Aerospace Engineering Masters of Science Program Assessment Plan

Fall 2015

The College of Engineering at California State Polytechnic University, Pomona (Cal Poly Pomona or CPP) offers an MS in Engineering with emphasis in Aerospace Engineering (MSE-AE) degree program at the Lancaster University Center. The Program which started in the Fall quarter 2007 has received WASC approval. Courses are taught in person, some by Cal Poly Pomona Engineering faculty and some by adjunct engineers/scientist from the local aerospace community in Antelope Valley.

Meaning of MS Degree in the Engineering Fields

The MS degree in Aerospace Engineering provides the student with the advanced knowledge necessary to elucidate the theories to their fields of specialization while grounding them in their practices. The MS degree enables the graduate to articulate the significant challenges confronting the field of aerospace engineering utilizing a solid foundation of advanced courses. Through a careful selection of challenging projects, graduate students propose creative approaches to solving selected contemporary engineering problems. These project experiences distinguish the CPP MS Aerospace Engineering graduate by providing them with the design and execution background to tackle complex problems using innovative approaches, that can be applicable in industry and research.

Expectations for entering students

Admission requirements for the program are:

- B.S. in Aerospace, Mechanical engineering from an ABET accredited institution received within the last 5 years.
- GPA in upper-division undergraduate courses in Math, Science and Engineering needs be ~3.0 or higher.
- If B.S. received from non-ABET institution or prior to 5 years ago or lower GPA than ~3.0, but higher than ~2.85, then GRE test score (quantitative + verbal) of at least 301 is required.
- Also visit Cal Poly Pomona Admissions Office at CPP website: www.cpp.edu
MSAE Program Educational Objectives

The educational objectives of the off-campus MSE with emphasis in Aerospace Engineering, which helps preparing the student for their future career, are:

I. To provide students with a comprehensive education at the Master’s level that includes in-depth instruction in aerodynamics, structures, propulsion systems, flight mechanics and astronautics;

II. To provide students with opportunities to master research methods and to learn the methodologies for conducting independent studies;

III. To prepare students for advancement in their aerospace engineering careers by exposing them to efficient approaches to analyzing and solving open-ended problems, and design issues while fostering teamwork, communication skills, and individual professionalism.

The learning experience includes comprehensive education at the Master’s level courses, team projects and activities in the Design classes, and oral presentation and written report for the Master’s project. The Department’s effectiveness in meeting these Educational Objectives are evaluated by indirect tools such as the Masters Employer Surveys and Masters Alumni Surveys.

Undergraduate and Graduate programs are distinctly different. Our department has both an undergraduate and a graduate program. They are distinctly different. Our undergraduate program has expectations which are given in a separate document.

Quality:

These program objectives will be accomplished through the achievement of learning outcomes, which are given below:

Program Learning Outcomes

After completing the proposed MSE program, the graduate will be able to:

1. Develop an understanding of advanced mathematical and numerical methods to effectively address real world engineering problems;
2. Analyze and design complex aerospace structural elements;
3. Perform graduate-level aerodynamic analysis;
4. Analyze sophisticated air-breathing propulsion systems;
5. Perform in-depth analysis of flight dynamics of aircraft and spacecraft and design advanced flight control systems;
6. Develop an ability to work efficiently in teams charged with the design of complex systems such as spacecraft from a conceptual design perspective;
7. Demonstrate excellent oral, written and graphic communications skills.

These program outcomes are a modified version of the outcomes for the undergraduate aerospace program (which were developed in 2004 in preparation for the last professional accreditation review by ABET) adapted to suit the curriculum of the MSE program.
Table 1 shows the relationship of student outcomes to the program educational objectives.

<table>
<thead>
<tr>
<th>Program Educational Objectives</th>
<th>Program Learning Outcomesa</th>
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<tbody>
<tr>
<td></td>
<td>1</td>
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<tr>
<td>I. To provide students with a comprehensive education at the Master’s level that includes in-depth instruction in aerodynamics, structures, propulsion systems, flight mechanics and astronautics;</td>
<td>✓</td>
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<tr>
<td>II. To provide students with opportunities to master research methods and to learn the methodologies for conducting independent studies</td>
<td>✓</td>
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<tr>
<td>III. To prepare students for advancement in their aerospace engineering careers by exposing them to efficient approaches to analyzing and solving open-ended problems, and design issues while fostering teamwork, communication skills, and individual professionalism</td>
<td>✓</td>
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</tbody>
</table>

Program Outcomes are reviewed on a two-year cycle. The outcomes for the undergraduate program were modified recently based on the judgment of the Aerospace faculty, with advice from employers and alumni provided through the Aerospace Industry Action Council. The Council typically consists of representatives from the local aerospace industry. In addition, several of the representatives are alumni of the Department. Therefore, this is an ideal group to provide timely input from alumni and employers.

Table 2 shows the relationship of student outcomes to the program educational objectives, and the level of proficiency at the “Practice” or “Masters” level.

\[\text{Table 2: Relationship of student program educational objectives}\]

Program Learning Outcomes

After completing the proposed MSE program, the graduate will be able to:

1. Develop an understanding of advanced mathematical and numerical methods to effectively address real world engineering problems;
2. Analyze and design complex aerospace structural elements;
3. Perform graduate-level aerodynamic analysis;
4. Analyze sophisticated air-breathing propulsion systems;
5. Perform in-depth analysis of flight dynamics of aircraft and spacecraft and design advanced flight control systems;
6. Develop an ability to work efficiently in teams charged with the design of complex systems such as spacecraft from a conceptual design perspective;
7. Demonstrate excellent oral, written and graphic communications skills.
Table 2: Relationship of Program Learning Outcomes to Required Courses

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Outcome 1</th>
<th>Outcome 2</th>
<th>Outcome 3</th>
<th>Outcome 4</th>
<th>Outcome 5</th>
<th>Outcome 6</th>
<th>Outcome 7</th>
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P= Practice level, M = Master level

The department **accommodates the entering students’ abilities** by allowing them to tailor their Master’s projects to the topics related to their current job position.

**Integrity:**

Our program is accredited by the WASC. The program uses appropriate processes for assessing and evaluating the extent to which the **student outcomes** are being attained.

Our department utilizes direct assessment instruments of the Master’s Student Outcomes including the faculty’s evaluation of the student Master’s research project final report and oral presentation. Indirect measurements include the Master’s Alumni survey. These evaluations are used to **verify that the students are achieving the outcomes at the expected level, update or add curriculum, introduce new teaching methodologies** (such as planning for distance learning from the Lancaster site to the Cal Poly Pomona campus, and addition of new masters courses to be taught at the Pomona campus), **identify needs for increasing department faculty**, and **identify needed improvements in laboratory equipment**. The oral presentation and the report for the Master’s project is used to **verify that sequence of student learning experiences** achieved its purpose.

Our tentative assessment plan is shown in Table 3.

* “Practice” or “Master” level depending on the topic of the final project.
Collection of Assessment Data and Analysis

Direct Data:
The following measurements will be used to assess each learning outcomes:

- Evaluation of student Master’s Project report or Master’s Thesis as well as the final student oral presentation.
- Faculty assessment of student oral presentations, written reports, and the final examinations of the courses.

Indirect Data

- Three-year assessment of program objectives by Alumni Surveys. Alumni Surveys are analyzed for potential improvements for faculty review.
- **External evidence of the value of the program** is evaluated by the feedback from the Aerospace Industry Action Council members.

Discussion of Assessment Results

Graduate committee reviews assessment results and discuss how to improve teaching and learning as well as inform planning and decision making. The results can highlight successes such as these:

- Evidence that students are meeting or exceeding learning expectations,
- Better alignment of the curriculum with desired outcomes,
- Creation of useful rubrics,
- Development of explicit standards and corresponding samples of student work.

Table 3: Proposed Assessment Plan

<table>
<thead>
<tr>
<th>Outcome</th>
<th>F-15</th>
<th>W-16</th>
<th>S-16</th>
<th>Su-16</th>
<th>F-16</th>
<th>W-17</th>
<th>S-17</th>
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<td>Outcome 3</td>
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</table>

C: Collection of Assessment Data and Analysis, D: Discussion of Assessment Result