

**SJSU Annual Program Assessment Form
Academic Year 2017-2018 Report**

Department:	Aerospace Engineering	
Programs:	BSAE / MSAE	
College:	Engineering	
Program Website:	BSAE: http://www.sjsu.edu/ae/programs/bsae/index.html MSAE: http://www.sjsu.edu/ae/programs/msae/index.html	
Link to Program Learning Outcomes (PLOs) on program website:		
BSAE: http://www.sjsu.edu/ae/programs/bsae/bsae_program_outcomes/ MSAE: http://www.sjsu.edu/ae/programs/msae/msae_program_outcomes/		
Program Accreditation (if any):	ABET (BSAE)	
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Date of Report:	15 March 2018	

Part A

1A. – **BSAE Program Learning Outcomes**

Changed – March 2018

BSAE student learning outcomes are specified by ABET. AE faculty have broken down each outcome into elements and performance criteria for each outcome element (see below). BSAE PLOs were re-grouped in March 2018 and reduced to seven (7) following a revision by ABET.

The original BSAE Outcomes, which were used in the 2017 AE Self Study, were very close to the newly adopted ABET Outcomes. For example, BSAE Outcome A was a combination of the original ABET Outcomes (a) and (e), just like the newly proposed ABET Outcome 1. Similarly, BSAE Outcome G was a combination of the original ABET Outcomes (h) and (j).

The most important changes to the BSAE PLOs are as follows:

- Outcome I (modern tools) has been eliminated from the list. It is, however, incorporated in outcomes 1 (problem solving skills), 2 (design skills), and 6 (lab skills), as each of these skill sets requires the use of modern experimental and computational tools.
- Outcome G (global, societal, and contemporary issues) has now been combined with Outcome F (professionalism and ethics) into the new Outcome 4. Some of these issues are also incorporated into Outcome 2 (design skills).

The table below shows a mapping of the original ABET(1999: a – k), original BSAE (2000: A – I), and new BSAE (1 – 7) PLOs.

New vs. Original BSAE Student Outcome Mapping

Student Outcomes									
<i>New ABET & BSAE Outcomes</i>	1	2	3	4	5	6	7	4	1, 2, 6
<i>Original BSAE Outcomes</i>	A	C	E	F	D	B	H	G	I
<i>Original ABET Outcomes</i>	(a), (e)	(c)	(g)	(f)	(d)	(b)	(i)	(h), (j)	(k)

BSAE.PLO-1: Ability to identify, formulate and solve complex aerospace engineering problems by applying principles of engineering, science, and mathematics.

Outcome Performance Indicators:

- 1.1: Engage in the solution of problems (spend adequate time on task, ask questions, etc.).
- 1.2: Define open-ended, complex aerospace engineering problems in appropriate engineering terms.
- 1.3: Explore problems (i.e., examine various issues, make appropriate assumptions, etc.).
- 1.4: Develop a plan for the solution (i.e., select theories, principles, approaches from aerospace structures, aerospace dynamics, aerodynamics, flight mechanics, aerospace propulsion, stability, and control, as appropriate).
- 1.5: If applicable, use modern software to conduct computer simulations, parametric studies, and ‘what if’ explorations.
- 1.6: Implement the solution plan and check the accuracy of the calculations.
- 1.7: Evaluate the results (do they make sense?)
- 1.8: Reflect on strengths and weaknesses in applying the problem solution process.

BSAE.PLO-2: Ability to design aerospace vehicles that meet specified requirements and subject to public health, safety and welfare, global, cultural, social, environmental, and economic constraints.

Outcome Performance Indicators:

- 2.1: Research, evaluate, and compare vehicles designed for similar missions.
- 2.2: Follow a prescribed process to develop the conceptual / preliminary design of an aerospace vehicle.
- 2.3: Examine economic, environmental, social, cultural, global, health and safety, manufacturability, and sustainability constraints for a vehicle being designed.
- 2.4: Select an appropriate configuration for an aerospace vehicle with a specified mission.
- 2.5: Apply AE principles (e.g. aerodynamics, structures, flight mechanics, propulsion, stability and control) to design and analyze vehicle subsystems.
- 2.6: Develop and compare alternative configurations for an aerospace vehicle, considering trade-offs and appropriate figures of merit.
- 2.7: Develop final specifications for an aerospace vehicle.

BSAE.PLO-3: An ability to communicate effectively with a range of audiences.

Outcome Element 3.1: Ability to communicate in writing

Outcome Performance Indicators:

- 3.1.1: Produce well-organized reports, following guidelines.
- 3.1.2: Use clear, correct language and terminology while describing experiments, projects or solutions to engineering problems.
- 3.1.3: Describe accurately in a few paragraphs a project / experiment performed, the procedure used, and

the most important results (abstracts, summaries).

3.1.4: Use appropriate graphs and tables following published engineering standards to present results.

Outcome Element 3.2: Ability to communicate orally

Outcome Performance Indicators:

3.2.1: Give well-organized presentations, following guidelines.

3.2.2: Make effective use of visuals.

3.2.3: Present the most important information about a project / experiment, while staying within allotted time.

3.2.4: In small group settings, listen carefully, ask clarifying questions when others speak, and respect the opinion of others when disagreeing.

BSAE.PLO-4: Ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, considering the impact of engineering solutions in global, economic, environmental, and societal contexts.

Outcome Element 4.1 – Recognize ethical responsibilities.

Outcome Performance Indicators:

4.1.1: Be familiar with professional codes of ethics (e.g. NSPE, ASME).

4.1.2: Properly acknowledge the work of others by citing all sources when writing reports.

4.1.3: Given a job-related scenario that requires a decision with ethical implications, identify possible courses of action, discuss the pros and cons of each one, decide on the best course of action, and justify the decision.

Outcome Element 4.2 – Recognize professional responsibilities.

Outcome Performance Indicators:

4.2.1: Demonstrate professional excellence in performance.

4.2.2: Demonstrate collegiality when working with others.

Outcome Element 4.3 – Make informed judgments, taking into consideration the impact of engineering solutions in global, economic, environmental, and societal contexts.

Outcome Performance Indicators:

4.3.1: Discuss the impact of aerospace vehicles in a societal context. Use appropriate references to support their arguments.

4.3.2: Discuss the impact of aerospace vehicles in a global context. Use appropriate references to support their arguments.

4.3.3: Describe the economic impact of aerospace vehicles, including those designed in course projects. Use appropriate references to support their arguments.

4.3.4: Describe the environmental impact of aerospace vehicles, including those designed in course projects. Use appropriate references to support their arguments.

BSAE.PLO-5: Ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives.

Outcome Performance Indicators:

5.1: Contribute to the creation of a collaborative and inclusive environment by showing respect for others.

5.2: Participate in making decisions, negotiate with partners, and resolve conflicts arising during teamwork.

5.3: Establish goals related to team projects, generate timelines, organize and delegate

work among team members, and coach each other as needed to ensure that all tasks are completed.
5.4: Demonstrate leadership by taking responsibility for various tasks, motivating and disciplining others as needed.

BSAE.PLO-6: Ability to design and conduct appropriate experiments, analyze and interpret data, and use engineering judgment to draw conclusions.

Outcome Elements

- 6.1: Ability to design aerospace engineering experiments.
- 6.2: Ability to conduct aerospace engineering experiments.
- 6.3: Ability to analyze data from aerospace engineering experiments.
- 6.4: Ability to interpret data from aerospace engineering experiments.

6.1: Ability to design experiments

Outcome Performance Indicators:

- 6.1-1: Define goals and objectives for the experiment.
- 6.1-2: Research relevant theory and published data from similar experiments.
- 6.1-3: Select the dependent and independent variables to be measured.
- 6.1-4: Select appropriate methods for measuring/controlling each variable.
- 6.1-5: Select a proper range for the independent variables.
- 6.1-6: Determine an appropriate number of data points for each type of measurement.

6.2: Ability to conduct experiments

Outcome Performance Indicator:

Given an experimental setup, become familiar with the equipment, calibrate the instruments to be used, and follow the proper and safe procedures to collect the data.

6.3: Ability to analyze data from experiments

Outcome Performance Indicators:

- 6.3-1: Given a set of experimental data, carry out the necessary calculations.
- 6.3-2: Tabulate and plot experimental results using appropriate choice of variables and software.

6.4: Ability to interpret data and draw conclusions

Outcome Performance Indicators:

- 6.4-1: Given a set of results in tabular or graphical form, make observations and draw conclusions regarding the variation of the parameters involved.
- 6.4-2: Given a set of results in tabular or graphical form, compare with theoretical predictions and/or other published data and explain any discrepancies.

BSAE.PLO-7: Ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

Outcome Performance Indicators:

- 7.1: Access information effectively and efficiently from a variety of sources.
- 7.2: Develop a systematic approach to acquiring new knowledge.
- 7.3: Reflect regularly on the effectiveness of this approach (i.e. determine what works and what doesn't).
- 7.4: Make any necessary adjustments to improve the effectiveness and the efficiency of this process.

GE Area S: Self, Society, and Equality in the US

S-LO1: Describe how identities (i.e. religious, gender, ethnic, racial, class, sexual orientation,

disability, and/or age) are shaped by cultural and societal influences within contexts of equality and inequality.

S-LO2: Describe historical, social, political, and economic processes producing diversity, equality, and structured inequalities in the U.S.

S-LO3: Describe social actions which have led to greater equality and social justice in the U.S. (i.e. religious, gender, ethnic, racial, class, sexual orientation, disability, and/or age).

S-LO4: Recognize and appreciate constructive interactions between people from different cultural, racial, and ethnic groups within the U.S.

GE Area V: Culture, Civilization, & Global Understanding

V-LO1: Compare systematically the ideas, values, images, cultural artifacts, economic structures, technological developments, and/or attitudes of people from more than one culture outside the U.S.

V-LO2: Identify the historical context of ideas and cultural traditions outside the U.S. and how they have influenced American culture

V-LO3: Explain how a culture outside the U.S. has changed in response to internal and external pressures.

BSAE PLO performance targets are defined as follows:

The scores earned by all students, in the assignments and test questions, which pertain to a particular performance indicator, in each course where this performance indicator is assessed, must be at least 70% to ensure working knowledge of the material.

1B. – MSAE Program Learning Outcomes

No changes

MSAE.PLO-A: Ability to use graduate level mathematics to model and solve complex aerospace engineering problems.

MSAE.PLO-B: Ability to apply aerospace engineering science (aerodynamics, propulsion, flight mechanics, stability & control, aerospace structures & materials, etc.) to perform an in-depth analysis and / or design of an aerospace engineering system taking into consideration economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability constraints.

MSAE.PLO-C: Ability to use modern tools (computational or experimental).

Outcome Performance Indicator:

Use modern software to analyze aerospace systems and conduct computer simulations, parametric studies, and ‘what if’ explorations.

MSAE.PLO-D: Ability to perform a literature search related to a given problem, demonstrate an understanding of this literature, and cite references in appropriate ways.

MSAE.PLO-E: Graduate level technical writing ability, including correct language and terminology, appropriate visuals, and summarizing key ideas.

Outcome A is assessed in AE200, a required course in the MSAE Program.

Outcomes B through E are assessed in students’ final project/thesis reports, using the form below:

MSAE Thesis / Project Evaluation Form

Title							
Name		Semester –					
Advisor							
MSAE Outcomes / Outcome Elements		Max Possible	Ave score	Min Passing	Project Advisor	Faculty Member 2	Faculty Member 3
B.1	Application of AE science (aerodynamics, propulsion, flight mechanics, stability & control, aerospace structures & materials, etc.)	20		14			
B.2	In-depth analysis and/or design of an aerospace system or vehicle.	20		14			
C	Application of modern tools (computational or experimental)	10		7			
D.1	Appropriate literature search (# and appropriateness of references cited)	10		7			
D.2	Understanding of the cited literature (summary of previous work)	10		7			
E.1	Correct language and terminology	20		14			
E.2	Appropriate use of graphs and tables	10		7			
Total Score		100		70			

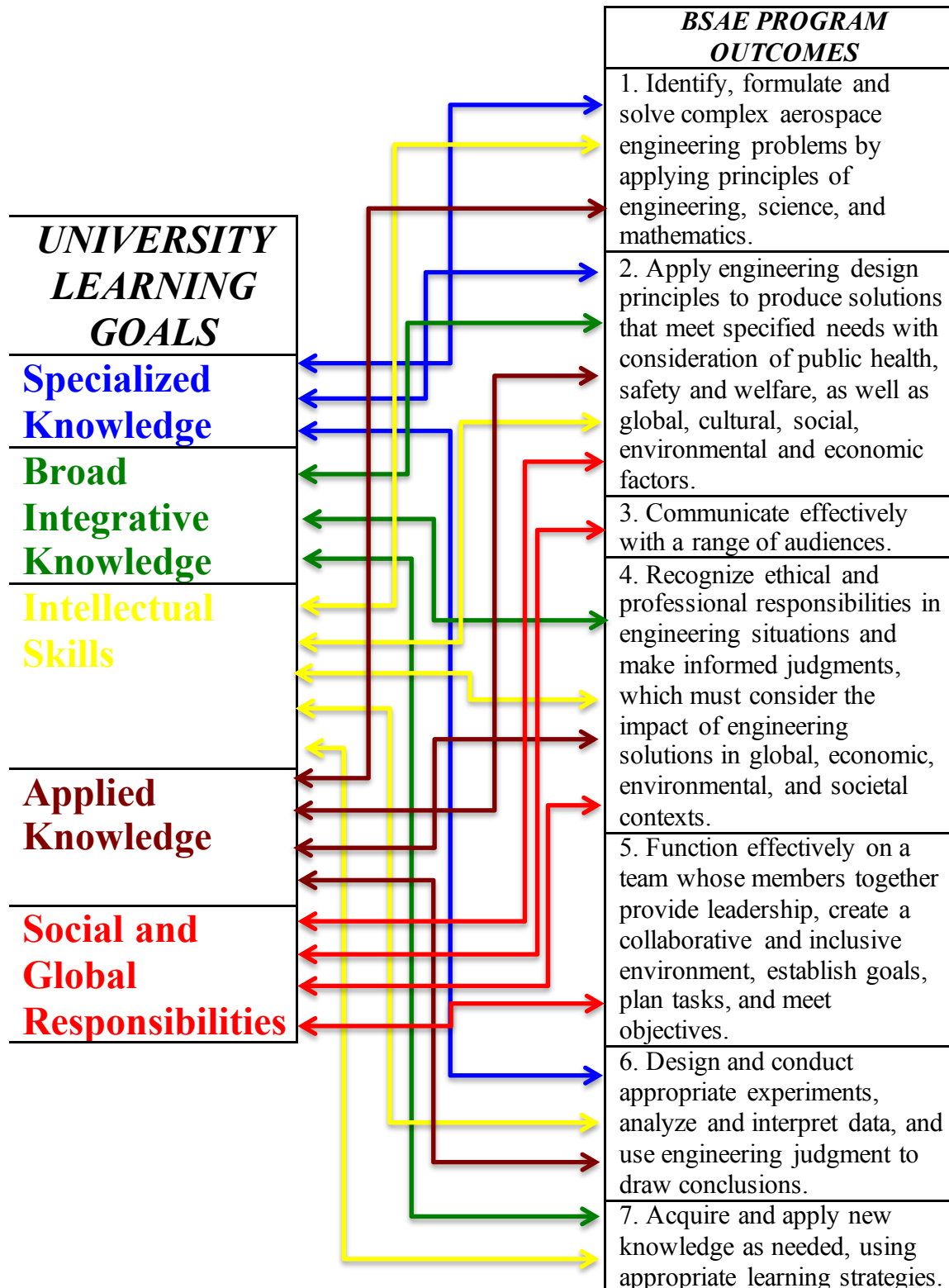
Overall Score: 90 – 100 = Excellent, 80 – 89 = Good, 70 – 79 = Acceptable, 50 – 69 = Weak, 00 – 49 = Lacking

Comments:

2. Map of PLOs to [University Learning Goals \(ULGs\)](#)

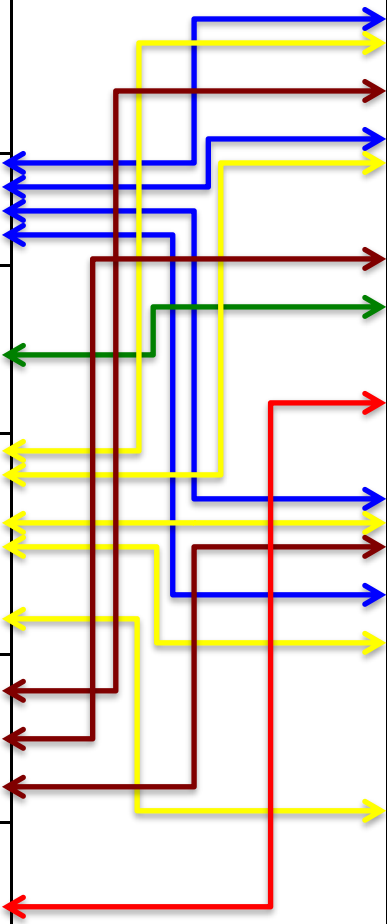
The BSAE map of PLOs to ULGs below was revised in March 2018 to reflect the changes in PLOs discussed above.

The MSAE map of PLOs to ULGs is the same.



UNIVERSITY LEARNING GOALS
Specialized Knowledge
Broad Integrative Knowledge
Intellectual Skills
Applied Knowledge
Social and Global Responsibilities

MSAE PROGRAM OUTCOMES
Use graduate level mathematics to model and solve complex aerospace engineering problems.
Apply aerospace engineering science to perform in-depth analysis and / or design of aerospace engineering systems taking into consideration economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability constraints.
Use modern tools (computational or experimental).
Perform a literature search related to a given problem, demonstrate an understanding of this literature, and cite references using accepted formats (AIAA, APA, etc.).
Demonstrate graduate level technical writing ability, including correct language and terminology, appropriate visuals, and an ability to summarize key ideas.



3. Alignment – Matrix of PLOs to Courses

Outcomes are addressed at different levels throughout the BSAE curriculum. For example, each and every upper division BSAE course addresses Outcome 1 at least at level 3 or 4 in the Bloom / Anderson Taxonomy. The table below shows only the courses which address outcomes at their highest level (5 or 6 in the Bloom / Anderson Taxonomy) and in which outcomes are assessed.

Student Outcomes							
<i>New ABET & BSAE Outcomes</i>	1	2	3	4	5	6	7
<i>Courses Assessed</i>							
Engr.100W			+++				
AE 114	+++						
AE 140	+++						
AE 162	+++					+++	+++
AE 164	+++						
AE 165	+++						
AE 167	+++						
AE 168	+++						
AE 171 A&B and AE 172 A&B		+++	+++	+++	+++		
GE Areas S&V		++		+++			

++: Skill level 3 or 4 in Bloom/Anderson Taxonomy

+++ : Skill level 5 or 6 in Bloom/Anderson Taxonomy

<i>MSAE</i>	Student Outcomes				
	A	B	C	D	E
Required Courses					
AE 200	+++				
AE 242/AE 243/AE 245/AE 246		+++			
AE 250		+++			
AE 262/AE 264/AE 280		+++			
AE 267		+++			
AE 269			+++		
AE 271					+++
AE 295A&B / AE299		+++		+++	+++

4. Planning – [Assessment Schedule](#)

BSAE Assessment Schedule

<i>ABET visits</i>		BSAE Student Outcomes						
		1	2	3	4	5	6	7
Fall 2017	AY 17-18		X					X
	AY 18-19	X		X				
	AY 19-20		X		X			
	AY 20-21			X		X		
	AY 21-22				X		X	
	AY 22-23					X		X
Fall 2023	AY 23-24						X	

MSAE Assessment Schedule

MSAE Student Outcomes					
	A	B	C	D	E
AY 17-18			X		
AY 18-19				X	
AY 19-20					X
AY 20-21	X				
AY 21-22		X			
AY 22-23			X		

5. Student Experience

BSAE PLOs can be found here:

http://www.sjsu.edu/ae/programs/bsae/bsae_program_outcomes/

MSAE PLOs can be found here:

http://www.sjsu.edu/ae/programs/msae/msae_program_outcomes/

a. How are your PLOs and the ULGs communicated to students, e.g. websites, syllabi, promotional material, etc.?

- BSAE and MSAE websites (see links above)
- Syllabi include a table, which shows how CLOs are linked to PLOs.
- The skills included in PLOs and their importance to engineering practice are discussed in every upper division (for BSAE) and graduate level (for MSAE) course on the first day of class and revisited throughout the semester, as various course activities and assignments are linked to CLOs and PLOs.

b. Do students have an opportunity to provide feedback regarding your PLOs and/or the assessment process? If so, please briefly elaborate.

Students are given opportunities in **each course** during the semester to provide feedback in regards to:

- How effective is the teaching in terms of helping them acquire the skills outlined in the CLOs / PLOs.
- How well the various assessment methods in each course measure their level of competence in these skills.

Graduating seniors are surveyed with the following questions:

Question 1: What do you think are the most important skills for an AE to compete successfully for entry-level positions in industry?

Question 2: What do you think are the most important skills for an AE to succeed in graduate school?

Question 3: Do you feel that our AE program prepared you adequately in the skills you consider important? Write "yes" OR "no" next to each skill you identified in questions 1 and 2 above.

Questions 4: Which courses prepared you for these skills? Write next to each skill you identified in questions 1 and 2 the course(s) you think helped you develop these skills.

Responses from questions 1 and 2 are summarized and compared to the skills listed in the BSAE PLOs. If students identify any new skills not listed in the BSAE PLOs, AE faculty discuss and recommend whether to modify PLOs and include these newly identified skill(s).

Responses from questions 3 and 4 help determine whether – always according to students – the BSAE Program prepares them adequately in the skills they consider important and which courses are most effective in this regard.

Part B

6,7,8 Assessment Data, Results, Analysis, and Proposed Changes

(Please briefly describe the data collected for this report (e.g., student papers, posters, presentations, portfolios, assignments, exams). The instruments used to evaluate student achievement (e.g., rubrics or other criteria) and actual data (e.g., assignment description or instructions) should be attached as appendices. PLOs should be evaluated based on direct assessments of learning, not grades earned by students.)

BSAE Assessment

According to our new assessment schedule this AY we are in the process of assessing Outcome 2 (design skills) and Outcome 7 (lifelong learning skills). The assessment of Outcome 2 extends over fall and spring and will be completed at the end of the AY in May 2018. Data from AY 16-17 are presented below.

Outcome 2

Assessment Summary: Overall, Outcome 2 is satisfied in the BSAE Program.

AE171A – Aircraft Design I

Prof. Gonzalo E. Mendoza

AE172A – Spacecraft Design I

Prof. Periklis Papadopoulos

AE171B – Aircraft Design II

Prof. Gonzalo E. Mendoza

AE172B – Spacecraft Design I

Prof. Periklis Papadopoulos

AY 2016 – 2017

Performance Indicator C-1: Research, evaluate, and compare vehicles designed for similar missions.

Assessment Summary: The performance target is **met** for Performance Indicator C-1.

Course Activities

AE 171 A – Students present a comparative study of airplanes with a mission similar to theirs. The objective is to become familiar with the competition and work done by others. They use encyclopedias,

the internet, and intelligence gathered from previous projects to collect data on various airplanes. Students compare and discuss important design parameters for the airplanes selected, such as takeoff and payload weight, available thrust, cruise speed and altitude, range, wing area, wingspan, wing aspect ratio, fuselage length, type of payload, etc.

AE 172 A

- a. Research various spacecraft projects which are existing and see how they have met their design and mission requirements.
- b. Develop a design space flow chart for your senior project.
- c. In the interim report reflect on historical spacecraft and describe and compare your final design to previous spacecraft of similar missions.

Assessment Tools

AE171A – Section 3 of Design Report 1: Mission specification and comparative study

AE172A – Subsystem requirements assignment, MEDLI assignment, Interim report (historical study)

AE171A: 100% of students scored at or above 70% in Section 3 of Design Report 1.

AE172A

Subsystem Requirements Assignment: 96.8% of students scored at or above 70%.
SEEME /TRL / Confidence Levels Assignment: 31.3% of students scored at or above 70%.
MEDLI Assignment: 78.1% of students scored at or above 70%.
Interim Report (Historical Study): 59.4% of students scored at or above 70%.

Analysis

AE171A – Students typically do well on this assignment; no improvements are needed. Statistics were skewed by a team, which did not meet the requirements of the assignment. Part of the course involves the preparation of a final design report, which must contain information from all previous reports in one place. Deficiencies found in the specific reports must be corrected on the final design report for a satisfactory grade.

AE172A – This performance criterion was further broken up into CLOs 2 and 3. The data shows that not all students were capable of meeting the target criteria of a 70% or higher on the assignment. While many students were able to develop mission requirements and design requirements for their spacecraft, most did not attempt to do an in-depth historical study. Students were given multiple opportunities to show their research, however neglected to do so in all of the assignments. In the MEDLI and SEEME assignments, students did show their ability to connect a single mission design to their project, however they did not focus in their historical study to spacecraft which were in similar missions overall.

Recommendations

AE171A – None

AE172A – (a) Make the historical study into a separate assignment at the beginning of the semester and increase its grade weight. (b) Put more emphasis on design space exploration and historical incremental approaches.

Implementation: AY 17-18

Performance Indicator C-2: Follow a prescribed process to develop the conceptual / preliminary design of an aerospace vehicle.

Assessment Summary: The performance target is met for Performance Indicator C-2.

Course Activities

AE171A&B – Students follow an iterative process (Roskam, 1985; Raymer, 2006) to design their airplanes. This process involves mission specification, configuration selection, weight sizing, performance sizing, fuselage design, wing design, empennage design, landing gear design, weight and balance, stability and control analysis, drag polar estimation, and final specification. The open-ended nature of design requires students to iterate through their design process in order to meet their mission requirements.

AE172A&B – Students apply the complete product development lifecycle to their project. They create the baseline design of a spacecraft and establish the final design of a spacecraft.

Assessment Tool

AE171A&B – 4 group (two in AE171A, two in AE171B) design briefings and 2 written examinations with concepts from all aspects of design (one on each class). The briefings include directed Q&A sessions.

AE172A&B – Interim Report

Student Performance Results

AE171A&B

Written Examination Students who scored 70% or higher		Team Design Reviews (DR) Students scoring 70% or higher			
1 st Exam (F16)	2 nd Exam (S17)	Prelim. DR (F13)	Interm. DR (F13)	Critical DR (S14)	Final DR (S14)
75%	66%	100%	100%	100%	100%

AE172A&B – Fall 2016: 100% of the students scored 70% or above in their Interim Report.

Analysis

AE171A&B – Student performance was mixed in AY 13-14, despite the fact that student teams produced reasonably good designs. Students divide the tasks among Team members and thus do not get detailed exposure to the various aspects of the design. Rather, they tend to specialize in particular areas of the design, for which they take responsibility. To ensure that all students are adequately knowledgeable in the entire design process, students are challenged with random questions on various aspects of the design individually during each of their design briefings in class. Students do relatively well in this area, as evidenced by the design review scores. More detailed questions, as included in the written examinations, posed greater difficulty for the students. This is reflected in the far less positive exam scores. The exams are conceptual in nature, with a design issue posed and a series of questions regarding potential treatments to improve mission suitability of the design, followed by more general questions regarding design procedures and aerodynamic, systems, and stability and control concepts.

AE172A&B – Students developed their ideas for a spacecraft system and began to create and evaluate conceptual design plans. By the end of the semester the first full design iteration of the system requirement was met and 100% of the students passed. As such were able to meet the performance criteria by having a preliminary design, which was close to completion for the building phase during the spring semester.

Recommendations

AE171A – Conceptual design questions used in the written exams form the basis for excellent discussions following the actual test. Similar exercises should be posed to the students during class to facilitate these discussions before the test and thus potentially improve the results.

AE172A – Continue having a two-part class where the design and prototyping is done in the first semester.

Implementation: AY 17-18

Performance Indicator C-3: Develop economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability constraints and design a vehicle that meets these constraints.

Assessment Summary

The performance target is met for Performance Indicator C-3.

Course Activities

AE171A&B

- Develop economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability constraints as appropriate for their airplane.
- Take into consideration these constraints in the design of their airplane and discuss how well their particular design meets these constraints.

AE172A&B

- Develop system requirements and subsystem requirements for your project.

Assessment Tools

AE171 – Sections in two design reports (Mission Specification and Final Design Reports) and participation in online and class discussions on this topic.

AE172 – Subsystem requirements assignment.

Student Performance Results

AE171A&B

Students who scored 70% or higher		
Mission Spec. Report (F16)	Final Design Report (S17)	Participation (S17)
100%	100%	100%

AE172A – Fall 2016: 96.8% of students scored at or above 70%.

Analysis

AE171A&B – Student performance is generally good in this area. Sometimes students need help identifying realistic constraints, especially for airplanes designed for the SAE Aero-Design or the AIAA Design-Build-Fly competitions. Students may also need help analyzing how well their airplane meets certain constraints. Nevertheless, they seem to grasp the importance of specific constraints in airplane design and do a fairly good job meeting those constraints in their designs. Their assignments for outcomes 3F and 3G helpful in this area, as they broaden their horizons beyond the technical aspects of airplane design. As a result of these assignments students have a much better understanding of how to deal with their specific constraints. The class incorporates a fair number of examples of real life designs which test safety, ethical, environmental, economic, and other societal concerns. Participation in online discussion threads on these topics are part of the evaluation plan. In addition, individual and group assignments related to outcome F and G are tied to specific design examples during class discussion. Early deficiencies during the Mission Specification Report are required to be addressed in the Final Design Report for a satisfactory score.

AE172A&B – Each group was required to create a set of overall and subsystem requirements while

meeting system level constraints. These were based on the SMART criteria which is a set of specific, measurable, achievable, relevant and time constrained requirements. These criteria were then measured against the mission criteria to determine the relevancy and impact on both performance, safety, economic, and other feasibility constraints.

Recommendations:

AE171 – None

AE172 – Expand the system requirements assignment to incorporate non-performance criteria to develop specific environmental, social, ethical and political constraints.

Implementation: AY 17-18

Performance Indicator C-4:

Select an appropriate configuration for an aerospace vehicle with a specified mission.

Assessment Summary: The performance target is met for Performance Indicator C-4.

Course Activities

AE171A

- Study the configurations of aircraft with a mission specification similar to the proposed airplane; discuss the reasons for the selection of the particular configuration in each of these aircraft.
- Select and sketch a few overall configurations for the proposed airplane; discuss the pros and cons of each configuration. Select one of these configurations for preliminary design purposes and justify the choice.
- Select the specific wing, empennage, landing gear, and propulsion system configuration, discuss the pros and cons of each configuration and justify the choice.

AE172A

- Establish the final design of a spacecraft.

Assessment Tools

AE171 – Configuration Design Report and Schematics, Final Design Report

AE172 – Interim Report

Student Performance Results

AE171

Students who scored 70% or higher	
Configuration Design Report	Final Design Report
83%	100%

AE172 – 100% of students scored at or above 70%.

Analysis

AE171A&B – Students typically do well on this assignment; no improvements are needed.

AE172A&B – The design of the spacecraft was an iterative process which was based on feedback from both the instructor and in class discussions of historical data. This enabled students to down select an appropriate system architecture that met system level objectives and missions requirements.

Recommendations

AE171 – None

AE172 – It is recognized that more time should be spent reviewing and discussing in class the historical data in-depth and in detail to leverage past spacecraft system designs.

Implementation: AY 17-18

Performance Indicator C-5: Apply AE principles (e.g. aerodynamics, structures, flight mechanics, propulsion, stability and control) to design various vehicle subsystems.

Assessment Summary: The performance target is met for Performance Indicator C-5.

Course Activities

AE171A&B

- Students apply AE principles throughout their conceptual and preliminary design of their airplane.

AE172A&B

- Perform in-depth analysis of four separate subsystems and relate their sizing/governing equations to the performance requirements of your system.
- Using trade studies, historical data and high fidelity analysis analyze your subsystems in order to develop an optimal solution which feasibly meets your performance criteria.

Assessment Tools

AE171A&B – The following design reports: Weight and Performance Sizing (AE171A), Weight and Balance (AE171A), Stability and Control (AE171A, report includes aerodynamic data estimation, as well as empennage and control surface sizing), and iterations of the Final Design Reports (AE171B).

AE172A&B – Subsystem report.

Student Performance Results

AE171A&B

Students who performed at 70% or higher				
Sizing Report (F16)	W&B Report (F16)	S&C Report (F16)	Draft Design Report (S17)	Final Design Report (S17)
71%	67%	63%	79%	100%

AE172A&B – 100% of students scored at or above 70%.

Analysis

This Criterion is very broad. Student performance in the various reports varies from team to team and from year to year. It is not uncommon for a team to receive a low score in one of their reports and a number scored grades just below the 70% threshold. Detailed written and oral feedback is provided to each team, and opportunities for resubmitting the assignment are given. The offer for re-submitting reports is often declined early in the semester, as students place their efforts in either hardware research or other priorities. In the end, a satisfactory evaluation of the analyses employed in the design of their aircraft is required to approve the course. Thus, performance improves as the students dedicate additional time to their assignments toward the final design report.

Recommendation

AE171A&B – The development of appropriate aerodynamic and mass models, as well as the completion of meaningful stability and control analyses, represent the areas which require additional attention. Re-introduction of the joint stability and control project tested out in prior years would add emphasis in these areas. This joint assignment increased the stakes for students to develop good quality weight estimation and aerodynamic models for analysis. The assignment was carried out in conjunction with the AE 168 course, a co-requisite for the aircraft design course.

AE172A&B – None

Implementation: AY 17-18

Performance Indicator C-6: Develop and compare alternative configurations for an aerospace vehicle, considering trade-offs and appropriate figures of merit.

Assessment Summary:

The performance target is met for Performance Indicator C-6.

Course Activities

AE 171 A&B – Extensive class discussion related to aircraft designs of varying configurations, missions, and degrees of success. Selection of configuration and design concepts for application in student design projects. Comparative analysis of projects with similar performance goals.

AE172A – Perform design trade studies in your design reports in order to evaluate the optimal system configuration for your spacecraft requirements.

Assessment Tools

AE171 – The following design reports: Configuration Design and Schematics Report (AE171A) and Final Design Report (AE171B). Both documents require the students to compare and select between various configurations for major components or overall design concepts. The selection must be based on objective or practical evaluation of a reasonable number of alternatives and how they are tied to mission requirements for their design.

AE172 – Subsystem report and conceptual design report.

Student Performance Results

AE171A&B

Students who scored 70% or higher	
Configuration Design Report	Final Design Report
83%	100%

AE172

Subsystem Report: 100% of students scored at or above 70%.

Conceptual Design: 81.3% of students scored at or above 70%.

Analysis

AE171A&B – Students enjoy and perform well in these areas. Re-directive feedback typically results from the student’s inclusion of clearly impractical design choices for the sake of providing what is felt is an appropriately large selection. In addition, design concepts are sometimes qualitatively selected or dismissed based on design myths which are common among popular enthusiast groups. These are relatively minor issues which are improved upon throughout the class experience.

AE172A&B – Students performed in-depth trade studies and developed several conceptual system

design architectures. Then a down selection process was implemented within each subsystem. These configuration studies were evaluated with design matrices and the pros and cons related to the system requirements.

Recommendations

AE171A&B – None

AE172A&B – Assign a stand-alone trade study report that elaborates on design space exploration instead of incorporating it into other assignments. This will enable the students to develop a better understanding of design space exploration techniques and methods.

Implementation: AY17-18

Performance Indicator C-7: Develop final specifications for an aerospace vehicle.

Assessment Summary: The performance target is met for Performance Criterion C-7.

Course Activities

AE171A&B – Students are required to develop specifications for their designs such that the mission goals from the Mission Analysis exercise are met. Students either test proof of concept aircraft or, if impractical, provide design validation analyses for their designs and are asked to compare the actual or estimated performance of their airplane against their design specifications.

AE172A&B – Establish the final design specifications of a spacecraft.

Assessment Tools

AE171A&B – C-7 is specifically assessed through the Critical Design Review, where suitability of design specifications is evaluated, and the Final Design Report, which contains the final set of specifications for the design and relevant mission scorecard.

AE172A&B – Interim report.

Student Performance Results

AE171A&B

Students who scored 70% or higher	
Critical Design Review	Final Design Report
100%	100%

AE172A – 100% of the students scored 70% or higher.

Analysis

AE171A&B – Students typically participate in design competitions such as AIAA Design Build Fly or SAE Aero Design. These competitions provide an interesting exercise in that the specifications are the product of mission score analyses, rather than suitability to a particular mission. Thus, aircraft with rather poor performance characteristics may very well achieve high scores based on one or more design attributes (low weight, short wingspan, etc). Students at San José State have done very well in these types of contests through careful analysis and definition of design specifications which result in high scoring aircraft. Three teams chose to design AIAA DBF aircraft this year. Other projects also showed reasonable judgment in the selection and analysis of final design specifications. One team struggled with the idea of having mission requirements dictate the specifications of their design. Corrective feedback resulted in a satisfactory outcome, but significant time for other activities was lost.

AE172A&B – Performance criteria was evaluated in CLOs C.7 and C.8. from AE172A. The final design

specifications of the spacecraft were based on feedback from both the instructor and in class discussions during critical design review (CDR) presentations that were captured in the interim presentations and reports. Previous assignments all contributed to enable the students to capture the final specifications properly that meet system level objectives and mission requirements.

Recommendations: None

Implementation: N/A

MSAE Assessment

According to our assessment schedule this AY we are in the process of assessing Outcome C (modern tools). Data from Fall 2017 are presented below.

Outcome C

Assessment Summary: Overall, Outcome C is satisfied in the MSAE Program.

AE269 – Advanced CFD

Prof. Periklis Papadopoulos

AY 2017 – 2018

Performance Indicator: Use modern software to analyze aerospace systems and conduct computer simulations, parametric studies, and 'what if' explorations.

Assessment Summary: The performance target is met for the Performance Indicator.

Course Activities

- a. Use a meshing program to generate the computational volume for a nozzle.
- b. Use a numerical solver to analyze the transient solution of a shock tube.

Assessment Tools: 3D Meshing Assignment, ShockTube Homework (4 Assignments, 4 variations)

Analysis

The performance indicator was assessed with multiple homework assignments. The first is the use of a mesh generating program. 66.7% of students passed with scores above 70%. Many of those who did not pass this assignment simply did not turn it in. The second assignment was a shock tube transient analysis in this assignment a numerical solver (ESI) was used to setup and solve a shock tube problem. In this assignment 87.7% of students passed with scores higher than 70%. There were three other variations of shocktube experiment assignments which resulted in 80, 70, and 80% of the students passing with each one. There was 1 person who did not turn in any assignment for the first, 8 for the second, 15 for the third, and 12 for the fourth. The common issue for this was the time requirement for each analysis as well as each assignment building off the previous. Many who could not complete one assignment would not be able to move forward to the next assignment

Recommendation

Assign only the original transient problem and leave any other variations to project level.

Implementation: N/A

Part C

9. Program Learning Outcomes

What are your proposed closing-the-loop action items and completion dates?

Proposed Changes	Status Update
<p>BSAE Performance Indicator A-1.3 (linear algebra) Spring 2016 – AE157:</p> <ul style="list-style-type: none"> ▪ Perform diagnostic assessment in the beginning of the semester to test students' skills in linear algebra. ▪ Create reference material (e.g. notes, videos, etc.) to help students review fundamental linear algebra concepts and bring lagging students up to speed. 	<p><u>Implemented in Spring 2017</u> 2 books were introduced: Kreyszig, Engineering Mathematics and Beer & Johnston, Engineering Mechanics</p> <p>Several examples were provided on how to locate video tutorials on youtube, (which, it turns out, students were already familiar with), to address student needs in ODEs, calculus, linear algebra and classical mechanics & dynamics.</p> <p>In hw # 02, students were assessed in regards to their ability to:</p> <ul style="list-style-type: none"> - Formulate and solve a set of equations using matrix algebra. - Use linear algebra, calculate matrix inverse and evaluate matrices based on algebraic manipulations (addition, subtraction,etc) <p>60/75 (80%) of the students performed @ 70% or higher in this assignment.</p>
<p>BSAE Performance Indicator A-3.2 (rigid body dynamics) Spring 2016 – AE140</p> <ul style="list-style-type: none"> ▪ Develop rigid body dynamics visualization tools as project topics. 	<p><u>Implemented in Spring 2017</u> Spring 2016 – AE140</p> <p>In AE138, students built a hardware project with which they validate an analytical model of their choice. Planar rigid body motion is taught briefly at the end of AE138 and Euler angles are introduced. In F16, one of the project teams built a custom tripod for a purchased high-quality gyroscope (gyro rotor speed = 12,000 rpm). With their experimental set-up, they demonstrated the precession, nutation and spin degrees of freedom which are common to spinning spacecraft. Although the theory for this hardware experiment was not learnt until AE140, the students correctly explained the complex motions in their class presentation. This project is now part of the demonstration hardware for AE140, enabling visualization of these degrees of freedom by all rigid body dynamics students.</p> <p><i>Results:</i> Spring 2016: 90% of students passed class Spring 2017: 95% of students passed class</p>
<p>BSAE Performance Indicator A-3.6 (stability & control) Fall 2016 – AE168</p> <ul style="list-style-type: none"> ▪ Present more example problems in class. ▪ Provide better student mentoring. ▪ More problems will be solved in problem solving sessions outside of class. ▪ Encourage collaborative learning to enhance students' analytical skills. 	<p><u>Implemented in Fall 2017</u></p> <p>Several example problems were presented in class in:</p> <ol style="list-style-type: none"> 1. Deriving stability & control derivatives from aircraft geometry 2. Estimating derivatives from both time response and frequency response data 3. Modeling statically and dynamically unstable aircraft, e.g., the Wright Flyer 4. Improving aircraft handling qualities by changing aircraft geometry 5. Meeting the specifications for improving aircraft performance using classical and modern feedback control methods 6. Modeling spacecraft open- and closed-loop dynamics <p>Solving these problems in class provided the understanding of a wide range of tools available to an aerospace dynamics & controls engineer. Office hours were also used to solve example problems of the types listed above. In addition, students collaborate on a semester-long project involving their senior design vehicle. In this project, the students bring their modest knowledge of stability and control to bear of the design of a real hardware problem. They collaborate with their teammates with the goal of a</p>

	<p>functioning, stable vehicle which meets its mission requirements. This process has been quite successful in integrating their course knowledge.</p> <p><i>Results:</i> Fall 2016: 91% of students passed class Fall 2017: 94% of students passed class</p>
<p>BSAE Outcome Element A-4 (open-ended problem solving) Spring 2016 – AE162</p> <ul style="list-style-type: none"> ▪ Present and discuss case studies in class to demonstrate the different requirements of airfoils designed for different airplanes. ▪ Present a parametric study in class, involving wing parameters, to illustrate how such studies can be used to optimize wing design. ▪ Add a step-by-step process to the class notes to guide students in their estimation of drag polars for an airplane in cruise, takeoff, and landing configurations, allowing also for compressibility drag if the plane operates at high speeds. 	<p><u>Implemented in Spring 2017</u></p> <ul style="list-style-type: none"> ▪ Case studies demonstrating different airfoil characteristics, depending on the type of airplane, have been added to the AE162 Course Notes and presented in class. ▪ A wing parametric study was presented in class to illustrate how to optimize wing design for a specific airplane mission. ▪ Step-by-step process describing how to estimate the grad polar of an airplane in cruise, takeoff, and landing configurations has been added to the AE162 Course Notes and presented in class. <p><i>Result:</i> 87% of the students met the 70% target score in their open-ended problem.</p>
<p>BSAE Outcome Element B-1 (design of experiments) Fall 2016 – AE160</p> <p>Provide a summary of the relevant theory for separated flows around delta-winged aircraft and bodies of revolution at high angles of attack during lecture as well as in notes, along with references for further study.</p>	<p><u>Implemented in Fall 2017</u></p> <p>As a result of this improvement, 90/95 students (95%) earned 70% or higher in their first lab report, which involved the flow visualization experiment.</p>
<p>BSAE Outcome Element B-4 (data interpretation) Fall 2016 – AE160</p> <p>Provide more guidance in class on how to interpret the flow patterns observed in the water tunnel experiments.</p>	<p><u>Implemented in Fall 2017</u></p> <p>As a result of this improvement, 90/95 students (95%) earned 70% or higher in their first lab report, which involved the flow visualization experiment.</p>
<p>BSAE Outcome E-1 (report writing) Fall 2016 – AE172</p> <ul style="list-style-type: none"> ▪ Implement an enhanced review of documentation standards. Minimum requirements are spelled out in the provided guidelines; however, additional discussion, with pertinent examples, should improve initial report outcomes. Review should focus on use of technical language and introductory to charting data in Excel & Matlab. ▪ All students produce a 3D printed part related to the overall 	<p><u>Implemented in Fall 2017</u></p> <ul style="list-style-type: none"> • Students followed standardized reporting formats and developed multiple subsystem analysis reports. Performance target (70%) was met. • The NASA Project Management Handbook (NASA/SP-2007-6105) was used to guide assignments. • 40% of students were able to perform 3D printed prototyping. Will continue to improve knowledge of currently available prototyping equipment. • Weekly project updates were required and all students performed well in this area. Weekly quad-charts will also be used in F18, to improve traceability of this objective. • Strict timelines on presentations were enforced to prevent excessive information being presented and ensure that only important project highlights are presented.

system/project through rapid prototyping.	
<p>BSAE Outcome E-2 (oral presentations) Fall 2016 – AE171 / AE172</p> <ul style="list-style-type: none"> ▪ Increase the proportion of the oral presentation grade allotted to individual performance. 	Implemented in Fall 2017
<p>MSAE Outcome B (Apply AE science to analyze / design...) Spring 2016 & Fall 2016 – AE295B/AE299</p> <ul style="list-style-type: none"> ▪ Final project/thesis reports should include a section on “future work”, as needed to carry the project to the next level. ▪ Final project/thesis reports involving the design of an aerospace vehicle or system should include a chapter addressing as many of the constraints listed in Outcome B as applicable. ▪ Outcome performance indicators will be added for Outcome B to address “future work” and “design constraints” and the MSAE Project Evaluation Form will be modified accordingly. 	Implemented in Fall 2017

10. Program Planning Action Items

What is the direct web link to the program’s latest action plan? (You can find it by selecting the relevant college in [Program Records](#) to locate your program.)

Describe the action items and the status in the table below.

Action item description	Status Update (what’s being done and results observed)	Date reported
<p>Take steps to advance assessment of student learning in the undergraduate program. Improvements to achievement of Outcome A should be demonstrated. The department should identify courses of concern and inform the home department of issues being found with students not meeting outcomes as outlined.</p>	<p>Following implementation of a series of improvements (see 2017 BSAE SSR) Outcome A (current Outcome 1) is now fully satisfied.</p>	<p>June 2017 In the BSAE SSR for ABET</p>

<p>Continue to improve graduation rates for first-time freshman and graduate students using implementation plan developed. Graduation rates have been lower in the past compared to the college and university rates. However, improvements have been noticed. Graduation rates should improve and remain steady at college and university rates.</p>	<p>The graduation rates for both the BSAE and the MSAE programs have been increasing dramatically since AE became independent in 2013:</p> <ul style="list-style-type: none"> • Six-year graduation rate for first-time freshmen: <ul style="list-style-type: none"> ○ 33.3% (F'07 cohort) ○ 60% (F'09 cohort – highest in the College) ○ 51.6% (F'10 cohort) • Three-year graduation rate for transfer students: <ul style="list-style-type: none"> ○ 14.3% (F'09 cohort) ○ 56.8% (F'13 cohort) • MSAE graduation rate for first-time graduate students: <ul style="list-style-type: none"> ○ 14.3% (F'08 cohort) ○ 62.5% (F'13 cohort) 	<p>Annually.</p>
<p>Establish a sustainable profile for the program within college limits in consultation with the dean that develops a successful model for growth of faculty, recruitment and course offerings.</p>	<p>Established.</p>	

Last updated: January 7, 2018 by Thalia Anagnos