5. **Program Effectiveness – Outcomes Assessment**

5.1 **Learning outcomes assessment procedures**

The program learning outcomes for the MSE program are divided by degree discipline. It is expected that students who wish to continue on in their studies will build upon the knowledge they have already received in the lower level degrees.

**Graduates of Materials Science and Engineering BS program are expected to:**
- Contribute to their chosen Materials Science and Engineering related professions and be successful in their careers.
- Continue to expand their knowledge of Materials Science and Engineering through continued education, and learning, and seek opportunities for growth and leadership.
- Exercise professional responsibility in dealing with a broad range of global issues that promotes the well-being of society.

**Undergraduate Student Outcomes**
- Students will have an ability to apply mathematical, scientific, and engineering knowledge to solve materials related problems.
- Students will have an ability to design and conduct experiments, characterize materials, and properly interpret data in order to understand materials behavior.
- Students will have an ability to select or design a materials based system, component, or process to meet desired needs within realistic constraints, such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.
- Students will have an ability to function on teams whose members have interdependent and complementary skills.
- Students will have an ability to identify, formulate, and solve materials-related problems, and understand the structure, properties, processing, and performance of materials.
- Students will have an understanding of professional and ethical responsibility for engineering.
- Students will have an ability to communicate technical information effectively in oral and written form.
- Students will have an ability to acquire a broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal issues.
- Students will have a recognition of the need for, and an ability to engage in life-long learning.
• Students will have an awareness and understanding of current trends and materials application that affect the materials science and engineering profession.
• Students will have an ability to use the techniques, skills, and modern engineering tools necessary in materials engineering practices.

By the time of graduation, MS non-thesis students in Materials Science and Engineering are expected to demonstrate:
1. Understanding of core Materials Science and Engineering topics at the level that clearly exceeds undergraduate expectations.
2. Effective oral and written technical communication skills.

By the time of graduation, MS thesis students in Materials Science and Engineering are expected to demonstrate:
1. Understanding of their selected area of research at a level that clearly exceeds undergraduate expectations.
2. Ability to conduct supervised research and make personal contributions towards the solution of posed problems.
3. Effective technical communication skills.
4. Ability to contribute to technical reports and peer-reviewed papers.

By the time of graduation, PhD students in Materials Science and Engineering are expected to demonstrate:
1. Expertise in their selected area of Materials Science and Engineering research that equals that of their advisor or members of their supervisory committee.
2. Ability to conduct independent research and be responsible for the execution and conclusion of the research.
3. Contributions to the selected areas of Materials Science and Engineering research as evidenced by the publication of at least two peer-reviewed papers in archival journal or conference proceedings.
4. Ability to effectively communicate the results of their research.

It is the responsibility of the individual faculty teaching their respective courses to periodically review the content of the course material and make changes accordingly to stay current with new trends. This is especially true of graduate courses. During fall semester 2017, the department developed 3 new special topics courses not previously offered. In addition, the department is in the process of developing an internship program, where students can receive up to 3 credit hours for internships completed in the department’s Materials Characterization Lab or in industry. Faculty are encouraged to develop Special Topic courses that emphasis their current research trends. In most
cases, these Special Topic Courses are then reviewed by the MSE Curriculum Committee for approval, after being taught at least once, and then are forwarded to the Department Chair for final approval to be added to the MSE graduate curriculum. Other graduate courses that were developed and are no longer meeting the needs of the current research trend are dropped from the graduate curriculum.

Description of outcomes assessment procedures for the MSE Department as outlined in the following areas:

a) Student Information

Recruitment – In the MSE undergraduate program, the outreach involvement with local high schools has resulted in an increased enrollment in the program due to the exposure of Materials Science and Engineering. As detailed in Section 4.5, the outreach program has opened the world of Materials Science and Engineering to students and teachers, many of whom were not aware of the MSE program available at the University of Utah.

As mentioned previously, the College of Engineering sponsors a Domestic Graduate Recruitment Weekend available to PhD applicants who are interested in the various engineering departments. MSE faculty are continuously encouraged to make contact with domestic students who would be interested through their various research contacts.

Quality of Students – Any student may be admitted to pre-major status in the MSE undergraduate program by requesting Pre-MSE on their application for admission or applying through the MSE Academic Advisor. This means that potential undergraduate students do not need to apply for admission into the program. The undergraduate students are required to maintain a minimum GPA of 2.3 to continue in the program and receive a least a “C” or better in the prerequisite courses required for upper division classes.

Graduate students are required to apply for admission to the graduate program. The minimum GPA for admission is a 3.0; the minimum GRE score is 300 combined Quantitative and Verbal with a 3.0 or higher on the Analytical Writing section. A minimum TOEFL score of 80 on the internet-based test or 550 on the paper-based test is required for international applicants. Graduate students are required to maintain a minimum GPA of 3.0, which is the requirement of not only the department but the University of Utah as well. All graduate students are also required to receive a “B-“ or better in all graduate level courses. The department maintains rigorous academic standards throughout the duration of the program. As discussed above in Section 4.6, the department recently adopted a new Qualifying
Exams format. The department continues to look for areas of improvement in our program and takes necessary steps to implement such change.

Retention – Scholarships that have been provided to the MSE Department have been an important retention tool for continuing MSE undergraduate students. There are also several scholarships available through the College of Engineering for undergraduate students. The department has a growing amount of scholarship funds available for undergraduate students. The College of Engineering also has available to each department the Wayne Brown Fellowship that is awarded for the first two years of PhD study for domestic students and is subsidized by the receiving departments.

For graduate students, retention is an issue that is controlled by the individual faculty advisors of the graduate students and is based on completion of required courses and continued research as outlined and required by the graduate student’s faculty advisor.

c) Employment and/or Employer Satisfaction Measures

The MSE Industrial Advisory Committee continues to be a great asset to the department by identifying areas of improvement and building local employment connections for our students. The department meets with the committee once a year, where topics such as student preparedness for the workforce and how the department can continue to meet employees’ needs are discussed. Overall, the Industrial Advisory Committee stated that the department’s graduates were equipped and were productive in their positions.

d) Mid-Program Review

Mid-Program Review for undergraduate students is done when students apply for major status. Students are required to meet with the MSE Academic Advisor to be moved from pre-major to major status. Admission to major status is based on performance in the freshman and sophomore-level course work. All courses required for major status must be completed with a grade of “C” or better. Students who do not receive a “C” or better will be required to take the course a second time. Failure to obtain a “C” or better on the second attempt will result in dismissal from the program.

There is no formal mid-point review for graduate students.
e) **End of Program Review**

The end of program review for undergraduate students is twofold. It begins with the completion and successful presentation of the Senior Capstone Design Project. Each student group is required to create a poster and present it at the annual Senior Banquet and Poster Presentation, where they are graded by the faculty for presentation and defense of their Senior Capstone Design Project. The Senior Banquet and Poster Presentation is held every spring semester in April. The written portion of the Senior Capstone Design Project is due the last day of class spring semester. Second, the graduating seniors are required to complete an exit survey. The exit survey is coordinated by the College of Engineering and is a very comprehensive evaluation of all aspects of the undergraduate program.

The end of program review for graduate students is the successful defense of either their MS thesis/project or their PhD dissertation.

5.2 **Outcomes assessment feedback**

Description of outcomes assessment feedback for the MSE Department as outlined in the following areas:

a) **Student Information**

Recruitment – In the MSE undergraduate program, the department has seen an increase in incoming freshman declared as Pre-MSE majors. This indicates that more students are leaving Utah high schools with knowledge about MSE. Between the summer 2016 and 2017 freshman orientation programs, MSE doubled the declared Pre-MSE majors. These results provide a good indication that the department has improved its recruitment efforts since the last review.

Regarding the Domestic Graduate Recruitment Weekend, the department is unable at this time to assess whether this effort makes an impact on our domestic student recruitment. The department is continuing to look for new ways to improve graduate recruitment.

Quality of Students – The MSE department continues to receive and graduate high quality students. Students are required to pass pre-major classes with a “C” grade or better, and should any student fail to maintain this standard, they will not be granted major status. This means the department is able to evaluate which students are most likely to be successful in the major. The quality of students who do reach major status and thus graduate from the department have proven throughout their
In a similar manner, the quality of graduate students is also maintained through high admissions standards and rigorous program milestones. At this time, there is no measurable feedback about the updated Qualifying Exam.

Retention – The department identifies scholarship and fellowship opportunities as a valuable tool in undergraduate and graduate student retention. Each year, the department and College of Engineering seek to reconnect with alumni to increase scholarship donations. During the 2016-17 academic year, the department awarded $48,000 in undergraduate scholarships. An additional $7,700 was awarded the following academic year with a total of $55,700 in scholarship funds given in 2017-2018. This included fellowship funds awarded to an outstanding graduate student.

b) Employment and/or Employer Satisfaction Measures

There is no measurable feedback at this time to identify the success of the MSE Industrial Advisory Committee’s assessment.

c) Mid-Program Review

As discussed, the mid-program review for students between pre-major to major status allows the department to determine whether students will be successful in advanced engineering classes. As a result, students are better prepared for the rigors of the program and will successfully graduate.

d) End of Program Review

The Senior Capstone Design Project is assessed through ABET, which provides any feedback for improvement. ABET sets the standards for the department’s design projects, and MSE is constantly working to implement any improvements received from our accreditation board. Individual projects are evaluated every year and adjustments are made to enhance their quality. Through student and faculty feedback, the department continues to make updates to the design process and experience.

We receive no feedback assessment from graduate students who complete their thesis/dissertation.
5.3 Degree completion data

See Table 5.1 for graduate degree completion/attrition data.

Table 5.1: Graduate Degree Completion/Attrition Data
Department of Materials Science and Engineering 2010-2017

<table>
<thead>
<tr>
<th>Entering Student Cohort Academic Year</th>
<th>Number of students newly enrolled in master’s program</th>
<th>Number of students newly enrolled in doctoral program</th>
<th>Number of students in cohort who left before completing master’s degree</th>
<th>Number of students in cohort who completed master’s degree</th>
<th>Number of students in cohort who left before completing doctoral degree</th>
<th>Number of students in cohort who completed doctoral degree</th>
<th>Average time to complete master’s degree (semesters)</th>
<th>Average time to complete doctoral degree (semesters)</th>
<th>Number of students in cohort remaining in graduate programs</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010-11</td>
<td>5</td>
<td>11</td>
<td>0</td>
<td>5</td>
<td>4</td>
<td>7</td>
<td>2</td>
<td>10</td>
<td>0</td>
</tr>
<tr>
<td>2011-12</td>
<td>0</td>
<td>5</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>4</td>
<td>NA</td>
<td>11</td>
<td>0</td>
</tr>
<tr>
<td>2012-13</td>
<td>0</td>
<td>4</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>NA</td>
<td>11</td>
<td>3</td>
</tr>
<tr>
<td>2013-14</td>
<td>0</td>
<td>6</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>NA</td>
<td>NA</td>
<td>4</td>
</tr>
<tr>
<td>2014-15</td>
<td>3</td>
<td>8</td>
<td>0</td>
<td>3</td>
<td>2</td>
<td>0</td>
<td>4</td>
<td>NA</td>
<td>6</td>
</tr>
<tr>
<td>2015-16</td>
<td>4</td>
<td>3</td>
<td>0</td>
<td>4</td>
<td>1</td>
<td>0</td>
<td>3</td>
<td>NA</td>
<td>2</td>
</tr>
<tr>
<td>2016-17</td>
<td>2</td>
<td>3</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td>NA</td>
<td>3</td>
</tr>
</tbody>
</table>

5.4 Employment

Undergraduate students

Each graduating senior class is required to complete an exit survey in which students are surveyed on employment information. In the past, exit surveys were paper based and tracked by the department’s Academic Advisor. During the 2016-17 academic year, the exit survey was converted to an electronic form with the help of the College of Engineering Dean’s Office. Students receive the exit survey the second to last week in April and have until the end of the spring semester to complete it. The employment data
captured is for students in their last semester of the MSE program. At the time of the survey, students indicated the following organizations as current or future employers: 2-GO Manufacturing, MOOG Medical Devices Group, ECME LCC, and Fisher Co. Employment data beyond the exit survey is difficult to track and primarily managed by the College of Engineering and the University of Utah Alumni Association. See Table 5.2 for undergraduate employment data.

Graduate Students

Since many of the graduate students are international students and return to their native countries after graduation it has been difficult to track postdoctoral appointments or employment placement.

Table 5.2: Undergraduate Employment Data
Department of Materials Science and Engineering 2016-2017

<table>
<thead>
<tr>
<th>Questions</th>
<th>Question Responses</th>
<th>Number of Responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>What is your primary plan after graduation?</td>
<td>Employment full-time (including entrepreneurship &amp; freelance)</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>Planning to continue my education</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Employment part-time (including entrepreneurship &amp; freelance)</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>No Response</td>
<td>1</td>
</tr>
<tr>
<td>Total Number of Responses</td>
<td>17</td>
<td></td>
</tr>
<tr>
<td>Select the category which BEST describes your employment.</td>
<td>I will begin searching for a position after graduation.</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>I will continue my current employment after graduation.</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>I am currently searching for a job.</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>I am doing freelance work.</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>I have accepted new employment upon completion of my degree.</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>No Response</td>
<td>5</td>
</tr>
<tr>
<td>Total Number of Responses</td>
<td>17</td>
<td></td>
</tr>
</tbody>
</table>