

School of Engineering
Mechanical Engineering, B.S.M.E.
Broad Learning Goals for Undergraduates

The Department of Mechanical Engineering will produce undergraduates who:

- A. have the educational background necessary to compete successfully with peers from other institutions.
- B. have an educational foundation which allows them to continue the growth of their career.

Undergraduate Student Learning Outcomes

Graduates of the Mechanical Engineering BS program will demonstrate:

- a. an ability to apply their knowledge of mathematics, science, and engineering;
- b. an ability to design and conduct experiments as well as analyze and interpret data;
- c. an ability to design a system, component, or process that meets desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability;
- d. an ability to function in multi-disciplinary teams;
- e. an ability to identify, formulate, and 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 lifelong learning;
- j. a knowledge of contemporary issues;
- k. an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice;

Mechanical Engineering BS degree Outcomes Assessment Plan

Direct Measurement

Each outcome is assessed by directly examining individual student's work on exams, homework, essays, reports, projects, or oral presentations. Group work is not used in the assessment.

Grades are not used for the assessment because the course grade may be based upon criterion other than that specified by the outcome. An example of this can be illustrated with outcome "g", "the ability to communicate effectively." The grade for a report in a technical course might be based upon the technical information presented in the report whereas outcome "g" would measure the communication skills of the writer. In this case, using the course grade to assess outcome "g" would be inappropriate.

Professors teaching the courses select the student work to be assessed. This work is a normal part of the course and may consist of part or all of an exam, homework assignment, essay, report, or oral presentation. The student work is carefully selected so that it:

- is directly applicable to the outcome being measured.
- demonstrates knowledge that every student in the class should have.
- constitutes work the students would do even if the outcome was not being evaluated.
- is individual student work, not group work

Rubrics are used to evaluate the student work. These rubrics consist of performance criteria and levels of performance. The performance criteria divide the work into several well defined components that relate to the outcome being assessed. The student is expected to show some level of performance in all of these components in the process of solving the problem, writing the report, etc. The level of performance defines how well the student performs in each criterion being measured. The Mechanical Engineering Department chose four levels to measure student performance. They are:

1. Poor – shows very little or no capability or knowledge in the performance criteria being measured.
2. Inadequate – shows some capability but the quality of the work is below what is expected for students in the course.
3. Adequate – the work meets the expectations for the class.
4. Exemplary – the work is exceptional and exceeds the expectations for the class.

Student work is evaluated to see how well the students performed in each of the performance criteria. The work is evaluated by the professor teaching the course using the scale shown above. The students' scores on each of the performance criteria are averaged to determine how the class did as a whole. Low averages for the performance criteria are considered problem areas and are examined more closely to see if there was a problem with the assessment or with students' performance.

After selecting the work to be assessed, professors define a rubric to be used in the evaluation of the work. They may choose one of the standard rubrics defined by the department (See Appendix B.11), modify one of these standard rubrics to better meet their needs, or they may elect to create their own. Most professors have elected to use one of the standard rubrics in this evaluation.

Once the students have turned in the assignment, it is copied and assessed by the professor. The results of the assessment and copies of the students' work are archived in the Mechanical Engineering Office. The results are also transmitted to the Curriculum Committee for their review.

Triangulation

The assessments are made using student work from required mechanical engineering courses. A minimum of three assessments for each outcome are used. Each of these assessments is made in separate courses. Both upper and lower division courses are used for the assessments. A chart showing which courses are assessed is shown in Appendix B.3.

The dark (blue) boxes indicate the courses in which an assessment is made. The required courses in the BSME degree program are listed across the top of the table and the 20 assessment outcomes are listed in the left-hand column.

Assessment Frequency

The first two assessments using the current assessment plan were made during the spring and fall semesters of 2008. Two complete assessments were made in rapid succession to test the plan and work out any difficulties encountered in the plan implementation.

These assessments were completed successfully but the amount of work necessary to complete two full assessments in two successive semesters was substantial and probably unsustainable. From that point on, assessments are made in a three year repeating schedule. This schedule is shown below.

Cycle 1

Spring 2009	ME 160L, ME 260L, ME 360L, ME 459, ME 460, and FSAE
Spring 2010	ME 217, ME 318L, ME 306, ME 357, and ME 320L
Spring 2011	ME 317L, ME 301, ME 370L, and ME 380

Cycle 2

Spring 2012	ME 160L, ME 260L, ME 360L, ME 459, ME 460, and FSAE
Spring 2013	ME 217, ME 318L, ME 306, ME 357, and ME 320L
Spring 2014	ME 317L, ME 301, ME 370L, and ME 380

Cycle 3

Spring 2015	ME 160L, ME 260L, ME 360L, ME 459, ME 460, and FSAE
Spring 2016	ME 217, ME 318L, ME 306, ME 357, and ME 320L
Spring 2017	ME 317L, ME 301, ME 370L, and ME 380

The bolded semesters are the spring semester prior to an ABET visit in the fall. Material from every course will be assessed at least twice during each ABET cycle.

Under this plan, all planned ABET outcomes scheduled to be assessed in a particular course would be assessed each time the course was assessed. Scheduling the assessments by the course in which the assessment is made works better than scheduling them by the outcome being assessed. Scheduling the assessments by outcome would lead to some courses being assessed every cycle placing an extra burden on the faculty teaching these courses.

All assessments are made in the spring. This allows the data to be compiled and tabulated the following summer. Fall assessments are difficult because winter break is short and most faculty are busy during that time. It is difficult for instructors to compile the data in a timely manner when the assessments are made in the fall.

Assessing in the spring has the added benefit in that if an assessment is missed, it can be made up in the following fall semester.

The assessments are scheduled by discipline. This allows the academic area committees to become actively involved in scheduling and overseeing the assessments. Each cycle begins with the assessments being made in the design classes, followed by the thermo-fluids courses, and completed by assessing the dynamics-materials courses.

The three year cycle should provide sufficient information to make changes to the curriculum then perform subsequent assessments to see if the changes have had a positive effect.

Review of the Outcomes Data

The Undergraduate Curriculum Committee is responsible for the outcomes assessment process and the review of the data collected. The outcomes data for all courses are compiled and reviewed by the Curriculum Committee. The committee looks at weak areas in students' performance and at areas targeted for improvement in past assessment cycles.

A weak area is indicated by a measurement or series of measurements where the average numerical value is notably less than it is in other areas. There is no fixed numerical target for acceptable or unacceptable outcome score but the rubrics used in the evaluation are designed so that a score of 3 indicates the students are meeting our expectations. The 3 value provides some guidance but it is not a hard and fast threshold indicating which problems will be addressed and which will not. The purpose of the outcomes assessment is to improve the quality of education and weak areas will be addressed regardless of whether they are numerically above or below 3.

Problems indicated by the data are discussed with members of one of the four Academic Area Committees for their review. These committees are comprised of the faculty teaching in a particular discipline. Some faculty members belong to several committees. The committees are:

1. Thermodynamics and Fluid Mechanics
2. Materials and Solid Mechanics
3. Dynamics, Vibrations, and Controls
4. Design and Manufacturing

The Curriculum Committee with input from the Academic Area committees examines the problem and decide upon the course of action. This might involve making changes to one or more courses.

Problem Remediation

Weaknesses in the outcomes data point to high priority areas for improving our curriculum. The curriculum can be improved by adding one or more lectures, adding or modifying study materials, modifying or adding homework assignments, or in some cases creating an entirely new course.

The changes to the curriculum may not be made in the course or courses where the problem was detected. The changes may be made in lower level courses so that students are better prepared for the work when they reach the course where the assessment was made. This is best determined by looking at the curriculum and outcomes results holistically. The Curriculum Committee must determine if there is a problem with one course or if there is a weak area that affects several courses. In this latter case, more than one outcome may be used to determine the problem and a suitable correction to the curriculum.

Once the correction to the curriculum is implemented, the outcome or outcomes will be reassessed to see if the change produces the intended effect. The reassessment may be done more frequently than the planned schedule if it is possible to immediately measure the effects of the change. The curriculum modification and outcomes associated with this modification will be closely monitored. The outcomes will be reassessed and the curriculum modified until the desired effect is clearly demonstrated.

Documentation

Outcomes are evaluated by collecting work from all of the students in the class, copying it, and evaluating it using a rubric carefully designed to measure a specific outcome. The scores for the rubric are written on each copy and these copies are stored in ring binders the Mechanical Engineering Office. There is a separate ring binder for each outcome and separate tabs in the binder for each course assessed. The binder material includes:

1. A description of the course and the outcome being assessed.
2. The rubric used for the assessment.
3. A table showing the rubric scores for each piece of student work being assessed. Each row of the table is numbered relating it to a particular student's work.
4. Copies of the student work used in the assessment. The students' names have been replaced with a number that relates each piece of work with a specific row in the rubric evaluation table.