

Institutional Effectiveness Report  
2021-2022

Program: Mechanical Engineering BS

College and Department: College of Engineering – Mechanical Engineering

Contact: Mohan Rao, Chair of the Department

Mission: The Mechanical Engineering (ME) Department, within a regional and global context, will prepare its students for productive career in a competitive, dynamic, technologically-based society; will advance the knowl0000912 0 612 792 reW\*ñBT/F2 12 Tf1 0 0 1 298.25 692.74 Tm0 g0 G dg12(m)-792 reW\*ñBT/Fartme

The web site also lists all the courses, their syllabi, faculty and staff and other program highlights. The Bachelor of Science in Mechanical Engineering (BSME) degree offered by the Department of Mechanical Engineering is accredited by the Engineering Accreditation Commission of ABET, <http://abet.org>.

#### Program Goals:

- PG 1: Our graduates excel in diverse career paths using their engineering knowledge and professional skills to address complex problems and make positive impacts on society.
- PG 2: Our graduates serve their profession and the public as ethical team members and leaders with awareness of modern issues, commitment to inclusive collaboration, and effective communication.
- PG 3: Our graduates practice adaptive learning, expanding and enhancing their knowledge, creativity, and skills through professional development, continuing education, and/or earning advanced degrees.

#### Student Learning Outcomes:

It is expected that by the time of graduation, the Tech's ME students will have...

- SLO 1: an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.
- SLO 2: an ability to apply engineering design to produce solutions that meet specified needs with

Our graduates serve their profession and the public as ethical team members and leaders with awareness of modern issues, commitment to inclusive collaboration, and effective communication.

Instructional Outcomes are achieved, as evidenced by student performance on specific test and homework problems, and other course assignments. The IOFA tool uses the 0-4 pt. level-of-attainment scale. Data from the Instructional Outcomes Faculty Assessment informs the evaluation of each of the Student Outcomes (1-7).

5. *Instructional Outcomes Student Survey (IOSS)*: The Instructional Outcomes Student Survey (IOSS) is administered to students in eight selected courses in the BSME curriculum, same as for the IOFA above. The IOSS tool provides a pre/post self-assessment of student progress in achieving the Instructional Outcomes of the course. This is based on the difference between a student's perception of their level of knowledge for each Course Instructional Outcome upon entering a course and upon leaving the course. The IOSS survey is considered an indirect data source for assessment of Student Outcomes, as it requires a conversion through detailed mapping of a Course Instructional Outcomes to the Student Outcomes. The Instructional Outcomes Student Survey tool uses the 0-4 pt. level-of-attainment scale. Data from the IOSS informs the evaluation of each of the Student Outcomes (1-7).
6. *Senior Exit Interview Written Survey (SEIWS)*: The Senior Exit Interview Written Survey (SEIWS) is one part of the Senior Exit Interview process. Students graduating from the BSME program provide self-assessment of their level of attainment of the ABET Student Outcomes, self-reporting of their engineering club and pre-professional activities while at Tennessee Tech, and text feedback regarding the BSME program and the ME Department. The Senior Exit Written Survey uses a quantitative 1-5 pt. "satisfaction" scale which is then converted to a 0-4 pt. scale for later combination with other assessment instruments results. The quantitative data is reviewed in conjunction with the Senior Exit Interview Oral Focus Groups, and the Goals and Assessment Committee summarize the qualitative comments. The data from the Senior Exit Interview Written Survey informs the evaluation of each of the Student Outcomes (1-7).
7. *Senior Exit Interview Oral Focus Groups (supporting source of evidence)*: The Senior Exit Interview Oral Focus Groups (SEIOFG) process consists of an open discussion forum of graduating seniors with the ME chair and associate chair. The interview serves as a valuable source of suggestions for program improvement, as well as a source of supporting feedback on student performance. After receiving the feedback from the students, continuing concerns are compiled by the Goals and Assessm

A score of 3-to-4 is the desired level-of-attainment for each Student Outcome. A score between 2-to-3 is cause for review by the ME Goals and Assessments Committee, with possible actions and/or continued monitoring recommended to the ME faculty. A score lower than 2 requires corrective action to be taken by the ME faculty after review and recommendations for change by the ME Goals and Assessments Committee.

Results:

*SLO 1: an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics*

*SLO 2: an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors*

*SLO 3: an ability to communicate effectively with a range of audiences*

*SLO 4: an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts*

*SLO 5: an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives.*

*SLO 6: an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions*

*SLO 7: an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.*

Assessment results from the various instruments mentioned above for the academic year 2021-22 are given in the table below along with some notes. Results from previous years were described in the 2020-21 IE report. The ME department went through successful review of the ME program by ABET in October 2020, a full six-year reaccreditation of the program was obtained with no concerns or weaknesses.

Table 2. Assessment Results AY 21-22

Academic Year Fall 2021 - Spring 2022							
	SO1	SO2	SO3	SO4	SO5	SO6	SO7
Alumni Survey	2.9	2.8	3.0	3.3	3.0	3.1	3.4

Assessment Notes: Beginning Fall 2021 our department adopted a plan for an overall change in process for assessment, evaluation, and change (AEC Plan). The two-year implementation cycle of the new AEC Plan impacts our data collection and tracking and reporting on outcomes in the transition years (2021-2023).

Details regarding the implementation of the new plan are provided in the next section. While we conduct this overall change in our process, we are continuing to collect data on our prior plan with some of the instruments and making changes with the other instruments. Observational analysis from existing data collection instruments used in Fall 2021-Spring 2022 were made by members of the Goals and Assessment Committee and are presented below. These observations document the procedural steps we are taking as a department as we consider modifications and/or use of current instruments into the new AEC Plan.

#### Alumni Survey

Six respondents in Fall 2021

Low response rates continue to be of concern as to how useful this data is and what weighting it should receive in a quantitative sense.

process and both have resulted in incomplete data that do not represent the level of review we are now seeking with performance indicators and levels for each SO.

The extensive body of student data that are contained in the Capstone Design Reports and Presentations are central to our new AEC Plan. This data has been collected and is awaiting review. Use of new rubrics that facilitate the assessment on four of the SOs are still a work in progress from 2021-2022. Outcomes will be detailed in the next year IE report when all seven SOs will have been assessed and evaluated via the Capstone Projects.

## Co-op Employer Surveys

21 Respondents in Summer 2021, 13 respondents in Fall 2021, 6 respondents in Spring 2022  
The Co-op Employer survey does not probe elements of at least some of the SOs. For instance, SO6 reads as "an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions." Our Co-op Employer survey does not ask any question evaluating the first part of this SO, i.e., "to develop and conduct appropriate experimentation, analyze and interpret data." We are currently evaluating their performance on SO6 by asking the supervisors to assess students' ability to "Use engineering judgment to draw conclusions." This question does not reflect on the students' ability to develop and conduct appropriate experimentation and analyze and interpret data, thus the weighting of this data in assessing SO6 is questionable.  
Can we adapt the Coop Employer Survey to directly offer levels of performance indicators? Could the coo-op survey use a coarser version of the rubrics for SOs that our department is developing. This would eliminate the need for mapping the current questions back onto the ABET framework. Any mapping leads to loss and distortion of information. Furthermore, it would allow the co-op supervisors to assess the students with a higher resolution tool, leading to a more accurate evaluation. For instance, to evaluate students' performance on SO1, we simply ask the supervisors whether the students can identify, formulate, and solve complex problems. Breaking this down into two to three more detailed questions can lead to a more rep

A modified IOFA instrument has been developed and proposed for use. The department will review the new instrument and decide on adoption after determining if this instrument has a place in the new AEC Plan.

Modifications for Improvement:

Continuous Improvement Plan for 2022-2023

The ME department goals and assessment committee is facilitating the department's implementation of the new paradigm for assessment and continuous improvement that was adopted in Fall 2021. Work is ongoing in the stepwise two-year implementation of the new Assessment, Evaluation, and Change (AEC) Plan during Fall 2022-Spring 2023.

Change 1: Implement a Cycle of Assessment, Evaluation, and Change (AEC) for the seven student outcomes on a two-year cycle schedule, see Table 3. The new AEC plan replaces the current practice of obtaining data every semester in seven courses using the Instructional Outcomes Student Survey and the Instructional Outcomes Faculty Assessment.

Table 3. New two-year cycle for ME Program **Assessment (A), Evaluation (E), and Change (C)**.

Change 2, Develop and Apply Rubrics to Student Artifacts at Programmatic Level, part a:

AEC Rubrics for levels of attainment for SO1, SO3, SO4, and SO5 were completed by faculty teams in in Spring 2022. See attached.

Applying these AEC rubrics to student artifacts (Senior Capstone Project Reports, Presentations and other artifacts) is a work in progress for 2022-2023.



Continue to implement the new AEC Plan to collect direct measures of student performance on the remaining three seven student outcomes, SO2, SO6, and SO7.

Identify performance indicators (PI) for each of these remaining three student outcomes. This was accomplished by full faculty participation in the Fall 2022 retreat.

During Fall 2022, teams of faculty for SO 2, SO6, and SO7 will be facilitated by a member of the Goals and Assessment Committee to develop AEC rubrics for levels of attainment of the performance indicators.

Each SO team will be involved in assessing the student artifacts using the AEC rubrics to assess each of the performance indicators for that particular student outcome.

The cohort of students assessed will be determined from the Spring 2023 courses as decided by the full faculty in December 2022.

Change 2, part c:

During Faculty meetings in Fall 2022, student artifacts will be assessed using the SO1, SO3, SO4, and SO5 rubrics to generate baseline data using the new AEC Rubrics. Students artifacts will be selected based on departmental discussion prior to the special sessions scheduled beginning in October 2022.

Change 3: ME department faculty are participating in a pilot program with the CITL and iLearn support staff to use the Learning Outcomes tool in their iLearn courses.

The learning materials, assignments, and rubrics in an iLearn course can be tied directly to the Student Outcomes and Performance Indicators.

The pilot use of the iLearn Learning Outcomes tool can generate data that shows how students are performing within courses against the departmental AEC Plan. The data can be aggregated across the courses taught by these faculty to observe a more granular assessment of student growth in attaining the SO.

The data collected via this pilot program may offer justification to adopt this method to inform the newly modified IOFA.

Additional faculty will be invited to join the pilot program during Fall 2022 and Spring 2023 to test drive the use of this approach to generate program level data for assessing student outcomes.

Change 4

ME3001 means all ME majors will

The learning outcomes for ME Fundamentals 1 have been established to engage students in their first semester as they learn about the ME profession during their first year at Tenn Tech. The goal is to help build students' awareness of the holistic nature of the profession in terms of knowledge, skills, and abilities (KSAs) and how they will attain these necessary KSAs for their chosen profession. See the attached description of ME Fundamentals 1.

The assumption that the ME Department will test with this pilot offering of ME Fundamentals 1 and 2 is that a first-year experience with the major taught by an ME faculty will improve retention from year one to year two. We will be tracking the progression of the first cohort of 39 students from Fall 2022 to Fall 2023 to test this assertion.

ME Fundamentals 2 will be offered in Spring 2023 to two sections of ENGR1120 Programming, with the 39 students in the pilot cohort being strongly encouraged to take ME Fundamentals 2 (ENGR1120-013).

Attachments: Rubrics



Appendices

1. Curriculum Map

Appendix 1: Curriculum Map

<b>Course</b>	<b>Student Outcomes</b>
	<b>I = Introduce, R = Reinforce, D = Demonstrate</b>