SAINT LOUIS UNIVERSITY.

Program-Level Assessment: Annual Report

Program Name (no acronyms): Mechanical Engineering	Department: School of Engineering
Degree or Certificate Level: Bachelor of Science	College/School: Parks College
Date (Month/Year): 10/21	Assessment Contact: Mark McQuilling
In what year was the data upon which this report is based collected? AY 2019-2021	
In what year was the program's assessment plan most recently reviewed/updated? AY 2019	

1. Student Learning Outcomes

Which of the program's student learning outcomes were assessed in this annual assessment cycle? (Please list the full, complete learning outcome statements and not just numbers, e.g., Outcomes 1 and 2.)

In this two-year assessment cycle, all three program outcomes were assessed:
Program Outcome 1 (PO1): To practice the principles of engineering in mechanical or allied organizations
Program Outcome 2 (PO2): To pursue further learning in mechanical engineering or in allied disciplines
Program Outcome 3 (PO3): To function as effective engineers with professional knowledge, skills and values

The above three program outcomes are directly mapped to three of seven criteria from our Accreditation Board for Engineering and Technology (ABET) criteria as identified in our HLC assessment plan. These are:
PO1 > ABET Criterion 1 (AC1): An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
PO2 > ABET Criterion 4 (AC4): 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
PO3 > ABET Criterion 7 (AC7): An ability to acquire and apply new knowledge as needed, using appropriate learning strategies
During the September and October months of 2021 program faculty evaluated every ABET criterion according to the newly-created ABET assessment plan of spring 2019 in order to begin the new assessment process on good standing (covid-19 issues delayed the initial round of assessment until fall 2021). Future ABET assessments will review 1-2 ABET outcomes per year.

Our ABET assessment plan includes evaluating three courses for each ABET Criterion, intended to assess early, middle, and late stages of student development. These are:
AC1: ESCI 2100 Statics (early), MENG 2300 Applied Thermodynamics (middle), and MENG 3510 Material Science
AC4: MENG 1001 Intro to Engineering (early), MENG 2000 Foundations to Engineering Design (middle), and MENG 4014 Design II (late)
AC7: ESCI 2300 Thermodynamics (early), AENG 3100 Computer-Aided Engineering (middle), and MENG 4004 Design I (late)

2. Assessment Methods: Artifacts of Student Learning

Which artifacts of student learning were used to determine if students achieved the outcome(s)? Please describe and identify the course(s) in which these artifacts were collected. Clarify if any such courses were offered a) online, b) at the Madrid campus, or c) at any other off-campus location.

The artifacts collected include project reports, design reports, homeworks and exams. The artifacts were collected from the following courses:

ESCI 2100 (early), MENG 2300 (middle), MENG 3510 (late)
MENG 1001 (early), MENG 2000 (middle), MENG 4014 (late)
ESCI 2300 (early), AENG 3100 (middle), MENG 4004 (late)
Madrid courses are not included in this assessment and no courses were offered at any other off-campus location.

3. Assessment Methods: Evaluation Process

What process was used to evaluate the artifacts of student learning, and by whom? Please identify the tools(s) (e.g., a rubric) used in the process and **include them in/with this report document** (do not just refer to the assessment plan).

Each of the courses were evaluated by the faculty member who taught the course and filled out an assessment form identifying whether the outcome was met or not; forms for all assessments are included later in this document. Success criteria was determined by each faculty member teaching the course, typically around a 70% score for at least 70% of the students on the assessed artifact.

All assessment material was then reviewed by a committee of three program faculty members for each ABET criterion, after which each group filled out a review form describing three main items for each criterion: (1) appropriateness of materials gathered, (2) recommendations for course changes, and (3) recommendations for adjusting assessment process. These forms are also included below for both the course assessments ("Outcome Assessment Template") and the criterion assessments ("AEME ABET Assessment Review Form").

4. Data/Results

What were the results of the assessment of the learning outcome(s)? Please be specific. Does achievement differ by teaching modality (e.g., online vs. face-to-face) or on-ground location (e.g., STL campus, Madrid campus, other off-campus site)?

PO1/AC1: an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics – This outcome was assessed across three courses in the curriculum (sophomore to junior) with receiving an outcome achievement of 70% or more. (homeworks, midterms, final exams). Suggestions were made to use a more consistent type of problem, but concerns were also made about academic freedom of instructors.

PO2/AC4: 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 – This outcome was assessed across three courses in the curriculum (sophomore to senior) with receiving an outcome achievement of 70% or more (project reports), where design philosophy was explored and executed. Instructor comments included consideration of how much of a project report is sufficient for addressing the outcome. Again, these details will help future assessments as we continually evolve our curriculum, teaching, and assessment expectations.

PO3/AC7: an ability to acquire and apply new knowledge as needed, using appropriate learning strategies - This outcome was assessed across three courses in the curriculum (freshmen to senior) with receiving an outcome achievement of 75% or more (design reports, project reports and exams). Evaluations included being difficult to assess early on, while later stages noted students' lack of concern for significant digits in presentation materials. No major changes recommended for coursework, but consistency of assessment strategy across courses was desired; however, this again begs the question of academic freedom in what instructors choose to assess. At a minimum this is helpful for instructors to see what others are doing.

5. Findings: Interpretations & Conclusions

What have you learned from these results? What does the data tell you?

The outcomes assessment from various courses across the curriculum indicates the students are achieving the desired program outcomes at the desired level of performance. It is difficult to interpret the assessments across the curriculum as they were certainly affected by covid disruptions, but at a minimum all faculty participated and we are well on our way to achieving a more consistent assessment process.

6. Closing the Loop: Dissemination and Use of Current Assessment Findings

A. When and how did your program faculty share and discuss these results and findings from this cycle of assessment?

The program keeps all the relevant assessment documents and the evidence collected in T-drive. The AE and ME program faculty will meet at least once every semester to discuss the assessment process and continuous improvement process. In fact, our next faculty meeting in November will focus mostly on ease of process for both ABET and HLC assessment cycles.

B. How specifically have you decided to use these findings to improve teaching and learning in your program? For example, perhaps you've initiated one or more of the following:

Changes to the Curriculum or Pedagogies	• Course content • Teaching techniques • Improvements in technology • Prerequisites	• Course sequence • New courses • Deletion of courses • Changes in frequency or scheduling of course offerings
Changes to the Assessment Plan	• Student learning outcomes • Artifacts of student learning • Evaluation process	• Evaluation tools (e.g., rubrics) • Data collection methods • Frequency of data collection

Please describe the actions you are taking as a result of these findings.

The outcomes assessment review indicates students have achieved the desired level of performance. The AE and ME program has revised and developed a new curriculum to include the University CORE requirements as well as course changes to satisfy ABET requirements. These new courses will be assessed from Fall 2021 assessment cycle. We are also in the process of developing new, simplified rubrics and other methods to establish more consistency among assessment activities.

If no changes are being made, please explain why.

N/A

7. Closing the Loop: Review of Previous Assessment Findings and Changes

A. What is at least one change your program has implemented in recent years as a result of assessment data?

Though students achieved desired outcomes, the review identified some deficiencies that should be resolved, like, lack of proficiency in trigonometry and units conversions, as well as multiple-choice questions under a timed interval was difficult for students to complete (final exam). Consistency among faculty and courses will also be continually addressed while acknowledging faculty have academic freedom (as long as the course outcomes are achieved).

B. How has this change/have these changes been assessed?

As noted above, faculty are hesitant to make changes to coursework based on assessments of student performance during the covid era. We have noted some inconsistencies during this review cycle and will continue to look for them as we transition back to fully in-person learning. We may also discuss our findings with math and physics departments if we continue to see a lack of student proficiency in fundamental courses used as pre-requisites for our engineering coursework.

C. What were the findings of the assessment?

See above.

D. How do you plan to (continue to) use this information moving forward?

Continue to develop the performance indicators and scoring rubrics to streamline the assessment process and methods. Put emphasis on the performance indicators and scoring rubrics to assess the outcomes achievement for more consistency across courses and outcomes.

IMPORTANT: Please submit any assessment tools (e.g., rubrics) with this report as separate attachments or copied and pasted into this Word document. Please do not just refer to the assessment plan; the report should serve as a stand-alone document.

OUTCOME ASSESSMENT TEMPLATE

Learning Outcome: 1 (Solve Problems using SEM) 2 (Design in Global Context) 3 (Effective Communication)
[select 1] 4 (Ethics in Global Context) 5 (Functional Teamwork) **6 (Experiment and Draw Conclusions)**
7 (Lifelong Learning)

Course: ESCI 3201 (Fluids Lab)

Location in Program: Early **Middle** End

Method: Formal Lab Report

Rubric: Lab reports are graded on: grammar and syntax; proper source citation; introduction; design of test; procedure; test results; discussion of results; conclusions; sample calculations; data reduction; tables and figures (see rubric)

Desired result: 70% of students will meet expectations

Student performance: 100% (3/3) of students met expectations

Observations: [this is the time to be detail-oriented and specific. Discuss what students do: "Most students were able to formulate the problem… More than 2/3rds made arithmetic or sign errors… Only one student drew a free-body diagram"]

Assessment: *[Circle back to the learning outcome. What does the student performance say about how this learning outcome is addressed in the course? "At this level, students need additional reinforcement about good problem-solving technique… "While we believe that students are meeting the program outcome, this particular measurement was too easy and did not adequately measure performance at the students' grade level."]*

Action: *[Recommended responses]*

AEME ABET Assessment Review Form

This form is to be used to record review group thoughts about assessment materials collected, including: appropriateness of materials gathered, recommendations for course changes, and recommendations for adjusting the assessment process.

Program (AE or ME): _____ Date materials reviewed: _____

Criterion reviewed (circle one): 1 2 3 4 5 6 7

Criterion period (circle one): Early Middle Late

Semester(s) reviewed: _____

Reviewers: _____

Appropriateness of materials gathered:

Recommendations for course changes:

Recommendations for adjusting assessment process:

Other:

CRITERIA 1

AEME ABET Assessment Review Form

This form is to be used to record review group thoughts about assessment materials collected, including: appropriateness of materials gathered, recommendations for course changes, and recommendations for adjusting the assessment process.

Program (AE or ME): **ME** Date materials reviewed: Sept 27 – Oct 6, 2021

Criterion reviewed (circle one): 1 2 3 4 5 6 7

Criterion period (circle one): **Early** Middle Late

Semester(s) reviewed: ESCI 2100 (Statics) / Spring 2019, Fall 2019, Spring 2020, Fall 2020, Spring 2021

Reviewers: Theodosios Alexander, Srikanth Gururajan, Jeff Ma

Appropriateness of materials gathered:

A range of materials are collected, including homework, midterms and final exams. It may be more helpful to identify a particular problem/concept and tracked consistently.

Recommendations for course changes:

Students are meeting the objectives, and appropriate actions are already being implemented (inclusion of additional exercise problems). So, the committee makes no further recommendations.

Recommendations for adjusting assessment process:

As noted, it would be appropriate to isolate questions/concepts on the assignment/exam that are pertinent to this topic and archive only those items.

Other:
N/A

AEME ABET Assessment Review Form

This form is to be used to record review group thoughts about assessment materials collected, including: appropriateness of materials gathered, recommendations for course changes, and recommendations for adjusting the assessment process.

Program (AE or ME): **ME** Date materials reviewed: Sept 27 – Oct 6, 2021

Criterion reviewed (circle one): 1 2 3 4 5 6 7

Criterion period (circle one): Early **Middle** Late

Semester(s) reviewed: MENG 2300 (Applied Thermodynamics) / Spring 2020

Reviewers: Theodosios Alexander, Srikanth Gururajan, Jeff Ma

Appropriateness of materials gathered:

One problem out of a homework set – "*formulation of simple, regenerative and intercooled regenerative gas turbine performance calculations with a view to plot graphs identifying three different optimum pressure ratios*"

Recommendations for course changes:

None.

Recommendations for adjusting assessment process:

None.

Other:
N/A

AEME ABET Assessment Review Form

This form is to be used to record review group thoughts about assessment materials collected, including: appropriateness of materials gathered, recommendations for course changes, and recommendations for adjusting the assessment process.

Program (AE or ME): **ME** Date materials reviewed: Sept 27 – Oct 6, 2021

Criterion reviewed (circle one): 1 2 3 4 5 6 7

Criterion period (circle one): Early Middle **Late**

Semester(s) reviewed: MENG 3510 (Material Science) / Spring 2019, Spring 2020, Spring 2021

Reviewers: Theodosios Alexander, Srikanth Gururajan, Jeff Ma

Appropriateness of materials gathered:

Materials used for this assessment "*Several different types of engineering problems on homework assignments, midterm exams, and on the comprehensive final exam*" is appropriate for evaluating this criterion

Recommendations for course changes:

None.

Recommendations for adjusting assessment process:

None.

Other:
N/A

CRITERIA 4

AEME ABET Assessment Review Form

This form is to be used to record review group thoughts about assessment materials collected, including: appropriateness of materials gathered, recommendations for course changes, and recommendations for adjusting the assessment process.

Program (AE or ME): **ME** Date materials reviewed: Sept 27 – Oct 6, 2021

Criterion reviewed (circle one): 1 2 3 **4** 5 6 7

Criterion period (circle one): **Early** Middle Late

Semester(s) reviewed: MENG 1001 (Introduction to AE/ME) / Spring 2019, Fall 2019, Spring 2020

Reviewers: Michael Swartwout, Srikanth Gururajan, Chi Hou Lei

Appropriateness of materials gathered:

The Play Pumps assignment is appropriate/effective; but the entire assignment should not be used. Rather, the specific questions associated with Outcome 4 should be identified and separately collected.

Recommendations for course changes:

None. As an introductory-level assignment/assessment, this is appropriate. Students are engaging with the material and meeting our objectives.

Recommendations for adjusting assessment process:

As noted above, isolate the questions on the assignment that are pertinent to this topic and archive only those items. At the next review, determine whether the current expectation is too low, as almost all students are meeting it.

Other:
N/A

AEME ABET Assessment Review Form

This form is to be used to record review group thoughts about assessment materials collected, including: appropriateness of materials gathered, recommendations for course changes, and recommendations for adjusting the assessment process.

Program (AE or ME): **ME** Date materials reviewed: Sept 27 – Oct 6, 2021

Criterion reviewed (circle one): 1 2 3 4 5 6 7

Criterion period (circle one): Early **Middle** Late

Semester(s) reviewed: MENG 2000 (Foundation of Engineering Design) / Spring 2000, Spring 2001

Reviewers: Michael Swartwout, Srikanth Gururajan, Chi Hou Lei

Appropriateness of materials gathered:

For both semesters, a group project on design was assigned.
Students were tasked with the design of a product starting from need analysis and concept design, where they researched similar products and interviewed customers / potential users as a way to realize non-technical aspects in engineering.
Students were also requested to
Samples of written reports / presentations and evaluations are collected.
The assessment is appropriate.

Recommendations for course changes:
No change is expected.

Recommendations for adjusting assessment process:
No recommendation.

Other:
N/A

AEME ABET Assessment Review Form

This form is to be used to record review group thoughts about assessment materials collected, including: appropriateness of materials gathered, recommendations for course changes, and recommendations for adjusting the assessment process.

Program (AE or ME): **ME** Date materials reviewed: Sept 27 – Oct 6, 2021

Criterion reviewed (circle one): 1 2 3 **4** 5 6 7

Criterion period (circle one): Early Middle **Late**

Semester(s) reviewed: MENG 4014 (Senior Design II) / Spring 2020, Spring 2021

Reviewers: Michael Swartwout, Srikanth Gururajan, Chi Hou Lei

Appropriateness of materials gathered:

(2020) Materials gathered are final reports by student groups. The contents of the reports have shown the students' awareness of non-technical aspects of engineering.
(2021) Individual students were tasked to write a short report as a reflection of their senior design projects at the end of the semester, in the aspects of:

- individual and group: ethical, professional responsibilities
- Impact on global, economic, environmental, and societal concerns; and possible solution

Materials gathered in both semesters are appropriate.

Recommendations for course changes:

No change is expected.

Recommendations for adjusting assessment process:

NA

Other:

NA

CRITERIA 7

AEME ABET Assessment Review Form

This form is to be used to record review group thoughts about assessment materials collected, including: appropriateness of materials gathered, recommendations for course changes, and recommendations for adjusting the assessment process.

Program (AE or ME): **ME** Date materials reviewed: Sept 27 – Oct 6

Criterion reviewed (circle one): 1 2 3 4 5 6 **7**

Criterion period (circle one): **Early** Middle Late

Semester(s) reviewed: ESCI 2300 (Thermodynamics) / Fall 20, Spring 20, Spring 21

Reviewers: Krishnaswamy Ravindra, Jenna Gorlewicz, Chi Hou Lei

Appropriateness of materials gathered:

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

Spring 2019 - (1/3 ME students met or exceeded 70%); Final Exam problem involving one of the main concepts in the course (conservation of energy) on a typical work producing device (turbine)

ESCI 2300 Fall 20 - 18/22 ME students met or exceeded - final exam problem involving some of the main concepts in the course (conservation of energy, entropy calculations, use of property tables) on a typical heat exchanging device (heat exchanger)

Spring 20 - 46/55 students met or exceeded - AE vs. ME not delineated; Two homework problems

Spring 21 - 9/11 ME students met or exceeded expectations; Final exam problem

Recommendations for course changes:

Perhaps an assignment (summary report or pptx) such as Thermodynamics of Geothermal energy, Thermodynamics in human body, etc., where students go beyond the textbook should be assessed.

Recommendations for adjusting assessment process:

Outcome 7 is: an ability to acquire and apply new knowledge as needed, using appropriate learning strategies. The current course may not be suitable for assessing objective 7. Perhaps MENG 2000 is better suited.

Measurement of new knowledge application is measured through solving a complex problem. It's a bit difficult to assess this acquisition unless we assume that the baseline is that they do not know how to do this or we have a pre-post type of setup. Something to consider for the future.
Additionally, on our evaluation sheets it says "lifelong learning" which doesn't really capture this outcome's intent.

Other:
N/A

AEME ABET Assessment Review Form

This form is to be used to record review group thoughts about assessment materials collected, including: appropriateness of materials gathered, recommendations for course changes, and recommendations for adjusting the assessment process.

Program (AE or ME): **ME** Date materials reviewed: Sept 26 – Oct 6, 2021

Criterion reviewed (circle one): 1 2 3 4 5 6 **7**

Criterion period (circle one): Early **Middle** Late

Semester(s) reviewed: AENG 3100 (Computer Aided Engineering) / Spring 19, Fall 19, Spring 20, Fall 20, Spring 21

Reviewers: Krishnaswamy Ravindra, Jenna Gorlewicz, Chi Hou Lei

Appropriateness of materials gathered:

Information gathered includes presentations by student teams that focus on designing a small engineering system or component by using computer engineering software and validation with available theoretical results via hand calculation. Students learn new software tools in the analysis and design, which satisfy outcome 7 of ABET.

CAE (ANEG 3100)
Students learnt various techniques in computational engineering analysis. They were then assigned projects where they solved new engineering problems with the said skills.

Spring 19 (4 ME students - average was 55% - not sure what this means in terms of meets/exceeds) Problem on exam on computational analysis of truss

Fall 19 - 89% of students met expectations? (17/19 ? Unsure on this) - a project was assigned that was presented through a ppt

Spring 20 - 5 ME student - average is 44% but not sure what this means in terms of meets/exceeds; final exam problem on computational analysis of beam

Fall 20 - 94% of students met (16 students total) - project presentation

Spring 21 - 100% of students met (8/8 ME) - project presentation

Recommendations for course changes:
N/A

Recommendations for adjusting assessment process:

We need to request for the number of AE and ME students to be listed on the evaluation form

We also need to consider what we are really measuring in this outcome and consider developing some consistency across the different courses that are being used to assess it.

The reviewers agree that the current assessment is appropriate, and no change is needed.

Other:
N/A

AEME ABET Assessment Review Form

This form is to be used to record review group thoughts about assessment materials collected, including: appropriateness of materials gathered, recommendations for course changes, and recommendations for adjusting the assessment process.

Program (AE or ME): **ME** Date materials reviewed: Sept 26 – Oct 6, 2021

Criterion reviewed (circle one): 1 2 3 4 5 6 **7**

Criterion period (circle one): Early Middle **Late**

Semester(s) reviewed: ME 4004 (Senior Design I) / Fall 2019, Fall 2020

Reviewers: Krishnaswamy Ravindra, Jenna Gorlewicz, Chi Hou Lei

Appropriateness of materials gathered:

(Fall 2019) - 100% (6/6 groups) Fall group reports were collected. Students demonstrate that they have learned new skills needed to resolve various issues in their designs / projects.
(Fall 2020) - 23/24 students met expectations on HW 1; 100% on HW1 and 2. The students worked on 4 teams of 5-7 students to design various systems. Individual and group homework assignments were collected. The intentions of the homework are to enable students to be aware of their deficiencies and explore ways to improve for the rest of the semester. Final reports are also provided as supplementary documentation but not included in the assessment.

Recommendations for course changes:
Observation: In both AE and ME design presentations, it is observed that many students do not pay attention to significant digits for relevant quantities.
Suggestion: Focus on the importance of expressing significant digits in engineering design and presentation.
(Fall 2020) At the end of the semester, students can be asked to share their experiences with learning new skills.

Recommendations for adjusting assessment process:
We need to add student numbers to our assessment forms.
It would be good to establish consistency of assessment across semesters / academic years, as well as consistency in the collection of assessed materials.
For example: a common rubric across the different instructors/course for assessing this outcome.

In addition, AE senior design routinely invites industry engineers to listen and evaluate the presentations. Such is not the case in ME design 1 and 2.
We should consider if design I and II are evaluated jointly.

Other:
N/A