Academic Assessment Plan

College: College of Engineering

Program(s): MS Mechanical Engineering

Reviewed: Spring 2025

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MISSION STATEMENT

The Department seeks to provide the highest quality of education through a learning environment that enables and inspires students to succeed academically and professionally, provides the highest quality instruction, fosters research and other creative activities, and instills a desire to embrace life-long learning.

PROGRAM INTRODUCTION

The Mechanical Engineering (ME) Program falls within the School of Engineering at University of Alaska Anchorage. The Master of Science, Mechanical Engineering (MSME) program prepares students for work that requires a greater degree of autonomy and mastery. A master's degree in mechanical engineering implies not only an enhanced level of understanding of the fundamentals of mechanical engineering, but also a skill set that includes original thinking and an ability to apply advanced concepts of mechanical engineering to problem solving.

The MSME has a thesis and a non-thesis option. The thesis option includes a focus on skills related to the acquisition of new knowledge and is designed for students who wish to pursue research-oriented occupations or to eventually pursue a PhD degree, as well as to prepare for advanced professional engineering practice. The non-thesis option is designed for students who wish to further emphasize engineering practice and prefer to substitute additional classroom education and a comprehensive written exam or a project and comprehensive oral exam for graduate research experience.

ASSESSMENT PROCESS INTRODUCTION

The Mechanical Engineering faculty have adopted three Program Objectives and four Student Learning Outcomes for the MSME degree. Outcomes assessment and implementation of continuous improvement is the responsibility of the faculty of the Mechanical Engineering Program.

The outcomes assessment strategy of the ME Program is voted upon by the ME faculty. The faculty select the measures which will be used to assess each outcome. Individual faculty members agree to administer these measures on a volunteer basis. One of the ME faculty serves as Chair of the Department Assessment and Curriculum Committee. Among other duties, the Chair of the Department Assessment and Curriculum Committee keeps central records of all assessment activities, prepares reports, and coordinates with the UAA Academic Assessment Committee.

PROGRAM OBJECTIVES AND STUDENT LEARNING OUTCOMES

Program Objectives

The UAA mechanical engineering graduate program objectives are to provide graduates with:

1. Graduate-level technical knowledge within mechanical engineering.
2. An ability to conceive and conduct graduate-level engineering research and problem solving.
3. An ability to effectively communicate graduate-level engineering concepts and applications.

Student Learning Outcomes

At the completion of the MSME program, students are able to:

1. Use in-depth methods of analysis.
2. Demonstrate graduate-level mechanical engineering theory.
3. Conduct advanced mechanical engineering research and applications.
4. Apply graduate-level engineering theory to the design of mechanical engineering systems.
5. Work effectively within the professional framework of organizations responsible for the practice of engineering.

TABLE 1: ASSOCIATION OF ASSESSMENT MEASURES TO STUDENT LEARNING OUTCOMES

Outcomes	Direct CLA	Exit Survey	Comp. Exam	Project or Thesis
1. Use in-depth methods of analysis	**1**	**1**	**1**	**1**
2. Demonstrate graduate-level mechanical engineering theory.	**1**	**1**	**1**	**1**
3. Conduct advanced mechanical engineering research and applications.	**0**	**1**	**0**	**1**
4. Apply graduate-level engineering theory to the design of mechanical engineering systems.	**1**	**1**	**0**	**1**
5. Work effectively within the professional framework of organizations responsible for the practice of engineering.	**0**	**1**	**0**	**1**

0 = Measure is not used to measure the associated outcome.
1 = Measure is used to measure the associated outcome.

ASSESSMENT MEASURES

A description of the measures used in the assessment of the student learning outcomes and their implementation are summarized in Table 2 below. The measures and their relationships to the student learning outcomes are listed in Table 1, above.

There is a separate appendix for each measure that shows the measure itself and describes its use and the factors that affect the results.

TABLE 2: ASSESSMENT MEASURES AND ADMINISTRATION

Measure	Description	Frequency/ Start Date	Collection Method	Administered by
Direct Course Level Assessment	Student work from selected courses, selected to measure the level of outcome achievement.	Spring and Fall semesters, beginning Fall 2013	Evaluation by course instructors	Course instructors
Indirect Course Level Assessment	Survey given to graduating students in which students self-assess their perceived level of outcome achievement.	Spring and Fall semesters, beginning Fall 2013	Surveys given by computer or hard copy	Graduate advisor
Comprehensive Exam	Student performance on comprehensive written or oral exam required for completion of the MSME degree. Project and thesis students take an oral exam as part of their defense, and non-thesis students may opt for a written exam instead of a project.	Spring and Fall semesters, beginning Fall 2013	Evaluation done by student's graduate committee	Graduate committee
Thesis or Project	Student performance on written report and oral presentation associated with project or thesis.	Spring and Fall semesters, beginning Fall 2013	Evaluation done by student's graduate committee	Graduate committee

ASSESSMENT PROCESS

General Implementation Strategy

The School of Engineering administration is responsible for:

- Providing sufficient financial and staff support for the implementation of this plan.
- Ensuring faculty assessment efforts are appropriately reflected in annual workload agreements.

The ME Program faculty are responsible for:

- Performing assessment as an integral part of teaching activity (course level assessment).
- Participating in meetings to discuss development and implementation of the assessment plan.
- Participating in meetings to discuss interpretation of the data and implementation of continuous improvement, particularly relating to the ME curriculum.
- Preparing the data from their own Course Level Assessments for the Chair of the Department Assessment and Curriculum Committee.

The Chair of the Department Curriculum and Assessment Committee is responsible for:

- Keeping central records of all assessment activities.
- Preparing reports related to assessment activities, subject to the approval of the ME faculty.
- Coordinating with the UAA Academic Assessment Committee.
- With the ME Department Chair, coordinating with ABET and any other external accrediting bodies.

The Chair of the ME Department is responsible for:

- Presiding at ME faculty meetings in which assessment issues are discussed.
- Communicating the assessment-related activities and needs of the ME Department to the School of Engineering administration.
- Coordinating as needed with ABET and any other external accrediting bodies.

Of the four assessment measures used to assess the MSME Program, three will occur as students prepare to finish their degrees (exit survey, comprehensive exam, and thesis/project report). Assessment data will be taken on these three items for every student. Direct CLA will be carried out on a schedule that complements the already-existing assessment program for the BSE ME degree.

The ME faculty operate on an assessment timeline wherein a full assessment, including closing the loop and continuous improvement, occurs every three years. Every three years, assessment data will be used to prepare an Outcomes and Objectives Assessment Report for the BSE ME degree. At these times, assessment data from the MSME program will be gathered into the same report and assessed in parallel with the already-existing process.

The first full round of assessment for the BSE ME Program was completed in AY2011-12. The next round of assessment will be completed in AY 2014-15. At this time, it is anticipated that the first round of assessment for the MSME will be completed as well.

Description of Faculty Involvement

The ME faculty are ultimately responsible for all aspects of the assessment process.

Development of assessment plans:

- Assessment plans are implemented following a vote of the ME faculty at a faculty meeting attended by a quorum.

Implementation of assessment measures:

- Direct course level assessments (CLAs) are undertaken on a volunteer basis by the instructors of certain courses, as discussed in the approved assessment plan.
- Course instructors collect data for direct CLAs and perform preliminary analysis and interpretation before turning the data over to the Chair of the Department Curriculum and Assessment Committee.
- Other assessment activities are lead by individual faculty members or special committees on a volunteer basis. The formation of special committees for the purpose of assessment is subject to a vote by the ME faculty. These individual faculty members of special committees are responsible for preliminary analysis and interpretation of the data.

Recommendations for continuous improvement:

- The Chair of the Department Curriculum and Assessment Committee prepares reports on the findings of assessment activities, which may contain analysis of the data and recommendations for continuous improvement. These reports are subject to the approval by the full ME faculty before adoption or dissemination.
- ME faculty members are free as instructors take action for continuous improvement within their own courses as suggested by the results of their assessment activities and the assessment activities of their colleagues.
- Recommendations for actions to be taken for continuous improvement at the Department level may be suggested by any ME faculty member, to be discussed and voted upon at an ME faculty meeting. These suggestions may include:
    - Changes in course content, sequencing, or prerequisites,
    - Substitution, creation or deletion of courses in the current curriculum,
    - Changes in instructor assignments,
    - Changes in advising methods, or
    - Additions or replacement of equipment, such as lab equipment.

Modification of the Assessment Plan

Potential changes to the assessment plan may be suggested by any faculty member to be discussed at one of the regular faculty meetings. Changes to the assessment plan are implemented following a discussion and a vote at a faculty meeting at which a quorum (2/3 of full-time faculty) is present.

APPENDIX A: DIRECT COURSE LEVEL ASSESSMENT

Measure Description:

Course instructors will evaluate student work to measure the level of outcome achievement. Assessment tools may include quiz and exam questions, projects, laboratory reports or other writing assignments, in-class presentations, or other materials deemed appropriate by the instructor. Instructors may choose which assessment tool or tools they wish to use.

Factors that affect the collected data:

- Clarity of the assignment or question.
- Student motivation.
- Instructor bias in evaluating results.
- Instructor style with respect to grading.

How to interpret the data:

Instructors may choose one of two methods for assessing outcomes and/or individual performance indicators. Instructors may choose to assess student work based on one of the attached rubrics, or to examine student grades on exam questions or projects that relate to particular outcomes or performance indicators.

The procedure for direct CLA using one of the attached rubrics is as follows:

1. Rate each student according to one of the attached rubrics on a scale of "Excellent," "Satisfactory," "Developing," or "Unsatisfactory."
2. Determine the percentage of students who have shown "Satisfactory" or "Excellent" achievement of the outcome.

The procedure for direct CLA using student grades is as follows:

1. Choose a project or exam problem which relates directly to a particular outcome or performance indicator.
2. Determine the percentage of students whose grades put them in the categories of "Excellent," "Satisfactory," "Developing," or "Unsatisfactory."

This data will be used to suggest the effectiveness of courses within the MSME program, and will also be used by the course instructor to gage student learning effectiveness at the course level. A sample Student Outcome Report for direct CLA is shown below. Rubrics for all Outcomes follow.

Student Outcome Report for Course Instructor: Outcome 1

Course title:	ME A642	Instructor:	Brock
Number of students:	8	Semester:	Spring 2013

Assessment Rubric:

Outcome 2: an ability to demonstrate graduate-level mechanical engineering theory				
Performance Indicator	**Performance Indicator**	**Performance Indicator**	**Performance Indicator**	**Performance Indicator**
1. Selects appropriate theory, model or governing equation	Does not demonstrate understanding of appropriate model	Demonstrates some idea of appropriate model	Selects appropriate model or theory for the problem	Judgment exceeds expectations when selecting model for problem
2. Understands simplifying assumptions or limitations of the chosen model	Does not demonstrate understanding of simplifying assumptions or limitations	Demonstrates incomplete understanding of simplifying assumptions or limitations	Demonstrates understanding of simplifying assumptions or limitations	Demonstrates particularly thorough understanding of limitations of model
3. Implements theory, model or governing equation correctly to perform analysis	Is unable to implement theory or model to perform analysis	Begins analysis but is unable to see it to completion	Implements theory or model correctly to perform analysis	Implements theory or model to perform analysis in a way that exceeds expectations

Summary of results:

		Number of Students Achieving this Level				
PI	**Assessment method**	**Poor (1)**	**Developing (2)**	**Satisfactory (3)**	**Excellent (4)**	**% Students scoring 3 or 4**
1	Exam, Q2	0	2	4	2	75%
2	Final, Q1	0	1	3	4	88%
3	Project	0	2	5	1	75%

Direct Assessment Action:

PIs 1 and 2 involved assessment of exam questions. For PI3, students were assigned one of three design problems where they were asked to model boundary layer flow. They worked in groups of two. Their project reports were assessed.

Comments and Proposed Improvement:

Outcome 1: an ability to use in-depth methods of analysis				
Performance Indicator	**Poor**	**Developing**	**Satisfactory**	**Excellent**
1. Identifies appropriate tools for a given task	Does not demonstrate understanding of appropriate tools for a given task	Demonstrates limited understanding of appropriate tools for a given task	Demonstrates satisfactory understanding of appropriate tools for a given task	Demonstrates exceptional understanding of appropriate tools for a given task
2. Understands advantages and disadvantages of the chosen tool in relation to possible choices	Cannot describe advantages and disadvantages of a particular tool, or description is incorrect	Can provide limited description of advantages and disadvantages of a particular tool	Can provide satisfactory description of advantages and disadvantages of a particular tool	Provides exemplary description of advantages and disadvantages of a particular tool
3. Utilizes the tool using correct technique	Is unable to utilize the tool using correct technique	Ability to utilize the tool is limited	Utilizes the tool in a satisfactory manner	Demonstrates exceptional mastery of the correct technique for using the tool
4. Assesses the validity of the results of the analysis	Is unable to assess the validity of the results	Makes limited attempts to assess the validity of the results	Assesses the validity of the results in a satisfactory manner	Assesses the validity of the results in an exceptional manner

Outcome 2: an ability to demonstrate graduate-level mechanical engineering theory				
Performance Indicator	**Poor**	**Developing**	**Satisfactory**	**Excellent**
1. Selects appropriate theory, model or governing equation	Does not demonstrate understanding of appropriate model	Demonstrates some idea of appropriate model	Selects appropriate model or theory for the problem	Judgment exceeds expectations when selecting model for problem
2. Understands simplifying assumptions or limitations of the chosen model	Does not demonstrate understanding of simplifying assumptions or limitations	Demonstrates incomplete understanding of simplifying assumptions or limitations	Demonstrates understanding of simplifying assumptions or limitations	Demonstrates particularly thorough understanding of limitations of model
3. Implements theory, model or governing equation correctly to perform analysis	Is unable to implement theory or model to perform analysis	Begins analysis but is unable to see it to completion	Implements theory or model correctly to perform analysis	Implements theory or model to perform analysis in a way that exceeds expectations

Outcome 3: an ability to conduct advanced mechanical engineering research and applications				
Performance Indicator	**Poor**	**Developing**	**Satisfactory**	**Excellent**
1. Demonstrates an understanding of the problem statement	Does not demonstrate understanding of the problem	Demonstrates limited understanding of the problem	Can explain the problem statement in a satisfactory manner	Demonstrates exceptional insight into the problem statement
2. Explains work in the context of current state of the art using a variety of references	Limited or no effort to explain work in context of current state of the art	Attempts to explain work in context of current state of the art but is unsuccessful	Explains work in context of current state of the art in a satisfactory manner	Demonstrates exceptional understanding of work in context of current state of the art
3. Provides appropriate analysis of elements of the solution	In unable to provide analysis of the problem	Provides limited analysis of the problem or aspects of the problem	Provides satisfactory analysis of the problem	Provides analysis of the problem which exceeds expectations
4. Assesses validity of solution based on mathematical\engineering insight	Makes no attempt to validate the solution/validation method incorrect	Makes limited attempts to validate the solution	Assesses the validity of the solution using an appropriate technique	Uses multiple techniques to assess validity of solution

Outcome 4: an ability to apply graduate-level engineering theory to the design of mechanical engineering systems				
Performance Indicator	**Poor**	**Developing**	**Satisfactory**	**Excellent**
1. Produces a reasonable design strategy, including tasks and subtasks, timelines, and evaluation of progress	Does not produce a design strategy, or the design strategy is especially poor	Limited attempts to form a design strategy	Produces a reasonable design strategy appropriate to the project	Produces an exceptional design strategy which exceeds expectations
2. Defines clear specifications and objectives	Does not define specifications or objectives for the problem	Attempts to define specifications or objectives, but they are unclear	Defines clear specifications and objectives appropriate to the project	Defines exceptionally clear specifications and objectives
3. Creates a final product for evaluation	Does not create a final product, or the final product is especially poor	Makes a start on a final product but is unable to meet final specifications	Creates a satisfactory final product which meets defined specifications	Creates an exceptional final product which exceeds expectations
4. Evaluates aspects of the design	No evaluation of aspects of design	Limited evaluation of design	Satisfactory evaluation of design	Exemplary evaluation of design

Outcome 5: an ability to work effectively within the professional framework of organizations responsible for the practice of engineering				
Performance Indicator	**Poor**	**Developing**	**Satisfactory**	**Excellent**
1. Communicates with committee and other colleagues in a clear, professional and timely manner	Does not communicate, or communicates sporadically and/or unprofessionally	Attempts at professional communication are uneven	Communicates to a satisfactory level	Demonstrates exceptional effort at communication
2. Offers and accepts constructive criticism	Ignores or takes offense to constructive criticism; offers criticism unconstructively	Limited ability to accept criticism; limited ability to offer constructive criticism	Offers and accepts constructive criticism	Exceeds expectations when offering and accepting constructive criticism
3. Participates in a community of professionals	Does not interface with other professionals	Limited participation in a community of professionals	Participates in professional development/ networking activities	Exceptional level of participation in community of professionals

APPENDIX B: EXIT SURVEY

Measure Description:

The Graduate Exit Survey is given to students about to receive their MSME degrees. This survey is a form of indirect assessment which asks students to rate both their own understanding of the student outcomes and the quality of the MSME program at delivering these Outcomes.

Factors that affect the collected data:

- Clarity of survey questions
- Student bias in answering survey questions
- Differing student perception of the terms “Poor,” “Fair,” “Good,” “Excellent,” and “Outstanding”

How to interpret the data:

As an indirect assessment method, self-assessment by students arguably not as accurate a method of outcomes assessment as direct evaluation of student work. However, there is value in collecting feedback from students who have completed the degree program and are able to comment on the program in its entirety. It is valuable to ascertain whether a gap exists between student performance/preparedness and student perception of performance/preparedness. The data will be analyzed to show which aspects of the curriculum the students identify as having only a “Poor,” “Fair” or “Good” understanding of. Improvements in those areas can then be discussed.

APPENDIX C: COMPREHENSIVE EXAM

Measure Description:

This measure uses student performance on comprehensive written or oral exam required for completion of the MSME degree. Project and thesis students take an oral exam as part of their defense, and non-thesis students may opt for a written exam instead of a project. Comprehensive exams are set by each student's graduate committee according to his or her specific areas of study.

Factors that affect the collected data:

- Clarity of the questions from different committee members.
- Student motivation.
- Committee member bias in evaluating results.
- The fact that each student will have a different committee.

How to interpret the data:

Committee members will assess student performance on the appropriate outcomes using rubrics similar to those presented in Appendix A (Direct CLA) on a scale of "Excellent," "Satisfactory," "Developing," or "Unsatisfactory." This data will be used to suggest the effectiveness of the MSME degree program, in this case the coursework combined with committee advising.

APPENDIX D: THESIS OR PROJECT

Measure Description:

This measure examines student performance on written report and oral presentation associated with the student's thesis or project. Assessment of both the written report and oral presentation are completed by the student's graduate committee.

Factors that affect the collected data:

- Clarity of the questions from different committee members.
- Student motivation.
- Committee member bias in evaluating results.
- The fact that each student will have a different committee.

How to interpret the data:

Committee members will assess both the written report and the oral presentation on the appropriate outcomes using rubrics similar to those presented in Appendix A (Direct CLA) on a scale of "Excellent," "Satisfactory," "Developing," or "Unsatisfactory." This data will be used to suggest the effectiveness of the MSME degree program, in this case the coursework combined with committee advising.