sufficient design instruction. The engineering advising office informed us that many students were delaying graduation because Senior Design I was only offered in the fall and Senior Design II was only offered in the spring.

Program Improvement Plans: The undergraduate curriculum committee recommended that the first semester of the design series be increased from 2 to 3 credits. This would allow the curriculum to include more instruction in design. Also, the new design courses (Capstone Design I and Capstone Design II) would both be offered spring term and fall term. The changes were made effective beginning with the Fall 2010 semester.

### **3) Reorganization of physics courses to be more effective with a focus on lab experiences.**

Results of Evaluation Process: The physics courses had fragmented topics and sporadic labs. The physics faculty informed the MAE faculty that the topics and lab experiences in the physics series were poorly organized and proposed a plan to fix the problem.

Program Improvement Plans: The undergraduate curriculum committee recommended to the MAE faculty that the physics department changes be implemented. The courses were

reorganized and now include a dedicated physics lab. The changes were made effective with the fall 2011 semester, and are summarized in the table below:

Old	New
PHYS 2210 (4 Credits, 3 lectures/week, 1 recitation/week, <i>labs fewer than 1/week</i> . The first half of this course and PHYS 2200 are the same.	PHYS 2200 (2 Credits, 3 lectures /week, 1 recitation/week, <i>no labs</i> ). Students meet for 8 weeks.
PHYS 2220 (4 Credits, 3 lectures/week, 1 recitation/week, <i>labs fewer than 1/week</i> )	PHYS 2220 (4 Credits, 3 lectures/week, 1 recitation/week, <i>no lab</i> )
N/A	PHYS 2225 (1 Credit lab to accompany PHYS 2220)

#### 4) Reorganization of statistics coursework.

Results of Evaluation Process: Student exit interviews reported that the statistics course was not effective in preparing the students. Additionally, the students enrolled in this course were typically from a variety of engineering, education, and science majors, and thus the course was not as rigorous as desired.

Program Improvement Plans: The undergraduate curriculum committee considered this information and voted to recommend that STATS 3000 be dropped as a requirement, effective Fall 2011. Key topics from this course were added to the MAE 3340, Instrumentation and Measurements.

#### 5) Emphasizing fundamental courses in the pre-professional program.

Results of Evaluation Process: Instructor evaluations pointed to deficiencies in sophomore mechanics preparation. Instructors from civil engineering, mechanical engineering and engineering education identified specific topics not sufficiently covered as shown below:

Course	Topics not Sufficiently Covered
ENGR 2010 Engineering Mechanics Statics	Center of Gravity, Moments of Inertia, Virtual Work, Free-Body Diagrams
ENGR 2140 Strength of Materials	Energy Methods, Mohr's Circle, Composite Beams

Program Improvement Plans: The number of credit hours associated with both the Statics and Mechanics of Materials courses was increased from 2 to 3. The topics deemed to be insufficiently covered were provided more time and emphasis in the new curriculum. The changes were made effective with the Fall 2011 semester.

#### **6) Deletion of MAE 2650, Manufacturing Processes, as a required course.**

Results of Evaluation Process: Most MAE students take MAE 2650 in their freshman year. Enrollment is over 200 students each year. Student evaluations are generally unfavorable. Student dissatisfaction stems from the crowded classroom, lack of hands-on facilities, and the nature of the topic.

Program Improvement Plans: The undergraduate curriculum committee recommended that the course be dropped as a requirement. The topics in this course misled freshman students into a false impression of mechanical engineering. A manufacturing processes course would be better implemented in the junior or senior year with fewer students and when students can better place the topic in context. It was recommended that a technical elective in manufacturing processes be created. This change became effective beginning with the Fall 2011 semester.

#### **7) Increase to entrance requirements for the professional program.**

Results of Evaluation Process: Instructor evaluations determined that maintaining the quality of the undergraduate experience given the consistent increase in MAE department student enrollments (from 715 in 2009 to 820 in 2013) was unsustainable, given that the level of resources has remained essentially constant.

Program Improvement Plans: The academic standards necessary to move from the pre-professional to professional program were raised. In particular, the minimum GPA necessary to advance from the pre-professional to professional program was raised from 2.20 to 2.80 beginning with the Spring 2012 semester.

#### **8) Addition of MAE 2165, Material Science Lab, as a required course.**

Results of Evaluation Process: Many of the transfer students entering the MAE department have had a material science course that did not include a lab. Students were required to repeat the MAE 2160 Material Science course to get the lab experience.

Program Improvement Plans: A new course, MAE 2165 Material Science Lab, was created to allow transfer students to take only the lab. USU students are required to take MAE 2160 Material Science and MAE 2165 Material Science Lab. This change became effective beginning with the Spring 2012 semester.

#### **9) Reorganization of numerical methods curriculum.**

Results of Evaluation Process: Low Instructor assessment scores indicated that students were ill-prepared to develop proper graphs and plots in upper division elective courses. This problem is exacerbated by unprepared transfer students.

Program Improvement Plans: Numerical Methods I went from 2 credits to 3 credits to accommodate instruction in MATLAB and an increased emphasis on graphing and communicating the results of the computer program output. The courses were moved to junior level to better accommodate transfer students. The changes became effective with the Fall 2012 semester.

#### **10) Modification to Program Educational Objectives.**

Results of Evaluation Process: During the May 2013 meeting, the Advisory Board recommended that the second Program Educational Objective be modified to state: "Graduates

will succeed in the pursuit of advanced degrees in engineering or other fields where a solid foundation in mathematics, science, *technology*, and engineering fundamentals is required.”

Program Improvement Plans: The work technology was added to expand the scope of the PEO. This modification was voted on and approved by the MAE faculty during the January 13, 2014 faculty meeting.

### **11) Creation of Advisory Board survey.**

Results of Evaluation Process: During the May 2013 meeting, the Advisory Board recommended that a written survey covering our student’s mastery of student outcomes (*a-l*) and associated performance indicators be developed.

Program Improvement Plans: The department has developed this survey, which was sent to Board members for the first time in January 2014.

### **12) Enhanced lab experience in MAE 3340, Instrumentation and Measurements.**

Results of Evaluation Process: The 2012-2013 assessment indicated a weakness in the attainment of student outcome 3b.

Program Improvement Plans: The instrumentation class implemented a design and build of a student pulse oximeter. The process included design, build, and testing. The changes were implemented Spring 2014 and are available in the MAE 3340 Course Notebook.

### **13) Increase in entrance requirements for MAE freshman.**

Results of Evaluation Process: Based on Instructor assessment data, the ABET Committee determined that maintaining the quality of the undergraduate experience (> 3.0) given the consistent increase in MAE department student enrollments (from 715 in 2009 to 820 in 2013) was unsustainable, given that the level of resources has remained essentially constant.

Program Improvement Plans: The academic standards necessary to enter the MAE major as a freshman were raised as summarized below. The changes take effect beginning with the Fall 2014 freshman class.

Previous Requirements:

- A minimum high school GPA of 2.5
- A minimum ACT of 18 (SAT >860) and a minimum Admission Index of 90

New Requirements:

- A minimum high school GPA of 3.0
- A minimum ACT of 23 (SAT >1050) and a minimum Admission Index of 110
- Prepared to enroll in MATH 1210 Calculus I

## **B.2 Results and Assessment of Previous Evaluations**

*Describe the results of any changes (whether or not effective) in those cases where re-assessment of the results has been completed.*

Not all changes indicated in 4.B.1 above have been in place for sufficient time for reassessment to take place. Nevertheless, all items from above are listed below, and where reassessment has taken place, the results are noted.

### **1) Addition of a Professionalism and Ethics Course.**

Results: FE scores of students have demonstrated improved abilities in professionalism and ethics. However, the attention still seems inadequate to the ABET committee. We are considering adding the ASME ethics module in the curriculum.

### **2) Creation of new Capstone Design courses with 6 credits instead of 5 credits for Senior Design.**

Results: Students have produced better analysis and design of projects as demonstrated by the independent evaluation of national design contests. More attention has been devoted to manufacturing and design with higher quality results. Present data (e.g. senior exit surveys) that shows there has been an improvement.

### **3) Reorganize physics courses to be more effective with a focus on lab experiences.**

Results: The curriculum continues to lack in the delivery of core physics material as compared to other programs and other departments in the college. It is proposed that the department adopt the second physics course and an additional lab.

### **4) Reorganization of statistics coursework.**

Results: After this change was made, FE scores, instructor evaluations, and senior survey all score above 4 in statistics. The alumni survey score is a 3. However, the alumni score reflects their observations from students before the change. It appears the change has been effective.

### **5) Emphasizing fundamental courses in the pre-professional program.**

Results: Students and instructors report better preparation for the advanced strength of materials courses and dynamics courses. An increase in the FE exam scores in these areas was not observed. Overall, the results are inconclusive.

### **6) Deletion of MAE 2650, Manufacturing Processes, as a required course.**

Results: Removal/deletion of MAE 2650 as a required course appears to be a good decision based on student surveys and management of department resources. However, a technical elective has yet to be created.

### **7) Increased entrance requirements for professional program.**

Results: The new requirements became effective Spring 2012. The results of this change cannot be properly assessed until Spring 2015.

**8) Addition of MAE 2165, Material Science Lab, as a required course.**

Results: This has worked out very well. Transfer students are able to complete the lab portion without repeating the entire course. Increased attention has been made to improve the lab as a separate course with increased student satisfaction as evidenced by student evaluations.

**9) Reorganization of numerical methods curriculum.**

Results: The level of instruction has not met expectations at this point. The department regularly hires graduate students to teach the course and consequently there exists significant variability in the level of the instructor preparation and ability. Thus, the department further modified the numerical methods sequence as shown below in item 3 of section 4.B.3.

**10) Modification of the Program Educational Objectives.**

Results: No assessment necessary.

**11) Creation of Advisory Board survey.**

Results: No assessment necessary.

**12) Enhanced Lab Experience in MAE 3340, Instrumentation and Measurements.**

Results: This change was made Spring 2014. The results cannot be properly assessed until Spring 2015.

**13) Increase in entrance requirements for MAE freshman.**

Results: The new requirements will become effective Fall 2014. The results of this change cannot be properly assessed until Spring 2016.

**B.3 Future Program Improvement Plans.**

*Indicate any significant future program improvement plans based upon recent evaluations. Provide a brief rationale for each of these planned changes.*

**1) Increased attention to engineering communications in response to concerns from the 2012-2013 assessment of 3g.**

Previous curriculum evaluations indicated that while many of our students write very well a significant number of our students lacked experiences in technical writing and critical feedback. After exploring our options the MAE department together with the College of Engineering has developed a new technical communications course that emphasizes both written and oral presentation skills. The course begins Spring 2014. MAE students will be required to take this course starting Fall 2014.

**2) Altering the presentation of the broader impact of engineering solutions in response to the 2012-2013 assessment of 3h1.**

There is limited data to support our education in this area (3h1). The evaluation of the seniors falls below the adequate level. The curriculum committee has enhanced the official syllabi for the Capstone Design courses (MAE 4800 and 4810) and the Professionalism and Ethics (MAE 3600) course to include specific assignments that address broader impacts. These changes will be implemented Fall 2014

### **3) Additional Curriculum Changes.**

During the February 10, 2014 faculty meeting, the undergraduate curriculum committee brought the following motions to the faculty. Each motion passed.

- Eliminated MAE 3400 Thermodynamics II from curriculum and altered content of MAE 3440 Heat and Mass Transfer. (To eliminate the non-standard hybrid Thermodynamics II course from the curriculum.)
- Dropped PHYS 2200 (2 credits) and added PHYS 2210 (4 credits) and PHYS 2215(1 credit). (Most students were taking this route anyway, and it provides additional credits to fulfill the ABET Basic Math and Science requirements.)
- Dropped one of the technical elective requirements from the curriculum. (To remain credit neutral.)
- Dropped MAE 3200 Engineering Numerical Methods I as a required course and added CS 1400 and CS 1405. This was done to improve efficiency and ensure a consistent treatment of course material as MAE was previously using graduate students to teach the course. See section 4.B.2.3 results.
- Voted to approve the change in student outcome L to align with new ABET Program Criteria for Mechanical Engineering Programs.

These changes will become effective Fall 2014.

