Mechanical Engineering Program Assessment Report

Name of the program: BS in Mechanical Engineering
Year: Academic year 2015/2016
Date: June 22, 2016
Faculty Participant: Dr. Xun Yu.

1. Which program learning outcomes have been assessed for the planned academic year?

The BS ME program is accredited by ABET, which requires the assessment of a set of (a)-(k) Student Outcomes (SOs) (the detailed list of ABET SOs is in attached at the end of this report). The ME department has an assessment process in place for the program to ensure continuous improvement on all of these SOs. Our direct method is based on Faculty Course Assessment Reports (FCARs) which are submitted by the faculty for each course they teach in the fall and spring semesters. The faculty developed a cyclical model of assessment in which we assess a different set of Student Outcomes (SOs) each year. This generates less data each semester for evaluation and these outcomes will be reassessed every three years, with the entire set of SOs completed on a six-year cycle.

During the spring semester of the academic year 2015/2016, we are assessing the following ABET SOs:

c. An ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.
d. An ability to function effectively in a team.
e. An ability to identify, formulate and/or solve engineering problems.

2. What measuring instruments were used for the assessment? (attach the criteria, or rubrics used)

The assessment process has both course embedded and constituency based assessment tools. The course embedded assessment is the Faculty Course Assessment Reports (FCAR) which are the primary tools used to assess the program and learning outcome achievement. At end of each semester, for each course offered, ME faculty are required to submit two Faculty Course Assessment Reports (FCAR): one for learning outcomes and one for program outcomes. The FCAR requires:

- Each faculty member to identify course specific learning outcomes (LO’s) for his/her course and to establish appropriate performance tasks (APT’s) with appropriate documentation to assess to what extent the learning outcomes are being met. These APTs may be quizzes, exam questions, reports, projects, presentations, etc. Each student’s APT is then scored with the method shown below, to create an EGMU Vector for that specific learning outcome and a corresponding assessment metric.
Each faculty member is required to satisfy a minimum set of program outcomes (POs) for his course as established by the ME department. This is accomplished by using a subset of the appropriate performance tasks (APT’s) used to satisfy the LO’s. Here the faculty member is required to show what part of each APT is being used to form a metric for the program outcome with appropriate documentation.

In this academic year, we choose two design courses (MENG 470 Senior ME Design and MENG 486 Advanced Machine Design) to assess student outcomes listed above.

RUBRIC FOR ASSESSMENT
The EGMU Vector is obtained as follows:

- 3 Demonstrates a complete and accurate understanding of the important concepts **Excellent**
- 2 Applies appropriate strategy or concepts with no significant errors **Good**
- 1 Displays an incomplete understanding of the important concepts and has some notable misconceptions; makes a number of errors when performing important strategies or skills but can complete a rough approximation of them **Minimal**
- 0 Demonstrates severe misconceptions about the important concepts; makes many critical errors **Unsatisfactory**.

For example, a typical EGMU vector for a class with 19 students in which the APT was the third problem of the first exam might be (8, 9, 1, 1) which would signify that 8 students demonstrated a complete and accurate understanding, while 9 students applied appropriate strategies etc. The average score in this case being 43/19 = 2.26 which is Good.

ME faculty have been clearly aware the fact that our department is requiring, as a minimum, an EGMU score of 1.5 for each (PO). This value was chosen because it represents a grade of C or Satisfactory (2.0).

**Interpretation of ABET SOs:**
c. An ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.
   - **Interpretation:** Is able to use technical, computer, and mathematical principles to develop alternative designs taking into consideration economic, health, safety, social, and environmental issues, codes of practice, and applicable laws.

d. An ability to function effectively in a team.
   - **Interpretation:**
     - Is prepared for group meetings with clearly formulated ideas and contributes a fair share to the project workload
     - Shares credit for success and accountability for team results
     - Shares information and provides assistance to/with others
     - Is able to assume a designated role in the group
     - Values alternative perspectives and encourages participation among all team members
- Remains non-judgmental when disagreeing with others/seeks conflict resolution

e. An ability to identify, formulate and/or solve engineering problems.
   - **Interpretation:**
     - Can relate theoretical concepts to practical problem solving and demonstrates creative synthesis and defense for the solution (solution is correct and checked in other ways when it can be)
     - Uses appropriate resources to locate information needed to solve problems
     - Effectively integrates new information with previous knowledge problems

Following is an example of the course FCAR of MENG 486 that was taught in Spring 2016.

**Faculty Course Assessment Report (FCAR)**
**Program Outcome Version**
**MENG-486**
**Advanced Machine Design**
**Spring 2016**

**Catalog Description**
Review of basic concepts, plus such considerations as impact loads, cumulative damage, reliability as a statistical concept, optimization, cost standardization, computer usage. In-depth treatment of such machine elements as clutches and brakes, special springs, roller bearings, gearing systems. Two open-end design projects, each combining various machine elements: conceptual design, feasibility, calculations, assembly drawing, detail drawings including dimensioning, fits and tolerance and parts lists. **Prerequisites:** MENG 370, MENG 212

**Grade Distribution:**

<table>
<thead>
<tr>
<th>Grade</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>F</th>
<th>I</th>
<th>W</th>
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<td></td>
<td>3</td>
<td>10</td>
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<td>0</td>
<td>0</td>
<td>1</td>
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**Modifications Made to Course:**

1. Add the analysis of 4-bar, Slider-Crank, and higher order closed kinematic structures, and conduct analysis of motion for control of structures and computation of forces to move the linkages.

**Course Outcome Assessment**

CO-1: Design, analyze and simulate 4-bar, Slider-Crank, and higher order closed kinematic structures, including their motion, velocity and acceleration.
This outcome is covered by the following performance task(s):
Design Project #1: EGMU (6, 5, 2, 0) score 2.3
CO-2 Design and analyze motion/power transmission mechanical components such as gears and cams.
This outcome is covered by the following performance task(s):
Design Project #2: EGMU score (8, 4, 1, 0) avg = 2.5

CO-3 Working with a teammate, design a mechanism that has kinematic and motion/power transmission components, conduct the stress analysis for the critical components and structure. Present results in both written report and oral presentation.
This outcome is covered by the following performance task(s):
Design Project #3: EGMU score (7, 6, 0, 0) avg. = 2.5

Program Outcome Assessment

a. Math, science, engineering: CO-1 – CO-3
   All reports required some math, science and engineering. Science is identified in “Theory” section of report. Math & engineering are used to quantify results.

c. An ability to design a system, component, or process: CO-1 – CO-3
   All design projects required the ability of designing a system and component.

d. Teams: CO-3
   Design project #3 was done by teams of 2-3 students.

e. An ability to identify, formulate and/or solve engineering problems: CO-3
   Design project #3 was an open choice design project, students were required to identify an engineering problem and then to solve it.

g. Communicate: CO-1 – CO-3
   All design project required written report. Design Project #3 also required oral presentation of results.

k. Knowledge and tools: CO-1 – CO-3
   Students are required to use CAD or other technical programs to design, analyze and simulate kinematic systems and perform stress analysis for mechanical components.

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<thead>
<tr>
<th>CO-1</th>
<th>EGMU score</th>
<th>Average</th>
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<tbody>
<tr>
<td>Design Project #1</td>
<td>(6, 5, 2, 0)</td>
<td>2.3</td>
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<tr>
<td>CO-2</td>
<td>EGMU score</td>
<td>Average</td>
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<tr>
<td>Design Project #2</td>
<td>(8, 4, 1, 0)</td>
<td>2.5</td>
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<tr>
<td>CO-3</td>
<td>EGMU score</td>
<td>Average</td>
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<tr>
<td>Design Project #3</td>
<td>(7, 6, 0, 0)</td>
<td>2.5</td>
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<tr>
<th>Benchmark for Outcomes a, c, g, k</th>
<th>Average</th>
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<tr>
<th>CO-3</th>
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<tr>
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**Student Feedback**

Overall, the students gave very positive comments for the course. One common comment from the students is the help on the using of the appropriate CAD program to simulate the kinematic systems, which was not covered in their previous CAD course.

**Instructor’s Comments**

As shown in the student feedback, one area to improve is to give more detailed review and instruction on the using of CAD program for kinematic analysis. Another observation is that quite some students could not present their results in satisfactory technical written reports. More instructions of technical writing skills will be taught in the class in the future.

3. What were the important findings? How well students achieved the targeted learning outcomes?

ME faculty have determined that the minimum level of quality that it felt was necessary in order to produce graduates that will ultimately achieve our Program Educational Objectives is an **EGMU score of 1.5 for each Student Outcome**. This value was chosen because it represents a grade of C or Satisfactory (2.0). The FACR reports show that our students have met the targeted EGMU and achieved the targeted learning outcomes. They demonstrated satisfactory knowledge and skills to identify and solve engineering problems, individually and with teammates.

4. Select action items the faculty believes may enhance student learning. Decide who will be responsible for the action, and establish a timeline for completion.

Although the students achieved the targeted learning outcomes, further improvement of the courses can further enhance student learning. One observation from the instructor is
that, typically, the engineering students have satisfactory technical writing skills to write
the project report. This needs the collaboration of engineering department and the
English department on the improvement of technical writing instruction. In addition, ME
faculty can also give some more technical writing skill instructions in their courses. This
is to be completed by ME department faculty that teach courses with required reports.

5. What’s the assessment plan for next academic year?

The ME BS program is preparing for the ABET review in Fall 2017. Therefore, ME
department is planning to assess all ABET SOs in 2016-2017 academic year with the
measurement system discussed above.

Attachment 1: ABET Student Outcomes (SOs)

a. An ability to apply knowledge of mathematics, science, and engineering.
b. An ability to design and conduct experiments, as well as to analyze and interpret data.
c. An ability to design a system, component, or process to meet desired needs within realistic
constraints such as economic, environmental, social, political, ethical, health and safety,
manufacturability, and sustainability.
d. An ability to function effectively in a team.
e. An ability to identify, formulate and/or solve engineering problems.
f. An understanding of professional and ethical responsibility.
g. An ability to communicate effectively.
h. The broad education necessary to understand the impact of engineering solutions in a
global, economic, environmental, and societal context.
i. A recognition of the need for, and an ability to engage in, life-long learning.
j. A knowledge of contemporary issues.
k. An ability to use the techniques, skills, and modern engineering tools necessary for
engineering practices.