**Department of Mechanical Engineering**

Lyles College of Engineering

California State University Fresno

**Master of Science in Engineering: Mechanical Engineering Option (MSE-ME)**

**Student Outcome Assessment Plan (SOAP)**

2021-22

Prepared by

**Sankha Banerjee, Ph.D.**

**Contents Page**

Mission Statement and Program Objectives 2

Program Goals 2

Student Learning Outcomes 3

Relationship between Program Goals and Student Learning Outcomes 4

Relationship between Student Learning Outcomes and MSE-ME Courses 5

Assessment Methods 6

Graduate Project/Thesis Assessment Form 8

Evaluation of Oral Presentation 9

Graduate Student Feedback and Exit Survey

Appendix A - Student Learning Outcome Rubrics to Assess Student Performance in the Culminating Experience

**Mission Statement and Program Objectives**

The mission of the MSE-ME program at California State University, Fresno is to educate engineers who, entrusted by society, will create a sustainable world and enhance the quality of life during the 21st century as engineering professionals. The MSE-ME program provides advanced engineering education in Mechanical Engineering to resident students as well as practicing engineers working in the industry and government surrounding the Fresno metropolitan area. Graduates of this program should be able to advance their careers and work on complex engineering problems dictated by continuing advances in technology. Additionally, the program seeks to prepare graduates for advanced research and engineering applications to fulfill the technical needs of the region and beyond.

**Program Goals**

The MSE-ME program builds on a previously acquired foundation in basic science, mathematics, engineering, and mechanical engineering to advance skills in research and applied engineering. The objectives of the MSE-ME program are to enhance the student’s ability to be successful and advance in their chosen careers in industry, academia, and government/public institutions. The MSE-ME program prepares graduates for today’s technology-driven careers with the following program goals:

* To enhance understanding beyond the undergraduate level, of the scientific principles involved in the practice of mechanical engineering
* To reinforce proficiency in the methodologies of design in mechanical engineering
* To increase competency in using advanced techniques, and related tools as applied to mechanical engineering
* To improve written, oral, and graphical communication skills including public speaking
* To develop creative thinking skills required in understanding and solving complex engineering problems
* To acquire and demonstrate a sufficient depth of knowledge in a substantive area of mechanical engineering
* To enhance analytical skills by developing a deeper understanding of major theoretical and practical concepts
* To increase competence for solving practical yet increasingly complex discipline-specific engineering problems

These program goals are consistent with the existing components of the mission and vision of California State University, Fresno.

Mechanical engineering is the use of basic science in the design and manufacture of components and systems. This requires the application of physical and mechanical principles in the development of machines, energy conversion systems, materials, and equipment for measurement and control. Knowledge of mathematics, physics, and chemistry lies at the core of this field. The application of this knowledge uses engineering technology -- a disciplined way of thinking, modeling, and testing that enables the development of new systems despite incomplete information and uncertainty.

The MSE-ME program in mechanical engineering provide advanced studies in design, advanced materials, alternative energy and sustainable systems, engineering mechanics, mechatronics and controls and thermo-fluids. All areas include statics, dynamics, materials, fluid mechanics, thermodynamics, and experimental methods. Application areas in design include mechanics of materials, applied mechanics, structural and manufacturing aspects of producing equipment, and vibrations. Application areas in thermal and fluid mechanics focus on energy conversion and include combustion, heat engines, refrigeration, and fluid flow.

**Student Learning Outcomes**

Students graduating in the MSE-ME program will be able to:

* To develop the students' advanced analytical skills by developing an in-depth understanding of major theoretical and practical mechanical engineering concepts
* To develop students' written and oral communication skills applied to technical areas
* To achieve an appropriate level of competence by the students in solving practical mechanical engineering problems
* To develop students' critical and creative thinking skills in mastering new topics required to understand and solve complex mechanical engineering problems
* To allow the students to demonstrate a sufficient depth of knowledge in a substantive area of mechanical engineering to pursue advanced academic or industrial work

Institutional learning outcomes (ILOs), Program learning outcomes (PLOs) and Student learning outcomes (SLOs)

Institutional Learning Outcomes (ILOs) at Fresno State:

1. Developing a foundational, broad and integrative knowledge
2. Acquiring specialized knowledge
3. Improving intellectual skills
4. Applying knowledge
5. Exemplifying equity, ethics, and engagement

**Relationship between Program Goals and Student Learning Outcomes**

**Table 1. Relationship between program goals and student learning outcomes**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | **Student Learning Outcomes** | | | | |
| **Program Goals** | **Outcome 1** | **Outcome 2** | **Outcome 3** | **Outcome 4** | **Outcome 5** |
|  | To develop the students' advanced analytical skills by developing an in-depth understanding of major theoretical and practical mechanical engineering concepts | To develop students' written and oral communication skills applied to technical areas | To achieve an appropriate level of competence by the students in solving practical mechanical engineering problems | To develop students' critical and creative thinking skills in mastering new topics required to understand and solve complex mechanical engineering problems | To allow the students to demonstrate a sufficient depth of knowledge in a substantive area of mechanical engineering to pursue advanced academic or industrial work |
| To enhance understanding beyond the undergraduate level, of the scientific principles involved in the practice of mechanical engineering | **X** | **X** | **X** |  | **X** |
| To reinforce proficiency in the methodologies of design in mechanical engineering | **X** |  | **X** |  |  |
| To increase competency in using advanced techniques, and related tools as applied to mechanical engineering | **X** |  | **X** |  | **X** |
| To improve written, oral, graphical communication skills including public speaking |  | **X** |  |  |  |
| To develop creative thinking skills required in understanding and solving complex engineering problems |  |  |  | **X** |  |
| To acquire and demonstrate a sufficient depth of knowledge in a substantive area of mechanical engineering | **X** |  | **X** |  | **X** |
| To enhance analytical skills by developing a deeper understanding of major theoretical and practical concepts |  |  | **X** |  |  |
| To increase competence for solving practical yet increasingly complex discipline-specific engineering problems | **X** |  | **X** | **X** | **X** |

**Relationship between Student Learning Outcomes and MSE-ME Courses**

**Table 2. Relationship between Student Learning Outcomes and MSE-ME Courses**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | **Student Learning Outcomes** | | | | |
|  | **Outcome 1** | **Outcome 2** | **Outcome 3** | **Outcome 4** | **Outcome 5** |
| **ENGR 200 Seminar in Engineering** |  | **H** |  | **H** |  |
| **ENGR 202 Applied Engineering Analysis** | **H** |  |  |  | **H** |
| **ENGR 205 Computing in Engineering Analysis** |  |  |  |  |  |
| **ME 211 Advanced Dynamics** |  |  |  |  |  |
| **ME 215 Design Optimization of Engineering Systems** | **H** |  |  |  | **H** |
| **ME 221 Incompressible Fluids** |  |  |  |  | **M** |
| **ME 225 Heat Transfer** | **H** |  |  |  | **M** |
| **ME 227 Advanced Thermodynamics** | **H** |  |  |  | **M** |
| **ME 241 Structural Analysis** |  |  |  |  | **M** |
| **ME 220 Compressible Fluids** | **H** |  |  |  |  |
| **ME 229 Advanced Gas Dynamics** | **H** |  |  | **M** | **M** |
| **ME 232 Advanced Aircraft Stability and Control** | **H** |  |  | **M** | **M** |
| **ME 243 Structural Dynamics** | **H** |  |  | **M** | **M** |
| **ME 251 Smart Materials** | **H** |  |  | **M** | **M** |
| **ME 290 Independent Study** |  |  | **M** | **H** |  |
| **ME 291T Topics in Mechanical Engineering** |  |  | **M** | **H** |  |
| **ME 298 Project** |  | **M** | **H** | **H** |  |
| **ME 299 Thesis** |  | **M** | **H** | **H** |  |

**Notes: H = High, M = Medium, L = Low**

**Assessment Methods**

The assessment of student learning outcomes is achieved through the formative instrument to measure students’ progress while going through the program and with summative instruments to measure the students’ level of achievement at the end of the program and after graduation by using alumni surveys. The assessment activities include:

**Direct Measures:**

1. **Students’ grades in specific MSE-ME courses (formative)**
2. **Students’ performance in writing and in oral presentations in ENGR 200 (formative)**
3. **Students’ performance in the culminating experience (summative)**

**Indirect Measures:**

1. **Exit Surveys conducted each semester (summative)**
2. **Alumni Surveys conducted annually (summative)**

**Students’ grades in specific MSE-ME courses** – Table 2 shows the relationship between student learning outcomes and MSE-ME courses. Students graduating from the MSE-ME program will have a level of preparation that is unique to the individual area of concentration and thus not all MSE-ME students will take the assessment courses. The following table indicates which courses are used for assessment. The assessment activity is conducted each time the particular course is taught. Since all these courses are offered either, once a year or once every three semesters, the aggregate of student results is used for assessment.

Table 2. Courses to be used for formative assessment

|  |  |
| --- | --- |
| Course | Mechanical Engineering |
| ENGR 200 Seminar in Engineering | X |
| ENGR 202/ME 202 Applied Engineering Analysis | X |
| ENGR 205 Computing in Engineering Analysis | X |
| ME 211 Advanced Dynamics | X |
| ME 215 Design Optimization of Engineering Systems | X |
| ME 221 Incompressible Fluids | X |
| ME 225 Heat Transfer | X |
| ME 227 Advanced Thermodynamics | X |
| ME 241 Structural Analysis | X |
| ME290 Independent Study | X |
| ME 291 Topics in Mechanical Engineering | X |

**Students’ performance in writing and in oral presentations** – The ENGR 200 Seminar in Engineering has to be completed by all MSE-ME students to be advanced to candidacy. The course has a strong component related to communication skills, in writing, graphical, and oral presentations. Among the several outcomes of the course, the two main outcomes are to prepare the MSE-ME graduate students to undertake the culminating experience in the form of a masters project or thesis (if applicable), and to develop their communication skills. Students in this course are graded for their general performance in the course and graded separately for their writing competency. A student may pass the course satisfactorily but not in the writing component. In that case, the student is allowed to pursue the completion of the writing requirements independently from the course and in collaboration with their graduate advisor. The overall grade of all the students in the class and the average grade of the class in the writing components are used for assessment purposes. The rubrics to assess the writing component are given in the syllabus of the ENGR 200 course. Assessment is conducted each time the course ENGR 200 is taught (at least once a year).

**Students’ performance in the culminating experience** – Although the MSE-ME program offers three plans to complete the program, namely Plan A – thesis, Plan B – project, and Plan C – comprehensive exam, the graduate faculty emphasizes plans A and B. The comprehensive exam required in Plan C is allowed only in special circumstances where a particular student has time constraints (e.g. full-time job) that create difficulty in pursuing independent research.

All students following plans A and B are required to make an oral presentation/defense of their independent project or thesis work and submit a final report. Both the oral presentation and the final report are used for a general assessment of the program outcomes. The program outcomes and assessment rubrics are shown in Appendix A.

**Graduate Thesis/Project Assessment Form**

**Master of Science in Mechanical Engineering**

To be completed by faculty members attending the project/thesis presentation

Student Name \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Date of Presentation \_\_\_\_\_\_\_\_\_\_\_\_

Thesis or Project Title \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**On a scale of 1 to 5, rate the following skills (1 for poor and 5 for excellent)**

**Oral Communication and quality of slides:**

Clarity of pronunciation \_\_\_\_ Eye Contact \_\_\_\_ Ability to express ideas \_\_\_\_

Ability of answer questions \_\_\_\_ Clarity of Slides \_\_\_\_ Organization \_\_\_\_

Additional Comments \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Technical Content:**

Clarity of methodology \_\_\_ Use of engineering tools \_\_\_\_

Use of scientific tools \_\_\_\_\_

Soundness of argument \_\_\_\_ Significance of conclusions \_\_\_\_

Suitability of work for a graduate level thesis/project \_\_\_\_

Additional Comments \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Written Report:**

Organization \_\_\_\_ Sentence structure \_\_\_\_

Spelling and/or grammar \_\_\_\_

Transition of paragraphs \_\_\_\_ Literature search and use of references \_\_\_\_

Additional Comments \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Overall Recommendation:**

Pass with no corrections or revisions \_\_\_\_ Pass with corrections or revisions \_\_\_\_

Needs major revisions \_\_\_\_

Faculty/Committee Member Name \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Faculty/Committee Signature \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Date \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Evaluation of Oral Presentation**

**Date:\_\_\_\_\_\_\_\_\_\_**

**Title:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**Presenters: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**Title of Presentation (0-3 points) \_\_\_\_\_\_\_\_\_\_\_\_**

**Introduction (0-3 points) \_\_\_\_\_\_\_\_\_\_\_\_**

**Outline of Presentation (0-4 points) \_\_\_\_\_\_\_\_\_\_\_\_**

**Voice**

Clear (0-5 points) \_\_\_\_\_\_\_\_\_\_\_

Loud (0-5 points) \_\_\_\_\_\_\_\_\_\_\_

**Delivery**

Enthusiastic (0-5 points) \_\_\_\_\_\_\_\_\_\_\_

Eye contact with audience (0-5 points) \_\_\_\_\_\_\_\_\_\_\_

**Audiovisual Materials**

Quality and Delivery (0-10 points) \_\_\_\_\_\_\_\_\_\_\_

**Organization and Presentation**

Logical Progression (0-10 points) \_\_\_\_\_\_\_\_\_\_\_

**Contents**

Completeness (0-20 points) \_\_\_\_\_\_\_\_\_\_\_

Technical Content (0-20 points) \_\_\_\_\_\_\_\_\_\_\_

**Timing**

Effective use of time (0-5 points) \_\_\_\_\_\_\_\_\_\_\_

**Questions and Clarification** (0-5 points) \_\_\_\_\_\_\_\_\_\_\_

Comments:

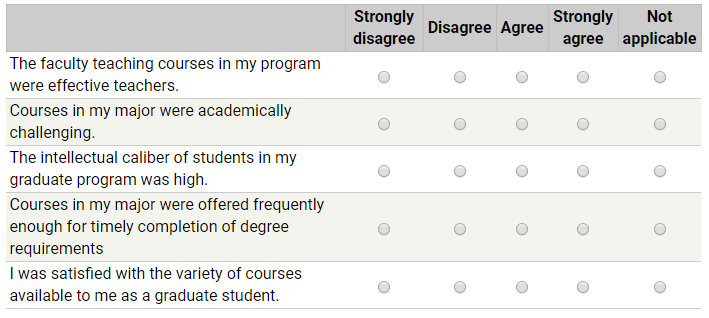
**Total Score: /100**

**Exit Surveys –** All students graduating from the MSE-ME program complete an exit survey. The survey is administered to the graduating students as they complete the program and that may occur either at the end of fall or spring semesters. For students completing a thesis or project in the summer semester, the survey is administered in the spring immediately presiding the graduating summer. The exit survey is shown in the following figure.

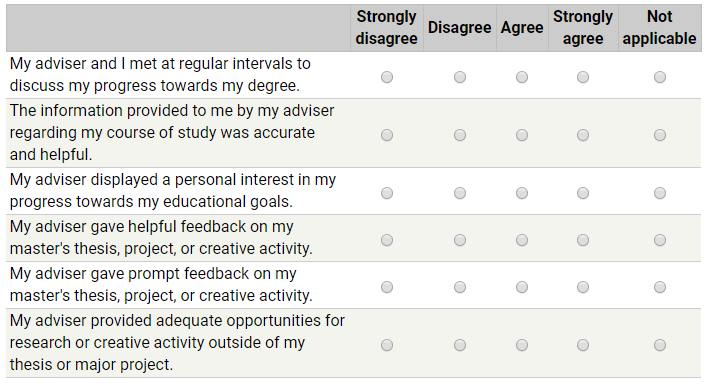
**MSE-ME Program Exit Survey**

**Program Name: Mechanical Engineering, M.S.**

1. Did you receive an undergraduate degree from Fresno State
   1. Yes
   2. No
2. How long did it take you to complete your graduate degree?
   1. 2 years or less
   2. 2 - 3 years
   3. 3 - 4 years
   4. 5 years or more
3. Select your level of agreement for each of the statements about your graduate program below.
4. Courses



1. Graduate Thesis/Project Advisor



1. Graduate Program Coordinator/Advisor

****

1. Summary

Please rate the overall quality of the following components of your graduate program.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Excellent** | **Good** | **Fair** | **Poor** |
| **Courses** |  |  |  |  |
| **Graduate Faculty** |  |  |  |  |
| **Instruction in graduate classes** |  |  |  |  |
| **Graduate Thesis/Project Advisor** |  |  |  |  |
| **Graduate Program Coordinator/Advisor** |  |  |  |  |
| **Research Labs/Infrastructure at Fresno State** |  |  |  |  |
| **Technology and Library Services** |  |  |  |  |

1. Please use the space below to share any recommendations you might have to improve graduate program in MS in Engineering ME Option or to make any additional comments.
2. What are your plans after graduation?

Note: Please leave your personal email with Ms. Ann Berg and/or the Graduate Coordinator for future communications.

**Alumni Survey -** Alumni survey are conducted from MSE-ME alumni on a regular basis but they are compiled and analyzed at the end of the academic year every two years. The survey instrument is shown here.

**Alumni Survey**

**MSE-ME Program**

1. When did you complete your MSE-ME program (month/year)? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

2. Current Job Title \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

3. Current Employer \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

4. In what sector do you work?

Industry \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Government \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Education \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Private Practice/Consulting

Other \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

5. Indicate your present employment status

Full time \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Part Time \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Full time Graduate Student \_\_\_\_\_\_\_\_\_\_\_\_\_

Unemployed \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Other \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

6. Please rank your professional success

Very Successful \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Successful \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Average \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Unsuccessful \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

7. How do you rate the quality of the your educational preparation through the MSE-ME program?

Higher than average \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Average \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Lower than Average \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

8. Use the following scale to rate the items in the MSE-ME Program

1 – weak, 2 – satisfactory, 3 – strong, 4 – very strong

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | 1 | 2 | 3 | 4 |
| Overall Quality of the MSE-ME program |  |  |  |  |
| Support assistance and general help from the ME department office |  |  |  |  |
| Support assistance and help from the faculty of the program |  |  |  |  |
| Preparation in handling professional tasks at the time you completed the MSE-ME program |  |  |  |  |
| Confidence in preparation for professional tasks now |  |  |  |  |

9. What changes do you foresee in the profession in the future and how can the MSE-ME program address those issues?

**\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

10. Please identify the areas in MSE-ME that contributed the **MOST** to your professional development.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

10. Please identify the areas in MSE-ME that contributed the **LEAST** to your professional development.

**\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**Appendix A**

Student Learning Outcome Rubrics to Assess Student Performance in the Culminating Experience

**Student Learning Outcomes 1 and 3**

Outcome 1: To develop the students' advanced analytical skills by developing an in-depth understanding of major theoretical and practical mechanical engineering concepts

Outcome 3: To achieve an appropriate level of competence by the students in solving practical mechanical engineering problems

|  |  |  |  |
| --- | --- | --- | --- |
|  | Mastered - 3 | Developed -2 | Introduced -1 |
| Representing advanced analytical skills and information. | The student is able to represent mechanical engineering information/concepts accurately without making any errors. | The student is able to represent mechanical engineering information/concepts without making any significant errors. | The student is NOT able to represent information/concepts without making significant errors. |
| Explaining advanced analytical methods and mechanical engineering problems. | The student has an in-depth understanding of information and is able to successfully explain its meaning. | The student has a competent understanding of information and adequately explains its meaning. | The student has a poor understanding of information and unsuccessfully attempts to explain the information’s meaning. |

**Student Learning Outcomes 2 and 4**

Outcome 2: To develop students' written and oral communication skills applied to technical areas.

Outcome 4: To develop students' critical and creative thinking skills in mastering new topics required to understand and solve complex mechanical engineering problems.

|  |  |  |  |
| --- | --- | --- | --- |
|  | Mastered - 3 | Developed -2 | Introduced -1 |
| Develop written and oral communication skills | The student gives a thorough and detailed explanation of advanced mechanical engineering principle(s) using written and oral communication. | The student gives an adequate explanation of advanced mechanical engineering principle(s) using written and oral communication. | The student does NOT give an adequate explanation of advanced mechanical engineering principle(s) using written and oral communication. |
| Develop creative thinking skills in mastering new topics | The student develops and applies creative thinking skills by accurately designing a solution or accurately drawing conclusions on a new topic in mechanical engineering. Discussion of results or conclusions are very detailed. | The student develops and applies creative thinking skills by accurately designing a solution or accurately drawing conclusions on a new topic in mechanical engineering. The discussion is not very detailed. | Students do NOT successfully develop and/or apply creative thinking skills and thus their results or conclusions are partly correct or incorrect. |

**Student Learning Outcome 5**

Outcome 5: To allow the students to demonstrate a sufficient depth of knowledge in a substantive area of mechanical engineering to pursue advanced academic or industrial work

|  |  |  |  |
| --- | --- | --- | --- |
|  | Mastered - 3 | Developed -2 | Introduced -1 |
| Develop and demonstrate advanced knowledge in a substantive area of mechanical engineering | The student demonstrates a thorough and detailed understanding of advanced mechanical engineering principle(s). | The student gives an adequate explanation of advanced mechanical engineering principle(s). | The student does NOT give an adequate explanation of advanced mechanical engineering principle(s). |