### SJSU Annual Program Assessment Form
#### Academic Year 2015-2016

<table>
<thead>
<tr>
<th>Department: Mechanical Engineering</th>
</tr>
</thead>
<tbody>
<tr>
<td>Program: MSME</td>
</tr>
<tr>
<td>College: Engineering</td>
</tr>
<tr>
<td>Program Website: <a href="http://www.sjsu.edu/me/programs/msme/index.html">http://www.sjsu.edu/me/programs/msme/index.html</a></td>
</tr>
<tr>
<td>Link to Program Learning Outcomes (PLOs) on program website: <a href="http://www.sjsu.edu/me/programs/msme/index.html">http://www.sjsu.edu/me/programs/msme/index.html</a></td>
</tr>
<tr>
<td>Program Accreditation (if any):</td>
</tr>
<tr>
<td>Contact Person and Email: Kathryn Gosselin, <a href="mailto:kathryn.gosselin@sjsu.edu">kathryn.gosselin@sjsu.edu</a></td>
</tr>
<tr>
<td>Date of Report: May 31, 2016</td>
</tr>
</tbody>
</table>

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## Part A

### 1. List of Program Learning Outcomes (PLOs)
Instead of having both Program Educational Outcomes (what graduates are to have accomplished 3-5 years after graduation) and Student Learning Outcomes (skills/knowledge attained by graduation) as in the BSME program, in the MSME program we have only Educational Outcomes, as shown. Graduates shall have

1. A strong foundation beyond the undergraduate level in their chosen focus area as well as in mathematics, basic science and engineering fundamentals, to successfully compete for technical engineering positions in the local, national and global engineering market, advance in their current position or pursue doctoral studies.
2. Contemporary professional and lifelong learning skills to be able to apply theory to solve practical engineering problems.
3. The expertise necessary to perform design and/or analysis of mechanical engineering systems with possible specialization in areas such as: energy systems, electronics cooling, electronics packaging & reliability, finite element analysis, computer-aided design, mechatronics, microelectromechanical systems, product design, robotics, automation & manufacturing.
4. Strong verbal and written communication skills, including the ability to read, write, and comprehend technical documents.
5. Ability to think and work independently to perform design and in-depth analysis in solving open-ended mechanical engineering problems.

As with the BSME PEO’s, these outcomes were developed through numerous faculty discussions and a discussion with our Department Advisory Council. While ABET is only used to accredit undergraduate programs, the SLOs required by ABET were used to inform the development of these MSME Educational
Outcomes. Additional feedback was solicited from our alumni via surveys, as well as from our Department Advisory Council, which discussed this during their recent meeting on April 25, 2016.

Students demonstrate achievement through exams and projects in the two required classes, ME 230 and 273, as well as their culminating experience, as discussed in Section 3. Assessment is also done in one elective, ME 265.

2. **Map of PLOs to University Learning Goals (ULGs)**

Table 1 shows the relationship between the Educational Outcomes and the University Learning Goals. The map shows good coverage of four of the five ULG’s. The last goal, related to social and global responsibility, is not explicitly covered in the Educational Outcomes. However, good design is not done in a vacuum and must address social and/or global needs. The department may consider re-writing the Educational Outcomes to explicitly consider global and social responsibility.

<table>
<thead>
<tr>
<th>University Learning Goal</th>
<th>Outcome 1</th>
<th>Outcome 2</th>
<th>Outcome 3</th>
<th>Outcome 4</th>
<th>Outcome 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Specialized Knowledge</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Broad Integrative Knowledge</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Intellectual Skills</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Applied Knowledge</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Social/Global Responsibilities</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>✔</td>
</tr>
</tbody>
</table>

3. **Alignment – Matrix of PLOs to Courses**

Table 2 provides a map of Educational Outcomes to our required courses. ME 230 and ME 273 are required courses, so all students will be assessed in areas 1, 2, 3, and 5 through those two classes. ME 265 satisfies the university Graduate Writing Assessment Requirement (GWAR), and it is anticipated that many students will choose this option. However some may elect Engr 200W or be exempt by virtue of completing a 100W course as an undergraduate at any of the CSU campuses.

For their culminating experience, students take either the comprehensive exam or six units of MS project or thesis (ME 295/299). The comprehensive exam was instituted in Spring 2014; however, it is being suspended effective Spring 2017, and all students will be required to complete an MS project or thesis and will automatically be assessed in all PLO’s.

<table>
<thead>
<tr>
<th>Program Learning Outcomes</th>
<th>ME 230</th>
<th>ME 273</th>
<th>ME 295/299</th>
<th>ME 265</th>
<th>Comprehensive Exam</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Technical Foundation</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td></td>
<td>✔</td>
</tr>
<tr>
<td>2. Lifelong Learning Skills</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Specialized Expertise</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Communication Skills</td>
<td></td>
<td></td>
<td>✔</td>
<td>✔</td>
<td></td>
</tr>
<tr>
<td>5. Independence in Discipline</td>
<td>✔</td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

4. **Planning – Assessment Schedule**

Assessment data for each learning outcomes will be acquired every semester and assessed each spring.
Program improvements will be implemented the following fall.

5. **Student Experience**
   a. How are your PLOs and the ULGs communicated to students, e.g. websites, syllabi, promotional material, etc.? The MSME Educational Outcomes are included on our department website. Students have some knowledge of outcomes, but they are not included on most syllabi, and discussions are occasional, largely limited to the MS project/thesis courses.

   b. Do students have an opportunity to provide feedback regarding your PLOs and/or the assessment process? If so, please briefly elaborate. Feedback from alumni was incorporated into the development of the outcomes but not current students.

**Part B**

6. **Assessment Data and Results**

   **ME 230: Advanced Mechanical Engineering Analysis**
   Assessment is not performed explicitly in this course. By virtue of ME 230 being a required course, all students must receive a passing grade and fulfill PLO 1 (Technical Foundation) in order to graduate.

   **ME273: Finite Elements Method in Engineering**
   Assessment is not performed explicitly in this course. By virtue of ME 273 being a required course, all students must receive a passing grade and fulfill PLO’s 1, 2, 3, and 5 in order to graduate.

   **ME 299: Master’s Thesis and ME 195A/B: Mechanical Engineering Project I/II**
   During ME 299 or ME 295A/B, students are each required to prepare a thesis or report detailing the methods and results of the research or design project. Students are required to give two presentations on these results, one at the end of each of the two semesters of enrollment in the thesis or project courses. Each student’s performance in 9 areas of assessment is rated on a scale of 1-5 by his/her three committee members. These areas of assessment are aligned with the PEO’s as shown in Table 3, and a sample assessment form is included in Appendix A.

   The results of assessment for the 2015-16 academic year are shown in Table 4. Results within each academic semester have been split into 1st semester (ME 295A or ME 299-1) and 2nd semester (ME 295B or ME 299-2) cohorts. Average student ratings in each area are listed, as well as the percentage of students who scored below acceptable (e.g., rating of less than 3.0) in the given area.
Table 3: Relationship Among Criteria Used for Project/Thesis Assessment and Educational Outcomes

<table>
<thead>
<tr>
<th>Criterion</th>
<th>PEO1 Technical Foundation</th>
<th>PEO2 Lifelong Learning</th>
<th>PEO3 Specialized Expertise</th>
<th>PEO4 Communication Skills</th>
<th>PEO5 Independent Performance</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Motivation for the work was convincing and clear objectives were defined.</td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>2 A thorough literature search was performed with proper citations, and an understanding of the cited literature was clearly evident.</td>
<td></td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>3 A methodical, in-depth analysis and/or design of a mechanical engineering system was performed, using appropriate assumptions as needed.</td>
<td></td>
<td></td>
<td>X</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>4 Mathematical representations and computations were applied appropriately for graduate level work.</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5 Science and engineering fundamentals were applied appropriately for graduate level work.</td>
<td></td>
<td></td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6 Modern tools (computational or experimental) were used effectively as needed.</td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>7 Results of the work were presented effectively, using graphs and tables appropriately as needed.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>8 The report was well written, with correct language and terminology used throughout.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>9 Key points of the work were summarized effectively and meaningful conclusions were drawn.</td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td>X</td>
</tr>
</tbody>
</table>

**Scale:** 1 = Lacking, 2 = Weak, 3 = Acceptable, 4 = Good, 5 = Excellent
Table 4: Summary of MS Project/Thesis Assessment Results (Spring 2016, N=46)

<table>
<thead>
<tr>
<th>Criterion</th>
<th>Fall 2015</th>
<th>Spring 2016</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1st Semester Cohort</td>
<td>2nd Semester Cohort</td>
</tr>
<tr>
<td></td>
<td>(N=11)</td>
<td>(N=4)</td>
</tr>
<tr>
<td>Criterion</td>
<td>Average</td>
<td>% Passed</td>
</tr>
<tr>
<td>1 Motivation and Objectives</td>
<td>3.33</td>
<td>81.82%</td>
</tr>
<tr>
<td>2 Literature Review</td>
<td>4.00</td>
<td>90.91%</td>
</tr>
<tr>
<td>3 Analysis and Design</td>
<td>3.33</td>
<td>54.55%</td>
</tr>
<tr>
<td>4 Applied Math</td>
<td>3.33</td>
<td>90.91%</td>
</tr>
<tr>
<td>5 Science and Engineering</td>
<td>3.67</td>
<td>90.91%</td>
</tr>
<tr>
<td>6 Modern Tools</td>
<td>4.00</td>
<td>100.00%</td>
</tr>
<tr>
<td>7 Presentation of Results</td>
<td>3.33</td>
<td>63.64%</td>
</tr>
<tr>
<td>8 Report Writing</td>
<td>4.00</td>
<td>54.55%</td>
</tr>
<tr>
<td>9 Conclusions</td>
<td>3.33</td>
<td>100.00%</td>
</tr>
</tbody>
</table>

ME 265: Computer-Aided Mechanical Engineering Design

Students in ME 265 are required to complete an individual design project utilizing the techniques learned in the course. This project also includes a written report, the completion of which satisfies the university GWAR. Students are assessed separately on the quality of the writing (PLO 4) and the technical content (PLO’s 2 and 3) of the final report. The rubrics used for assessment are included in Appendix B, and the results from Spring 2016 are shown in Table 5.

Table 5: Summary of ME 265 Assessment Results (Spring 2016, N=46)

<table>
<thead>
<tr>
<th>Writing Assessment</th>
<th>Technical Assessment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average</td>
<td>% Passed</td>
</tr>
<tr>
<td>70.20%</td>
<td>52.17%</td>
</tr>
</tbody>
</table>

7. Analysis

ME 299 and 295A/B

In order to fulfill the MSME Educational Outcomes, students must achieve an average rating of 3 (acceptable), 4 (good), or 5 (excellent) in all areas. An overall program goal of 70% of students being rated acceptable or higher has been set; however, ideally, 100% of students would meet this goal. The group with the greatest percentage of students rated below acceptable was the 1st semester cohort in Fall 2015, which struggled in several areas, including analysis and design, presentation of results, and report writing. Anecdotally, it is not uncommon for students to struggle in the first semester and then make up for lost time/effort during the second semester, which may explain the low scores during the first semester.

Although students seem to be performing well overall, there remains some room for improvement. Additionally, scores can occasionally vary widely among three members of a committee. In similar
undergraduate courses, it was observed that creating a rubric with descriptions for each rating level garnered more consistent assessment results. Thus, the assessment form may be changed in the future to improve uniformity among committee members.

**ME 265**
Students performed well on the technical portion of the project, with an average grade of a B and nearly 90% of the students earning a grade above the performance threshold (70% or higher). However, student performance on the writing portion of the project is much weaker, indicating significant weakness in PLO 4 (Communication Skills). The average grade is just slightly above the performance threshold, and more than half the students in the course received a grade below the threshold. Although some students in this course may later complete ME 295A/B or ME 299 and improve their writing skills, others may choose to take the comprehensive exam and will not receive any further instruction or assessment in communication skills. This is certainly cause for concern.

Additionally, students are not being individually assessed in PLO’s 2 and 3. In the future, perhaps the syllabus will be refined to allow recording of separate assessment for those two outcomes.

**General Analysis**
At this time, it is not clear how well students who take the comprehensive exam are covering outcome 4, as it is unknown how many of those students take ME 265, and further, how many of those who do so achieve an acceptable grade on the writing assessment. While it is unfortunately too late to ensure that all students whose performance was unacceptable in ME 265 in Spring 2016 will have an opportunity to improve their communication skills, as of Spring 2017, all students will be required to complete ME 295A/B or ME 299 and be assessed during completion of a project or thesis.

8. **Proposed changes and goals (if any)**
   1. Rewrite Educational Outcomes to eliminate redundancy and explicitly integrate Social/Global Responsibilities ULG
      - This change was initially suggested in Spring 2014, but the graduate studies committee has not yet been able to return to it due to significant changes to the culminating experience over the past two years.
   2. Improve assessment forms for ME 265 and ME 299 and 295A/B to improve consistency and accuracy of ratings.
      - Detailed descriptions should be included for each rating level
      - The ME 265 assessment forms could be improved to separately assess PLO’s 2 and 3 in the technical portion.

**Part C**

<table>
<thead>
<tr>
<th>Proposed Changes and Goals</th>
<th>Status Update</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assessment of communication skills in ME 265</td>
<td>This change has been instituted, as discussed above. However, only half of students are meeting the minimum score for acceptable fulfillment of this outcome. Further improvement is needed.</td>
</tr>
<tr>
<td>Assessment of students who take comprehensive exam</td>
<td>No longer necessary, as the comprehensive exam will be suspended effective Spring 2017.</td>
</tr>
<tr>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>New/improved lab facilities</td>
<td>Two new faculty members, Profs. Saeid Bashash and Kathryn Gosselin, were hired in the Fall of 2015. They have taken over the mechatronics lab and Renewable Energy Lab, respectively, and have begun developing the facilities. Prof. Fred Barez continues to develop the Hybrid and Electric Vehicles Lab.</td>
</tr>
</tbody>
</table>
Mechanical Engineering Department
MSME Thesis/Project Assessment Form

Student Name: ___________________________  SJSU ID: _______________________

Project/Thesis Title: ____________________________

☐ ME 295A  ☐ ME 295B  ☐ ME 299 (1st)  ☐ ME 299 (2nd)  Semester: ____________

Evaluated by: ___________________________  Date: ___________

Scale: 1 = Lacking, 2 = Weak, 3 = Acceptable, 4 = Good, 5 = Excellent

<table>
<thead>
<tr>
<th>Criterion</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Motivation for the work was convincing and clear objectives were defined.</td>
<td></td>
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<td>2 A thorough literature search was performed with proper citations, and an understanding of the cited literature was clearly evident.</td>
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<tr>
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<td></td>
</tr>
<tr>
<td>9 Key points of the work were summarized effectively and meaningful conclusions were drawn.</td>
<td></td>
</tr>
</tbody>
</table>

Comments:

Revised 1/12
## Appendix B: Sample Assessment Forms for ME 265

### ME265 Written Communication (GWAR) Rubric

<table>
<thead>
<tr>
<th>Performance level</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Document preparation</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cover page presented essential identifying information including title, author full name(s), prepared for, institution, class, and date.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>All required sections and sub-sections are present and properly labeled.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Page numbers, tables, figures, and equations are formatted and labeled properly.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Quantitative reporting (e.g., units and significant digits) and nomenclature (e.g., variables and acronyms) are used appropriately.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>All external content is cited diligently at the point of use, citation formatting is prepared properly according to a professional standard (e.g., APA, MLA, IEEE).</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Written Skills</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ideas flow logically from sentence to sentence, from paragraph to paragraph, from section to section.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Document shows evidence that writer has considered a mixed audience and provided sufficient background.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grammar, spelling, capitalization, and punctuation are used correctly throughout the document.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Writing is concisely effective (i.e., to-the-point and not roundabout or verbose).</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

5 Exceptionally good
Coverage and/or correctness of content demonstrate superior understanding of the subject matter.

4 Good
Coverage and/or correctness of content demonstrate a good understanding of the subject matter, capability for use of the relevant concepts.

3 Adequate
Coverage and/or correctness of content demonstrate adequate understanding of the relevant material.

2 Needs improvement
Coverage and/or correctness of content demonstrate only partial familiarity with the subject matter, some capacity to work with the concepts in simple applications. Deficiencies are serious.

1 Unacceptable
Content is missing, so incomplete, or so full of errors that it does not satisfy minimum requirements of acceptability.
San Jose State University  
Mechanical Engineering Department  
ME 265  
Design Project Technical Evaluation Rubric

<table>
<thead>
<tr>
<th>Name:</th>
<th>Product name:</th>
<th>Comments:</th>
</tr>
</thead>
</table>
| **Cover page quality & design (3%)**  
Quality of 3D rendered view in color | | |
| **Geometric model, 3D (35%)**  
Complexity and quality of components  
Assembly and exploded views | | |
| **2D layout and Dimensioning (5%)**  
2D standard views of the assembly with overall dimensions, *No 2D part drawing* | | |
| **FEA Analysis (20%)**  
FEA model, performance,  
Stress, displacement, thermal, or drop test.  
Include complete explanation of boundary cond. and discussion of the results (*color plots*) | | |
| **Motion Analysis (15%)**  
Position, velocity and force analysis include explanation and discussion of the results.  
Or crank slider mech. analysis | | |
| **Animation (15%)**  
Quality and completeness | | |
| **Quality of report (7%)**  
Overall quality | | |

| **Total (technical)** |  |
| **Total (GWAR)** |  |
| **TOTAL** |  |