# ABET
# Self-Study Report

**for the**

# B.S. in Aerospace Engineering

**at**

# San Jose State University
# San Jose, California

**June 21, 2011**

**CONFIDENTIAL**

# Table of Contents

# BACKGROUND INFORMATION

## A. Contact Information

Dr. Nikos J. Mourtos
Professor & Aerospace Engineering Associate Chair
Department of Mechanical and Aerospace Engineering
San Jose state University
One Washington Square
San Jose, California 95192-0087
Tel. (408) 924-3867
Fax (408) 924-3995
Email: nikos.mourtos@sjsu.edu

## B. Program History

The BSAE Program was formally installed in 1987 in the new Department of Aerospace Engineering. It grew quickly, one year enrolling more new freshmen students than any other program in the College. When it began, it offered the only BSAE degree between Seattle, Salt Lake City and San Luis Obispo. At its peak, the Program had 4 regular faculty (3 tenure-track and one full-time temporary), ten laboratories, and over 400 students. It achieved accreditation in its 4th year, then had its review cycle aligned with the rest of the College, and has been continuously accredited since. Awarded national recognition (ASEE/AIAA Atwood Award) in 1993 for innovation in AE education, the Program then experienced the same precipitous decline in enrollment, as did all other similar programs nationally with the end of the cold war in the early 1990s.

Consequently, in 1996 the Program merged with ME to form the Department of Mechanical and Aerospace Engineering (MAE). The MAE Department houses the BSAE, MSAE, BSME and MSME programs. It currently has 9 full-time, tenured ME faculty and 2 full-time, tenured AE faculty. While the merger worked well for several years it faltered due to the absence of AE representation in the administrative structure of the Department as well as the absence of a dedicated budget for the AE Program. This void hampered the AE faculty in their ability to carry out their responsibilities, such as student advising, curriculum and laboratory development, supervision of MSAE projects/theses, as well as AE faculty recruitment. The situation reached the point where the AE faculty had no input in any of the decisions affecting the AE Program. The imbalance between the number of faculty in the AE and ME programs was not addressed in a timely fashion and as a result, it has escalated into a full conflict.

The last general review, conducted in AY 2005–2006, resulted in an interim report requirement due to weaknesses indicated in Criteria 5 (now 6) Faculty and 7 (now 8) Institutional Support. The 2007–2008 interim evaluation indicated the Criterion 5 weakness remained unresolved.

In AY 2010-2011 the College appointed Dr. Desautel as Interim Chair of the MAE Department. At the same time, the University approved the request for a new

Department Chair at the full-professor level and a national search was initiated in Fall 2010.

## C. Options

The BSAE program does not have formal concentrations. However, it has two focus areas: Aircraft Design and Space Transportation & Exploration.

## D. Organizational Structure

The organizational structure of the University and the College is shown in Figures B.1 and B.2 respectively.

The AE and ME programs comprise the Department of Mechanical and Aerospace Engineering reporting to the Dean of the College of Engineering. The current organizational structure of the Department, established in AY 2010-2011 is shown in Figure B.3.

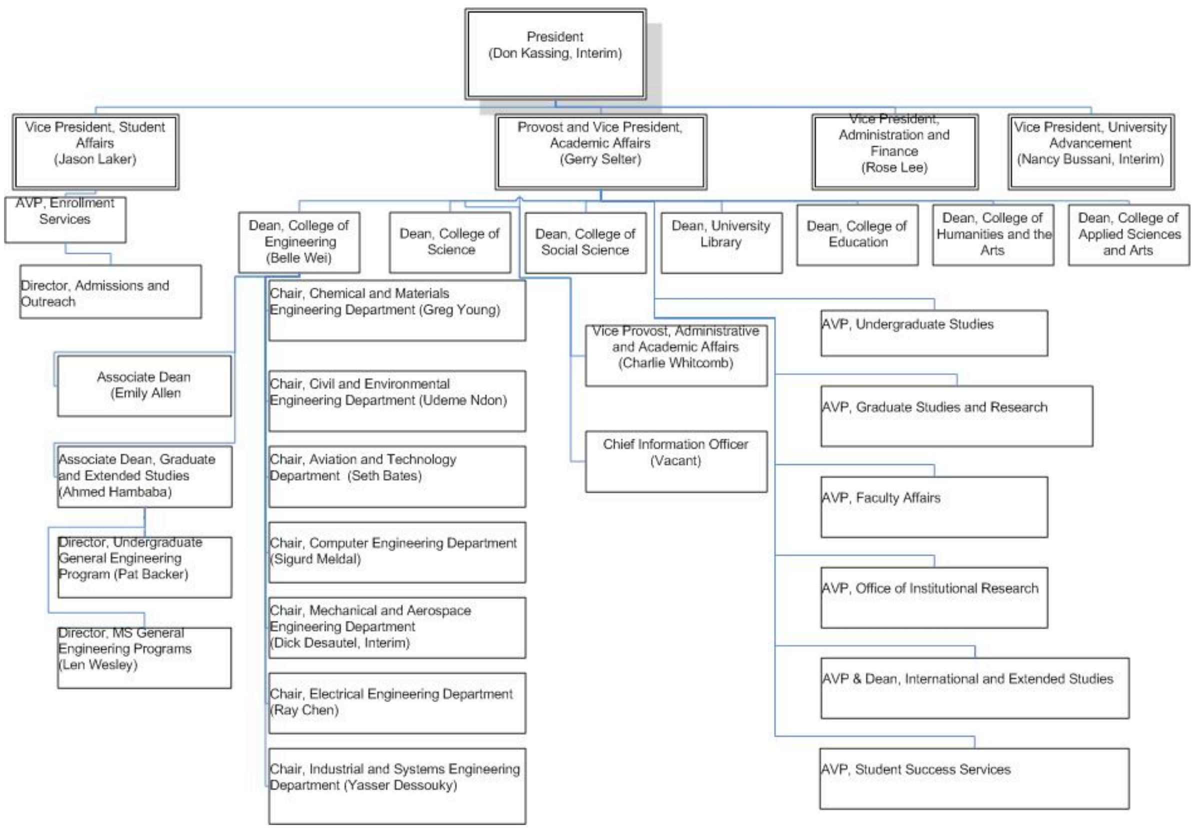



Figure B.1 – SJSU organizational structure

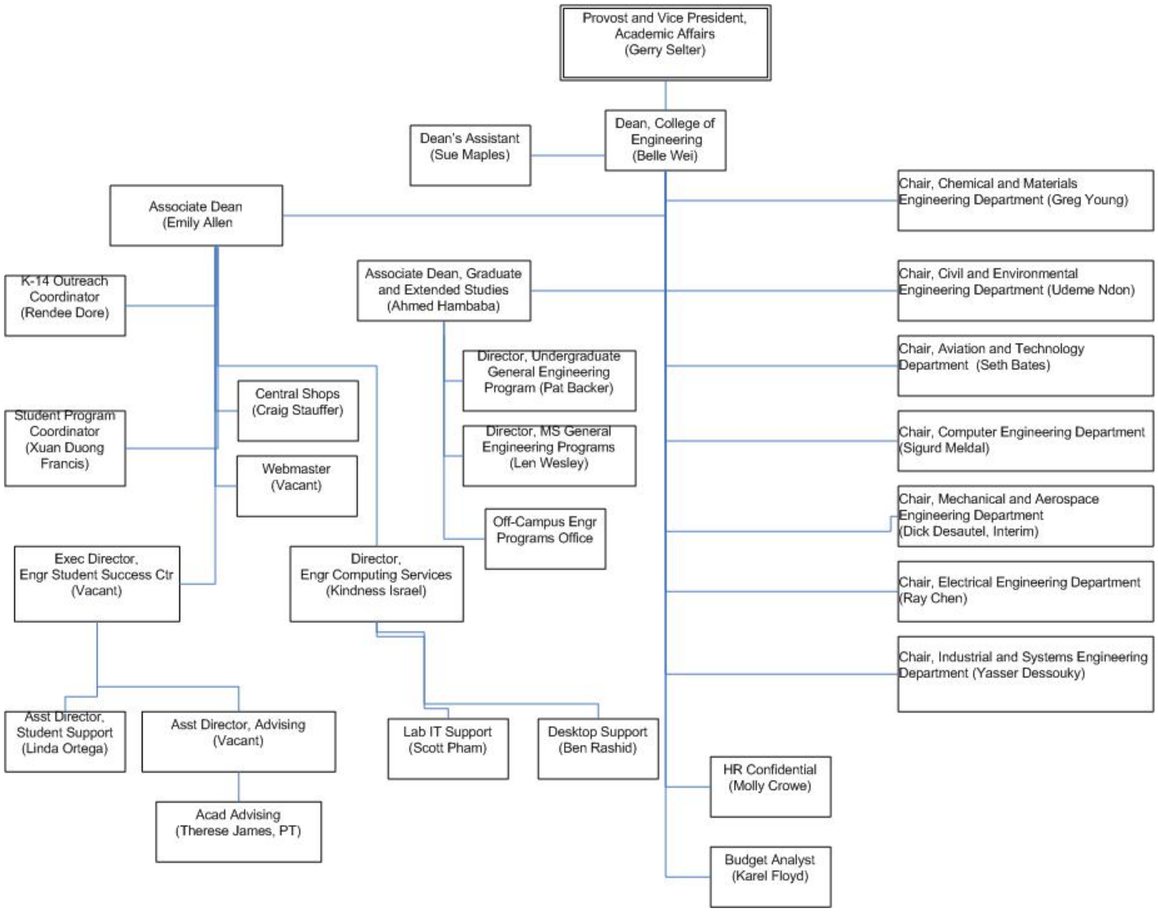



Figure B.2 – College of Engineering organizational structure

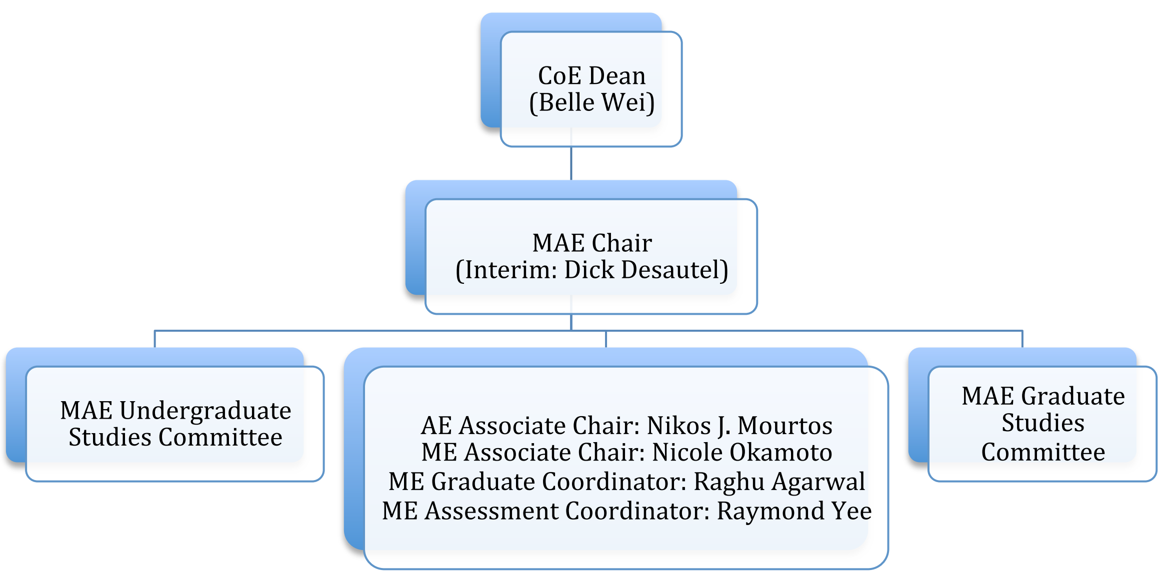



Figure B.3 – MAE Department organizational structure

This management structure serves the AE Program well, as a minority Program in a larger Department. It was based on a national survey of successful merged MAE Departments as well as other departments within the College. It is similar to the one installed in Fall 1996, at the time of the merger of the AE and ME programs. The appointment of Dr. Mourtos as the AE Associate Chair with 20% release time has allowed him to carry out the following responsibilities:

1. Scheduling and Staffing (Undergraduate & Graduate)
    - Design scheduling patterns that optimize program schedules and coordination between programs, and present for Chair's approval.
    - Assist Chair in resolving scheduling conflicts, determining schedule priorities and adjustments in response to budgetary requirements.
    - Assist Chair in recruitment, assignment and evaluation of Lecturers.

2. Lead Program Advisor (Undergraduate & Graduate)
    - Coordinate and contact BSAE and MSAE student advising and lead efforts to improve the advising process.
    - Resolve student issues with major forms, course equivalencies, violation of prerequisites or other infractions.
    - Forward to the Chair advising and graduation requirement issues that remain unresolved.
    - Provide detailed review and signature of BSAE major forms and MSAE Candidacy forms.
    - Coordinate and serve as instructor-on-record for AE180, AE295A&B, AE298, and AE299. This involves (a) preparing the course syllabi, (b) meeting with students on the first day of class to highlight requirements and expectations, (c) organizing monthly progress reports and attending all student presentations for the purpose of providing feedback, and (d) organizing and attending the final, end-of-semester student presentations.

3. Program Assessment and Review
    - Develop and implement an effective, efficient assessment process for the assessment of the BSAE and MSAE programs.
    - Coordinate the implementation of curriculum and laboratory improvements recommended through the assessment process.
    - Promote faculty involvement in and contributions to successful program assessment and accreditation processes.
    - Promote faculty ownership of program improvements developed through assessment processes.
    - Prepare the BSAE (ABET) and the BSAE / MSAE (WASC) Self-Study reports and assist the Chair in planning, preparation, and carrying out review visits.

4. Outreach
    - Assist in Program visibility and promotion with prospective students and the community by organizing displays for the Engineering Open House and participating in transfer advising.

- Form and maintain the AEAB[1], organize the Board meetings, serve as an ad hoc member on the Board, and summarize the Board's input.

In all the above areas, interfaces exist between the AE and the ME programs. The Program Associate Chairs work as a team under the Chair's leadership to benefit both programs by promoting information exchange, smooth operations, and conflict resolution.

Our experience in the past eight years has shown that the position of the AE Associate Chair is absolutely essential for the normal, day-to-day operations of the AE Program as well as for long-term vision and planning in a merged Department where the majority of the faculty and the Chair are Mechanical Engineers. Unfortunately, the benefits from this recent re-organization in the Department remain tentative as a large number of ME faculty are opposed to the management structure shown in Figure B.3 and in particular they are opposed to having an AE Associate Chair. Furthermore, there is still no dedicated budget for the AE Program. As a result, the AE Program is faced with a future of uncertainty in a largely hostile environment, without a formal structure that would preserve its character.

# E. Program Delivery Modes

The BSAE Program is delivered as a traditional lecture / laboratory, daytime program.

# F. Program Locations

The BSAE Program is located on the main San Jose State University campus in downtown San Jose.

# G. Deficiencies, Weaknesses or Concerns from the Previous Evaluation(s) and the Actions taken to Address Them

The 2005-2006 general review resulted in weaknesses indicated in Faculty (Criterion 5 then, now 6) and Institutional Support (Criterion 7 then, now 8). It indicated competent faculty members (regular faculty augmented by qualified part-time instructors) cover all curricular areas, but that teaching loads were very high for the small number of faculty. Also, the number of faculty was small relative to the number of students and overall scope of the program. Furthermore, it stated that no margin exists to accommodate faculty member departures, retirements, sabbaticals or even extended leave situations. It required a 2007/2008 interim evaluation by report. This interim evaluation addressed the faculty criterion weakness and determined it remained unresolved. The evaluation noted that the Department had conducted national searches in AY 2005/2006, AY 2007/2008, and AY 2008/2009, none of which resulted in hiring a new faculty member.

At the start of AY 2010/2011 Dr. Desautel, Emeritus Professor, was appointed as Interim Chair of the Department. Recruitment for a new permanent Department Chair was deemed critical, and a national search is underway in AY 2010/2011. The search seeks a leader with qualifications and experience in both AE and ME. It is one of only 12 searches approved for the entire campus.

[1] Aerospace Engineering Advisory Board

Furthermore, Dr. Desautel re-established the organizational structure that was in place at the start of the merger in 1996. In particular, the appointment of an AE Associate Chair, elected by the AE faculty, has resulted in some of the Program needs for support and planning being addressed. On the other hand, teaching loads for the AE faculty remain high compared to ME faculty due to the large number of preparations necessary with the smaller class sizes in the BSAE Program[2]. An additional factor for the higher AE faculty workload is the fact that assessment, as well as the implementation of necessary improvements in both the BSAE and MSAE programs is shared by only two full-time faculty members. On the positive side, a new part-time faculty member who played a pivotal role in the development of the BSAE Program has returned and is currently teaching and doing laboratory development in the area of aerospace structures and rigid-body dynamics.

## H. Joint Accreditation

The SJSU BSAE Program does not have joint accreditation.

[2] ME faculty have the option of reducing their number of preps by teaching larger sections of required core BSME courses.

# CRITERION 1. STUDENTS

## College Overview

The student body of the Charles W. Davidson College of Engineering mirrors that of the University in its demographics, with the exception that there are fewer women, and more Asian-Americans than in the general student body. Table 1.1 shows the demographic diversity of the College and the University. Many students at SJSU are first generation college students and as such need significant support and mentoring to find their way to degree attainment.

Table 1.1 – Student demographics

| *Ethnic Group* | *Engineering* | *SJSU* |
|---|---|---|
| American Indian | 0.2% | 0.3% |
| Black | 3.4% | 4.2% |
| Asian | 39.1% | 33.0% |
| Hispanic | 20.0% | 22.7% |
| White | 23.0% | 25.9% |
| Foreign | 6.7% | 4.2% |
| Other | 7.6% | 9.7% |
| Female | 14.1% | 51.4% |

From 2006 to 2010, the average incoming freshman composite SAT scores rose from 1,036 to 1,101 (Table 1.2), while the net enrollment remained at about 400 new freshmen; however there was rapid growth between 2006 and 2008 leading to a high incoming class of over 600. The new student enrollment has dropped since then, due to the establishment of campus enrollment caps.

Table 1.2 – Freshman enrollment and SAT scores

| *Fall* | *New FTF* | *SAT Composite* |
|---|---|---|
| 2006 | 389 | 1,036 |
| 2007 | 504 | 1,042 |
| 2008 | 625 | 1,054 |
| 2009 | 427 | 1,064 |
| 2010 | 399 | 1,101 |

The Charles W. Davidson College of Engineering currently (AY 2010-11) has about 2,750 undergraduates and 1,770 graduate (masters') students. The College has 79 tenured / tenure-track faculty, 156 part-time lecturers (for 33 FTE), and 26 clerical, administrative and technical staff.

## College Initiatives

In AY 2008-09 and 2009-10 the College launched two parallel initiatives intended to improve attainment of its mission: the 15x12 Initiative, and the Vision 2015 Initiative. The goal of the 15x12 Initiative is to improve the College Retention and Graduation rates by 15% by 2012. This initiative dovetails with the University's overall goal of improving Retention and Graduation rates. In support of this initiative, the College created the Engineering Student Success Center (ESSC), renovating a space and hiring an Executive Director through an Endowment Fund. (The Executive Director left in March 2010 and a recruitment process is in place as of this writing.)

The Vision 2015 Initiative is a strategic planning process, designed to review the Vision 2010 goals, determine whether or not they have been met, decide whether the College Vision and Mission statements are still appropriate, and create new goals to strive for through 2015. This initiative has been driven by Dean Belle Wei and has used multiple strategic planning task forces, the creation of a Resource Advisory Board, surveying of constituents, focus groups, and open forums to converge on a set of goals. This exercise is expected to be complete by the end of AY 2010-11 but not in time for inclusion in this Self-Study Report. Initial results of the process indicate that the existing Mission and Vision statements should be retained. The major areas, which are emerging include goals for supporting faculty success, and plans for supporting more interdisciplinary student projects.

The major focus areas for 15x12 Initiative have been the following:

(a) Raise the preparedness level of incoming students by declaring "impaction" (a CSU mechanism for raising admission criteria thresholds)
(b) Strengthen advising
(c) Increase the effectiveness of cohort programs to improve retention
(d) Remove bottlenecks to graduation by examining and improving gateway courses or improving enrollment management to ensure that students can find seats in critical path courses.

Item (a), impaction, is discussed below in Section A (admissions for freshmen) and Section C (admissions for transfer students).

Item (b), advising, has entailed significant effort at the College and Departmental levels over the last two years. The creation of the ESSC and the hiring of professional advisors has improved general education advising and removed it from the departmental workload; the ESSC advisors also work with students on academic probation and serve as a general resource center for students. Unfortunately the Assistant Director for Advising of the ESSC, Kate Bruffet, resigned in January 2010 (a recruitment process is under way at the time of this writing). To improve faculty advising, the Master Faculty Advisor Team (MFAT) was created, consisting of at least one faculty advisor from every department. The MFAT is responsible for discussing and approving (along with department faculty) academic performance policies as well as advising best practices, guidelines and tools. The MFAT has also worked with the University to create new Query Tools, which can extract specific student transcript information from the CMS database to help monitor student performance. The MFAT also is provided with training from University personnel. The Associate Dean is responsible for convening and managing the agenda for the MFAT meetings each semester; professional advising staff from the ESSC also participate in the meetings and contribute a different perspective based on their background in student development. MFAT personnel participate in the University Advising Liaisons and Advising Council meetings, which helps the College keep in touch with changes in policies, practices and advising processes University–wide. A College-level Advisors' Group Blog was created in 2010 and is the site of numerous discussions on policies and practices within the College. University advisors are also members of the Group and often contribute advice and information.

Item (c), increasing the effectiveness of cohort programs has mainly been the responsibility of the ESSC Assistant Director for Student Support Services (Linda Ortega). Linda directs the MESA Engineering Program (MEP) as well as the engineering frosh residential program (CELL) and the Women in Engineering Program. To improve the effectiveness of all the cohort programs as well as the ESSC, Peer Advisor and Peer Mentor programs have been created in the last two years. Corporate and individual donor support has been instrumental in creating the funds for these programs, which are supervised jointly by the ESSC staff in Advising and Student Support Services.

Finally, item (d), removing bottlenecks in curriculum is the responsibility of each program. Currently, there are no bottlenecks in the BSAE curriculum.

# A. Student Admissions

## A.1 Procedures, Criteria and Impaction

All new, transfer, and reentry students are admitted to SJSU by the Office of Admissions (part of Enrollment Services, reporting to the VP of Student Affairs). Students are provisionally admitted on self-report data, which is then checked and confirmed after the final transcript due date in July. At present the departments and the College have no involvement in any admission decisions. Our first contact with freshmen students and their academic records is either at the optional Admitted Spartans Day event in April or the mandatory Frosh Orientation in the summer. First contact with transfer students is either at the optional Admitted Spartans Day event in April or mandatory Transfer Orientations in the spring and summer (December and January for Spring transfer admits).

In Fall 2009, the CSU restricted admission due to the high demand by shutting off the application window earlier than usual. Preference for admission was then given to students from our "service area" which is Santa Clara County.

Beginning with the Fall 2010 admission cycle, certain high-demand majors went on "Impaction Status" which allowed them to have higher thresholds for admission requirements; this also enabled our "service area" to be widened to include the entire state as in the past. In Engineering, the impacted programs are: AE, CE, CompE , GE, ME, and EE.

It is required that each CSU campus allow access to students from its immediate "service area", students, Santa Clara County for SJSU. Under impaction, students who do not get accepted into their major of choice are admitted to the University as Undeclared majors. These students then have another opportunity to work their way into Engineering majors. This is discussed below in the Transfer Admission Section.

Admission of Freshman Students (Acceptance of transfer students and Change of Major students is described in Section C below).

### A.2 Freshmen Admissions

Up until the Fall 2010 admission cycle, all Engineering students had the same admission requirements as students in any other major at the University. All California residents or graduates of California high schools who met the minimum CSU Eligibility Index threshold were admitted to the major of their choice, including Engineering. There are no special course requirements (such as calculus or physics) for admission beyond those required for all freshmen in the CSU.

For freshman admits, the CSU Eligibility Index, the only numerical criteria used for admission, is used along with other high school completion requirements including completion of the a-g UC/CSU college prep course requirements. The CSU Eligibility Index (EI) is defined by the following formulas. The EI equals the high school GPA multiplied by 800 plus the SAT combined score for critical reading and math sections. Alternatively, the EI equals the high school GPA multiplied by 200 plus ten times the ACT composite score. The minimum CSU eligibility for California residents is 2900 (SAT) or 694 (ACT); for domestic out-of-state or international students the required EI is 3502 (SAT) or 842 (ACT).

Beginning Fall 2010, the impacted programs have a minimum EI of 3200 for California residents. Students with higher eligibility index are given higher priority, and limits are placed on the number of students accepted into the impacted majors. These limits are reviewed and adjusted each year.

## B. Evaluating Student Performance

Each engineering department maintains its own process of reviewing student performance and monitoring student progress. However, there are also new processes that are utilized college-wide, many of which have been instituted very recently.

### B.1 New College Academic Policies

In AY 2009-10, the college adopted a new policy on Academic Progress to Degree (attached in Appendix E). This policy defines major-related GPA as consisting of all courses in math, science and engineering which count towards the degree. Student must maintain a 2.0 minimum major-related GPA, in addition to the University requirement of overall 2.0 GPA. Previous to this policy, the 2.0 major-related GPA requirement was applied only as a graduation requirement, rather than a maintenance requirement. This meant that students could continue in the program repeating courses with very poor performance before eventually being subject to disqualification by the university. The flowchart shown in Figure 1.1 indicates the recovery process to good standing from probation to major disqualification, which can occur if the student does not maintain this GPA. Because this policy is brand new, the disqualification step has not been implemented yet. GPA query tools are needed for CMS in order to monitor this GPA. It is expected that these tools will be ready for Fall 2011 use. In the meantime, we have developed a lower-division-only Query Tool, which essentially shows Frosh and Sophomore students who are performing below the required GPA. These students are alerted by the departments that they are at risk of being on probation in the major.

If appropriate, they are requested to enroll in a probation workshop at the ESSC. In addition, they are restricted to 12 units the following semester. And they may be given a study plan to ensure that they take the appropriate courses that will not only improve their performance but ensure they still make progress towards their degree and demonstrate their ability to succeed in the major.

Most students now in the Engineering College have been here since before this policy was put in place. Therefore, the Probation in Major provision is being used to correct their performance.

All students in Engineering must see an advisor every semester in order to be able to register for classes, and advisors track student performance and perform intervention as needed. The advising process is described in section D below.

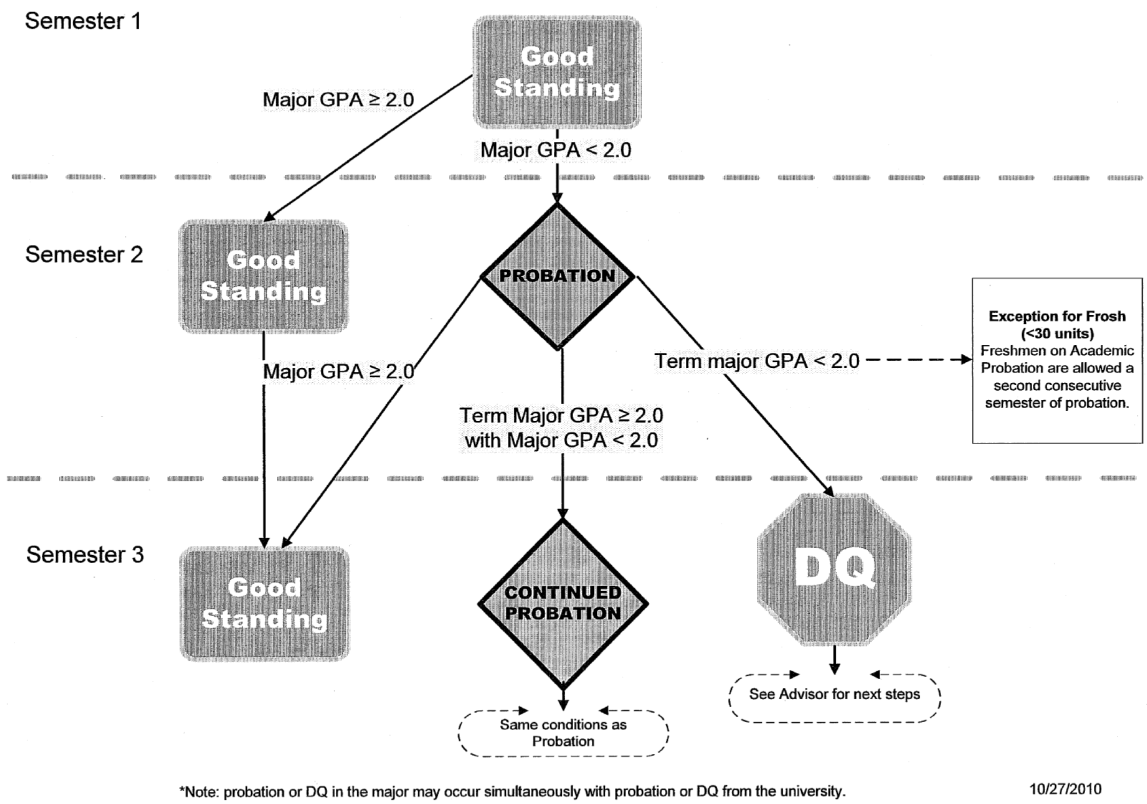



Figure 1.1 – Academic probation and disqualification process in the College

## B.2 AE Student Advising

AE students may come for advising any time during the semester and are advised only by full-time AE faculty. Students are required to meet prerequisites before taking a course. This is enforced in multiple ways:

- The online registration system checks that students have either completed or are currently enrolled in prerequisites. However, for spring courses students enroll before the end of the semester, so the online registration system can only check that students are enrolled in courses; it cannot check whether they have passed them or not at the time students enroll.

In addition, many students take their lower division courses at community colleges. Because the system cannot check these prerequisites, online checking of perquisites is only performed for courses with few or no lower division prerequisites.

- When students come for their mandatory advising every semester they are required to list on their Academic Advising Guide (Figure E.2, Appendix E) the courses they are taking in the current semester as well as the courses they plan to take in the following semester. Furthermore, they are required to list all the prerequisites for each and every course they plan to take. Faculty advisors check to make sure that students take courses in their proper sequence and do not violate prerequisites. Students sign a statement at the bottom of the form that they will not change their courses without advisor consent.
- On the first day of class instructors check their roster for students who may be enrolled or may be requesting an add code without having completed all the prerequisites. When in doubt, students are asked to furnish a transcript showing the successful completion of all their prerequisites. This is easily done in the AE Program because classes are small (10 to 30 students) and AE faculty members know most of the students by name.

Nevertheless, students will occasionally violate prerequisites. In a few cases, special permission is given due to unusual circumstances. These situations are documented in the student's file. If students are caught violating a prerequisite early in the semester, the instructor will typically drop them from the course. However, sometimes a student is not caught until after he/she has completed the course. Each situation is handled on a case-by-case basis, and some leniency is applied for a first-time offence.

# C. Transfer Students and Transfer Courses

## C1. Admission of Transfer Students

Up until the Fall 2010 admission cycle, all Engineering transfer students had the same admission requirements as students in any other major at the University. Students can transfer from any of the 112 California Community Colleges to SJSU after completing a minimum of 60 baccalaureate units at their community college.

The transfer students must also meet the following requirements: (1) have at least a 2.0 grade point average; and (2) have completed 30 semester units of general education including one course in English composition, one speech course, a math course with intermediate algebra as a prerequisite, and have earned a grade of C or better in each general education course.

Under impaction beginning Fall 2010, the minimum GPA for transfer student admission to impacted programs is 2.6. Students are admitted on a space-available basis, with more qualified students being given higher priority.

## C.2 Change of Major into Engineering

Prior to AY 2010-11, students could change major into Engineering simply by filling out a form and receiving approval by an advisor or chair of the new major. In AE, approval typically was given only if the student had a GPA of about 2.6 or higher, although there was no official policy in place. Once Impaction was declared (indicating a capacity issue) in Fall 2010, a new process was put in place. Students wishing to change major either within the College or from outside the College are required to speak to an advisor in the desired Major and agree on a study plan. The study plan must include a minimum of nine units of coursework required for the major and the student must earn a minimum C- in each course, and a 2.0 minimum GPA each semester, before being allowed to change into the new Major. Change-of-major decisions are made after the end of each semester after reviewing semester grades. Although technically students are only allowed to change major into AE as space is available, in the first round of this process at the end of Fall 2010, all students meeting the minimum requirements were allowed to change major. The CoE Change of Major policy is given in Appendix E.

## C.3 Evaluation of Transfer Credit

Transfer coursework is reviewed when a transfer student begins enrollment at SJSU. Beginning in AY 2010-11, Transfer Orientation became mandatory for all new transfer students. During the mandatory Transfer Orientation the student meets with a Faculty Advisor to review his or her previous coursework so that the appropriate roadmap can be developed for the student. Before the student arrives for orientation, professional advising staff in the ESSC review student work and identify which courses are articulated, and which need review. A marked copy of this review is provided to the student when they arrive for the College Orientation in the afternoon, and they bring this review to their Major Advisor. For General Education credit they meet with ESSC advisers.

It should be noted that prior to AY 2010-11, this process was not in place, and it was entirely up to the Major Advisor to review the transfer transcripts. Unfortunately the workload created by this sometimes caused a delay in the review. In some cases students did not learn until close to graduation that they had not met a lower division prerequisite. Thus the process described above was instituted, made possible by the establishment of the ESSC, as well as by the University recognition that Transfer Student Orientation should be mandatory.

The University administers transfer acceptance according to the CSU policies. The department is responsible for ensuring that engineering and support course transfers are properly documented. Some courses within the CSU or UC system have been articulated and no paperwork is required. All lower division courses from CCC have been articulated. Transfer equivalencies for upper division course or courses outside the CCC must be documented with various types of equivalency forms: international and domestic forms are different. In either case, the student must provide a catalogue description and course grade; these documents are submitted to the department which houses the equivalent course, and their evaluator makes a judgment and returns the form to the department. If the course is considered equivalent it is entered into the Major Form; if not, the student is required to take the SJSU course instead.

### C.3.1 California Community College Transfer Credit

Credit from California Community Colleges (CC) in courses required for the major or for General Education is given on the basis of articulation agreements between SJSU and each specific community college. Articulation of course credit among community colleges, other CSU institutions and University of California campuses is provided on a web page at www.assist.org. Transfer students are all aware of the Assist website as it is used extensively in community college pre-transfer advising.

### C.3.2 Non-California Community College Transfer Credit

Students transferring courses from institutions other than California CC must have their transcripts reviewed by their Major Advisor or an ESSC Advisor to determine who should evaluate their transfer credit and make the decision of whether their work is substantially equivalent to SJSU requirements. This is done by filling out an Equivalency Form, which is circulated to the department which offers the relevant course at SJSU, along with the transcript; sometimes a catalog description or other course materials may be required. The chair, or designee of the program responsible for the discipline at SJSU must attest to the equivalency of the course before credit is given. The student has a right to challenge the decision of the chairperson, in which case an examination will be given, and the student can obtain credit by satisfactorily completing the examination.

Courses from international institutions are evaluated on a separate document from those from domestic institutions. Admissions and Records assign the course to upper or lower division status and indicate the equivalent transfer units that can be allowed for the course. However, the same process of reviewing the content is carried out by the relevant department at SJSU.

### C.3.3 Appealing Credit Decisions

In the event a student wishes to contest transfer of courses for GE credit, they may petition for a review by the GE evaluation team in Undergraduate Studies. For those students transferring from institutions where no articulation agreements exist, the student is asked to present catalog information, textbook, and grade received, before any action is taken.

# D. Advising and Career Guidance

Continuing students are required to obtain advising from their Major department every semester. All Engineering students have a registration hold on their account until they have seen an advisor and been cleared for registration.

The Major Advisor provides guidance on which course to take as well as reviews the student roadmap. They also provide guidance in selecting technical electives, funding internships, and considering career options. The ESSC advisors provide guidance on GE courses.

When students get into academic performance trouble, for example being placed on probation, they are notified by their Department and required to attend a probation workshop conducted by the ESSC staff. They also meet with Peer Advisors at the Center. New policies on Academic Performance are discussed above in Section B.1.

Student advising is also available through the Academic Advising and Retention Services (AARS), which primarily helps with GE, University probation, progress to degree and other aspects of advising that are not specific to engineering. AARS advisors hold advising hours in the ESSC as well, which ensures that the College and the University are aware of all policies, which affect our students. Both faculty and staff advisors also maintain relationships with counselors in the Disability Resources Center (DRC) so that special student situations can be handled.

The Learning Assistance Resource Center (LARC) provides tutoring in most lower division math, science and engineering courses, often hiring students from the College as tutors. In addition the Writing Center, established in 2006 and located in Clark Hall, provides excellent instruction and tutoring for students in upper division (and graduate) courses with writing components.

### D.1 AE Continuing Student Advising

Each student comes for advising with a copy of their transcript and their AAG, shown in Figure E.2 (Appendix E). Students may come for advising during office hours or they can make a special appointment with one of the two full-time AE faculty members, any time during the semester. During the advising session, advisors fill in the BSAE Academic Course Log (ACL) shown in Figure E.3 (Appendix E). In particular, they fill in grades from the previous semester as well as the recommended courses for the following semester. Important information provided by the faculty member or the student is recorded in the "comments" section of the log. Faculty members are encouraged to discuss not only courses for the following semester but also plans for graduate school, employment or internships, as well as problems with which the students are dealing. Advisors refer students to other resources as needed, such as the ESSC for GE advising and special seminars, the DRC for students who may be suffering from a physical or learning disability, the Career Center, the Financial Aid

Office, and the Counseling Center. At the completion of the advising session the signed AAG is given to an administrative assistant, who lifts the advising hold and places the form in the student's file.

### D.2 Probation Advising

Students on probation by the university have an additional "hold" placed on their registration account. To remove this hold, they must meet several conditions – they must meet with an advisor in the Engineering Success Center, attend several probation workshops aimed at improving their performance, and attend regular meetings with a peer advisor who checks on their progress in courses. In addition, they are limited to 12 units per semester while on probation. Students on probation in the major only do not have such a "hold" placed on their registration accounts. They are sent a message via email asking them to come see the designated AE advisor. The advisor attempts to address the issues causing problems and also refers the students to the programs offered by the Engineering Success Center. These students are also told that they may not sign up for more than 12 units of coursework per semester although the registration system does not enforce this requirement.

## E. Work in Lieu of Courses

SJSU policies comply with Executive Order No. 1036, governing system-wide credit awarded for examinations, experiential learning, and instruction in non-collegiate settings. This executive order also establishes a framework for annual review and revision of academic credit for external examinations (such as Advanced Placement), and gives campuses additional clarity on how to apply ACE-recommended academic credit for military service. Campuses are encouraged to use this policy in determining the number of credits veterans have upon admission.

For Credit by Exam (CBE), student registers and pays and if s/he passes the course prior to the Drop Deadline, earns a Credit By Examination (CBE) which shows on the transcript. Administration of such exams is at the discretion of the Instructor and not all course grades can feasibly be based on examinations only. Waiver Exams (WE) are administered by the Testing Center. These satisfy the requirement, but do not earn baccalaureate credit. CBE and WE are rarely if ever applied to engineering requirements.

Military credit may be used to satisfy Area E (Human Understanding) and clear the 2-unit PE requirement with submission of the DD214 or DD295 showing one year of active duty.

SJSU grants credit toward its undergraduate degrees for successful completion of examinations of the Advanced Placement Program of the College Board. Students who present scores of three or better will be granted up to six semester units (nine quarter units) of College credit. The number of units granted, course equivalence, and satisfaction of requirements vary. Table 1.3 shows only the AP courses, which give credit within the engineering programs. Many other AP courses provide GE credit. Note that the Chemistry credit is not for the required Chem 1A course so it is not included on Table 1.3.

Table 1.3 – Course credit through AP exams

| Exam | Units | Course |
|---|---|---|
| Calculus AB* | 03 | Math 030 |
| Calculus BC* | 06 | Math 030 & 031 |
| Computer Science A | 03 | CS 046A |
| Physics C, Electricity & Magnetism | 04 | Phys 051 |
| Physics C, Mechanics | 04 | Phys 050 |

Similar documentation exists for IB and CLEP coursework.

# F. Graduation Requirements

## F.1 BSAE Graduation Requirements

Graduation requirements include a minimum of 134 units subdivided as follows:

- 30 units of GE = 24 units of lower division + 6 units of upper division. Before enrolling in upper division GE courses, students must pass the CSU-wide Writing Skills Test (WST), in which students answer multiple-choice questions relating to grammar and write an essay.
- 02 units of physical education
- 33 units preparation for the major[3]
- 63 units required engineering courses subdivided as follows:
    - 30 units of non-AE engineering courses[4]
    - 27 units of AE core courses
    - 06 units of capstone senior design experience
    - 06 units of upper division electives chosen with the consent of the AE Associate Chair.

To qualify for the degree, a student must receive a grade of a grade of "C-" or better in each and every course and earn a cumulative GPA of at least "C" (2.0) in each one of the following categories: all college work (overall average), all units attempted at SJSU, all units in the major, and all units in any minors. When students graduate from the AE Program, they receive the degree of Bachelor of Science in Aerospace Engineering.

[3] 35 units for students who take the physics 50-series. Most AE students take the 50-series.
[4] Math129 – Linear Algebra is counted with the math units. The 30 units include Engr100W, which is also a GE course.

## F.2 Process for Ensuring and Documenting that Each Graduate Completes All Graduation Requirements for the Program

Students typically apply for graduation when they complete 90 units or 15 months before graduation. The process involves assembling a packet with the following:

- BSAE Major Form (MF)
- Application for Graduation
- GE Checklist filled out by an advisor in the ESSC
- Equivalency forms for transfer courses from schools outside the CSU system and CC network (if any)
- SJSU and other transcripts (for non-SJSU courses)
- Minor forms (if any)

Examples of a BSAE MF, the GE Checklist, and Application for Graduation are shown in Figures E.4, E.5, and E.6 respectively (Appendix E).

The key (paper) document for ensuring that every graduate has met all graduation requirements is the MF. The MF lists all Courses Required in Preparation for the Major (Math and Science, bottom part of the form) and all Courses Required for the Major (top part of the form). The latter include the Engineering Core (#1–12), the AE Core (#13–21), the Capstone Senior Design Sequence (#22–23), and the Technical Electives (#24–25). With the exception of Engr100W – Technical Writing, which is required for all engineering students, GE courses are not included.

If a course has been completed, students type in their grade. Any course substitutions from the official plan are clearly indicated on the MF. The most common substitutions are for lower division transfer courses, which are automatically approved, if articulated. These courses are listed on assist.org, as discussed earlier. Substitutions from outside this list are possible with an approved Equivalency Form signed by the course coordinator from the SJSU department that offers the particular course. The AE Associate Chair before signing the MF must ensure that all course substitutions from transfer institutions have been carefully reviewed. Occasionally the AE Associate Chair may approve a course without an official Equivalency Form. For example, CompE46 is similar to ME30, and this substitution is accepted with no paperwork. Another common substitution is *Engr11 – Intro to Engineering for Transfer Students* in place of *Engr10 – Intro to Engineering*.

Student grades are also checked to ensure that each and every course meets the minimum requirement of C- for graduation. Once the AE Associate Chair signs the MF, it is sent to Evaluations and it serves essentially as a contract between the student and the University. The University Evaluations Office checks the student transcript (both SJSU and transfer) for completion of all requirements listed on the MF. A Graduation Worksheet is sent to the student indicating all un-fulfilled requirements to be completed. A diploma is only issued after all requirements have been met and grades recorded. Changes can be made to the MF by Course Substitution forms and must be approved by the AE Associate Chair. Changes typically involve technical electives. Evaluations also checks for an overall SJSU GPA of 2.0, plus any other GPA requirements for the Major. For the BSAE Degree, these are:

- Overall GPA of 2.0 on the MF and

- GPA of 2.0 in the Required Courses for the Major (top section of the MF).

## G. Transcripts of Recent Graduates

The students' major on their transcripts reads "Bachelor of Science in Aerospace Engineering". There are no official program options. However, students may choose to indicate a focus area on their major form, "Aircraft Design" or "Space Transportation and Exploration", based on their choice of capstone senior design experience.

# CRITERION 2.
# PROGRAM EDUCATIONAL OBJECTIVES

The BSAE Program Educational Objectives (PEO) have been developed to be consistent with the mission of (a) San José State University (SJSU), (b) the College of Engineering (CoE) and (c) the Department of Mechanical and Aerospace Engineering (MAE).

## A. Mission Statement

***San Jose State University***

SJSU is a major, comprehensive public university located in the center of San José and in the heart of Silicon Valley. SJSU is the oldest state university in California. Its distinctive character has been forged by its long history, by its location, and by its vision – a blend of the old and the new, of the traditional and the innovative. Among its most prized traditions is an uncompromising commitment to offer access to higher education to all persons who meet the criteria for admission, yielding a stimulating mix of age groups, cultures, and economic backgrounds for teaching, learning and research. SJSU takes pride in and is firmly committed to teaching and learning, with a faculty that is active in scholarship, research, technological innovation, community service and the arts.

*In collaboration with nearby industries and communities, faculty and staff is dedicated to achieving the University mission as a responsive institution of the State of California: To enrich the lives of its students, to transmit knowledge to its students along with the necessary skills for applying it in the service of our society, and to expand the base of knowledge through research and scholarship.*

The University goals are that graduates should have:

- In-depth knowledge of a major field of study.
- Broad understanding of the sciences, social sciences, humanities, and the arts.
- Skills in communication and in critical inquiry.
- Multicultural and global perspectives gained through intellectual and social exchange with people of diverse economic and ethnic backgrounds.
- Active participation in professional, artistic, and ethnic communities.
- Responsible citizenship and an understanding of ethical choices inherent in human development.

***College of Engineering***

*Vision:* to be a learning community that empowers students to better the world through innovative applications of engineering knowledge and skills.

Learn Engineering Knowledge and Skills

By deepening students' understanding of engineering fundamentals, scientific knowledge, and analytic concepts and methods as well as providing them with engineering skills:

- To sharpen students' grasp of foundational scientific theories by linking them to engineering applications.
- To provide students cutting-edge engineering knowledge and skills that reflect current and future engineering practices.
- To instill in students the love of learning through active engagement with teachers both inside and outside classrooms.
- To develop students' intellectual capabilities through inquiry-based teaching and learning.

Develop Innovative Applications

By providing students opportunities and tools to develop innovative solutions to significant societal and technological problems:

- To guide students to identify current and future problems and understand their social and economic contexts.
- To teach students to think creatively and methodically and cultivate their creative processes to "see" beyond limits and boundaries.
- To encourage and teach students to reach across their major fields of study for integrated solutions to real-world problems.

Better the World

By fostering students' moral commitment to use their education in a way that benefits not only themselves but also the world:

- To educate students on the unique role that engineering plays in the advancement of society: building infrastructure, advancing technologies, expanding possibilities and developing solutions.
- To foster students' understanding of the complexity and interconnectedness of the globalized society of the 21st century.
- To help students grasp the future trends of the world and the challenges and opportunities it will present.

*Mission:* to educate new engineers for the new century, who are technically excellent, globally informed, and socially responsible.

***Mechanical & Aerospace Engineering Department***

*Mission:* to serve society, the public sector, and private industry by:

- Providing undergraduate and graduate aerospace and mechanical engineering education that prepares students with the knowledge, modern applications, and lifelong learning skills required to serve the engineering profession and industry.
- Contributing to the development and application of knowledge through faculty scholarship.
- Preparing students for the modern professional-practice environment.

## B. BSAE Program Educational Objectives

The BSAE Program is designed to fulfill the University, College, and Department mission as described above. It attracts students who have strong interests and fascination with flight vehicles (aircraft and spacecraft) and / or the advanced technologies pioneered in the field of flight. The curriculum is designed to prepare students for:

- Professional careers in aeronautical and astronautical engineering research, design, development, testing, and systems integration.
- Entry-level positions in a broader spectrum of the aerospace industry, not just the traditional flight vehicle manufacturers.
- Graduate study.

The PEO of the BSAE Program reflect our constituents' expectations that our graduates:

1. *Hold positions of technical responsibility, as members or leaders of multi-disciplinary teams engaged in aerospace engineering problem solving, modeling, systems analysis, design, development, testing or research.*
2. *Have enhanced and continue to enhance their professional skills by pursuing / completing a graduate degree or other post-graduate training.*
3. *Are well rounded in their understanding of multicultural and global perspectives and work effectively with engineers and customers from around the world, while providing for issues such as public safety, honest product marketing, and respect for intellectual property.*

The PEO are posted on the MAE Department website[5] and are normally published in the Department brochures. As of the writing of this report the Department brochures have not yet been updated with the current PEO.

[5] <http://www.engr.sjsu.edu/mae/aboutus_missionBSAE.html>

# C. Consistency of the PEO with the Mission of the University

Table 2.1 – Mapping of BSAE PEO to SJSU Missions and Goals

| *SJSU Mission* | *BSAE Program Educational Objectives* | *SJSU Goals* |
|---|---|---|
| To enrich the lives of its students.<br><br>To transmit knowledge to its students along with the necessary skills for applying it in the service of our society.<br><br>To expand the base of knowledge through research and scholarship. | PEO#1: Hold positions of technical responsibility, as members or leaders of multi-disciplinary teams engaged in aerospace engineering problem solving, modeling, systems analysis, design, testing or research. | In-depth knowledge of a major field of study. |
| | PEO#1: Engaged in problem solving, modeling, systems analysis, design, testing or research.<br>PEO#3: Well rounded in their understanding of multicultural and global perspectives. | Broad understanding of the sciences, social sciences, humanities, and the arts. |
| | PEO#3: Well rounded in their understanding of multicultural and global perspectives and work effectively with engineers and customers from around the world. | Multicultural and global perspectives gained through intellectual and social exchange with people of diverse economic and ethnic backgrounds. |
| | PEO#1: Hold positions of technical responsibility, as members or leaders of multi-disciplinary teams engaged in aerospace engineering problem solving, modeling, systems analysis, design, testing or research. | Skills in communication and in critical inquiry. |
| | PEO#2: Continue to enhance their professional skills by pursuing / completing a graduate degree or other post-graduate training. | Active participation in professional, artistic, and ethnic communities. |
| | PEO#3: Provide for issues such as public safety, honest product marketing, and respect for intellectual property. | Responsible citizenship and an understanding of ethical choices inherent in human development. |

Table 2.1 shows how the BSAE PEO are aligned with the University mission and goals. For example, PEO#1 is consistent with SJSU mission to enrich the lives of its students and to transmit knowledge along with the necessary skills for applying it in the service of our society. PEO#1 corresponds directly with SJSU goals to prepare graduates with an in-depth knowledge of a field of study who have a broad understanding of the sciences, social sciences, humanities, and the arts, and have skills in communication and critical inquiry. PEO#2 emphasizes the need of lifelong learning skills in an era of rapid knowledge development and emerging technologies and is consistent with SJSU mission to enrich the lives of its students, so they can continue to be effective players in an ever-changing world. PEO#2 corresponds directly with SJSU goal to prepare graduates who are active participants in their professional communities. Lastly, PEO#3 recognizes the importance of breadth in the education of our graduates and is consistent with SJSU mission to educate students, so they can apply their knowledge in the service of our society. PEO#3 corresponds directly with SJSU goal to prepare graduates with multicultural and global perspectives gained through intellectual and social exchange with people of diverse economic and ethnic backgrounds as well as for responsible citizenship and an understanding of ethical choices inherent in human development.

## D. BSAE Program Constituencies

The BSAE Program has identified the following as its constituents:

***AE Students***

The primary goal of the BSAE Program, as reflected in the University mission and the PEO, is twofold: to prepare students for (a) a successful career in their chosen field, and (b) responsible citizenship in a multicultural, globalized world. Hence, it is only reasonable that student input is taken into consideration when defining the PEO. This input is solicited through exit interviews, when students are mature enough and have had some experience in job searching. Student input is not used in any way to assess the achievement of the PEO.

***AE Program Faculty***

The AE faculty manages the educational process and has an understanding of the current skills and knowledge required to practice in the field as well as a vision for the future. Moreover, the AE faculty is responsible for Program assessment and the implementation of a process for the continuous improvement of the Program. Hence, their input is important in defining the PEO. Faculty input is not used in any way to assess the achievement of the PEO.

***AE Program Alumni***

The alumni, especially a few years after graduation, are likely to gain additional perspectives about AE in general and more specifically, about the Program from which they graduated. Alumni have a unique view of how the Program has supported their career goals and professional accomplishments. Hence, their input is critical both in regards to the appropriateness of the PEO as well as the achievement of the PEO.

***AE Employers***

PEO should be strongly influenced by the needs and opinion of current and potential employers of our graduates. Employer satisfaction with our graduates reflects a positive image for our Program and gives a competitive advantage for our graduates.

***AE Advisory Board (AEAB)***

The AE Program has its own Advisory Board (see Appendix F). It consists of representatives from key companies and government organizations (Space Systems Loral, Lockheed-Martin, Cessna, and NASA), which employ our graduates. The AEAB was formed in 2005 and the goal is to convene twice a year to:

- Provide guidance on current AE industrial trends and the kinds of skills aerospace engineers need to have to succeed in today's industry.
- Assess how well the BSAE Program prepares students in these skills.

- Help establish an ongoing, productive relationship between the AE Program and their companies / government organizations through student internships, faculty research grants, and equipment donations for instructional purposes.

## E. Process for Revision of the of the BSAE PEO

The BSAE PEO are normally reviewed periodically every three years, according to the process illustrated in Figure 2.1. Input from all our constituents is used to validate the definition of the PEO. However, only employer and alumni input is used to assess achievement of the PEO.

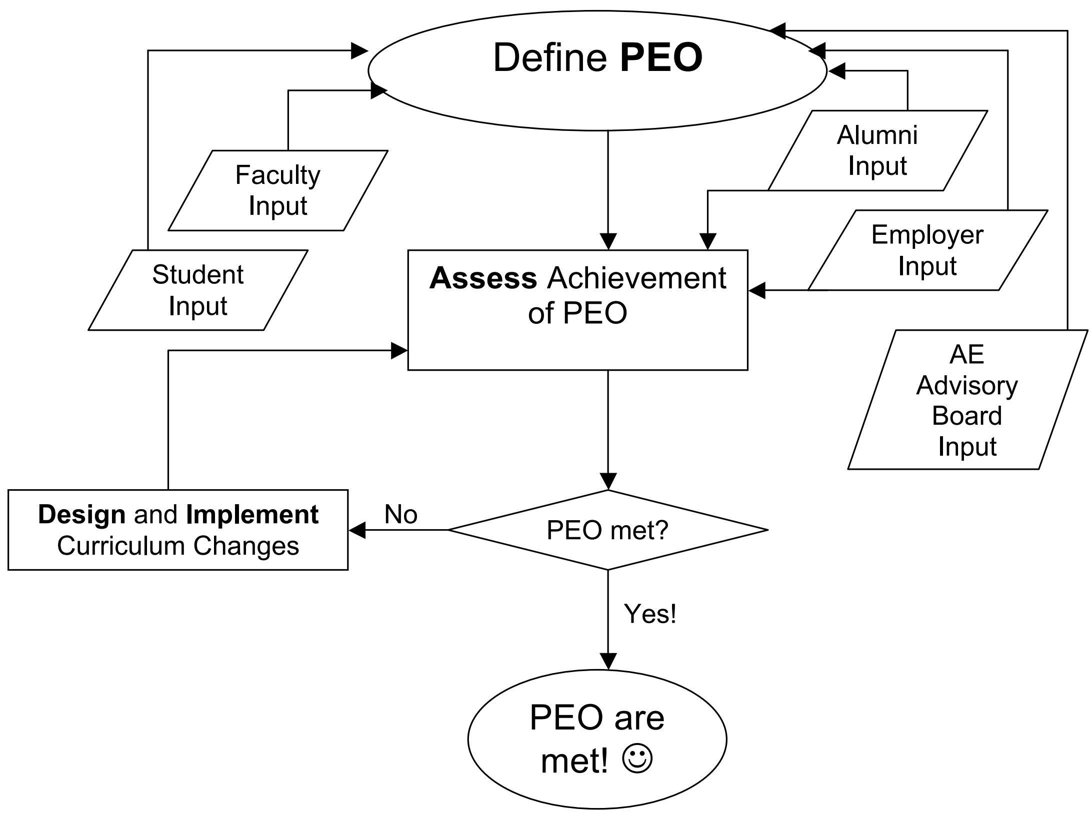



Figure 2.1 – Definition and assessment process for PEO

In Fall 2010 the BSAE PEO were revised to conform to the new ABET definition, namely that they reflect the career and professional accomplishments of graduates during the first several years after graduation. This revision followed a significant amount of discussion by the AE faculty. The revised BSAE PEO were presented at the MAE Department retreat and were finalized at one of our department meetings in Fall 2010. Exit interviews of graduating seniors, alumni surveys, and input from the AEAB validate all three PEO and indicate that they are indeed current and meet their needs. Furthermore, alumni and AEAB input shows that the BSAE Program adequately prepares students to meet these objectives, hence our PEO are met. The assessment of the PEO is presented in Criterion 4.

# CRITERION 3. STUDENT OUTCOMES

## A. Student Outcomes

*Outcome 3A* Ability to apply mathematics, science, and engineering principles to identify, formulate and solve aerospace engineering problems

*Outcome 3B* Ability to design and conduct water tunnel and wind tunnel experiments, as well as to analyze and interpret data from such experiments

*Outcome 3C* Ability to perform conceptual and preliminary design of aircraft or spacecraft to meet a set of mission requirements within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability

*Outcome 3D* Ability to collaborate with people from different cultures, abilities, backgrounds, and disciplines to complete AE projects

*Outcome 3E* Ability to communicate effectively through technical reports, memos, and oral presentations as well as in small group settings

*Outcome 3F* Understanding of professional and ethical responsibility

*Outcome 3G* Broad education to understand current events, how they relate to aerospace engineering, as well as the impact of aerospace vehicles in a global / societal context

*Outcome 3H* Recognition of the need for, and ability to engage in life-long learning

*Outcome 3I* Ability to use the techniques, skills, and modern engineering tools (analytical, experimental, and computational) necessary for aerospace engineering practice

The original ABET Outcomes 3(a) and 3(e) were merged into BSAE Outcome 3A because the AE faculty feels that the ability to identify, formulate, and solve AE problems very much dependents on student ability to apply mathematics, science, and engineering principles. Similarly, the original ABET Outcomes 3(h) and 3(j) were merged into BSAE Outcome 3G because the broad education necessary to evaluate the impact of engineering solutions in a global / societal context also contributes to, and depends on one's understanding of current events and how these events are influenced by technology. Table 3.1 provides a mapping of the BSAE Student Outcomes to the original (a) through (k) Student Outcomes as listed in ABET Criterion 3.

## B. Relationship of Student Outcomes to PEO

The PEO are linked to the Student Outcomes as shown in Table 3.1.

Table 3.1 – Mapping of BSAE Student Outcomes to original ABET (a) – (k) Student Outcomes and to the PEO.

| | Student Outcomes | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| *BSAE* | A | B | C | D | E | F | G | H | I |
| *Original ABET* | (a), (e) | (b) | (c) | (d) | (g) | (f) | (h), (j) | (i) | (k) |
| *PEO # 1* | O | O | O | O | O | O | | O | O |
| *PEO # 2* | O | | | | | | | O | O |
| *PEO # 3* | | | | O | | O | O | | |

# CRITERION 4.
# CONTINUOUS IMPROVEMENT

## A. Students

### A.1 Improvements in Student Advising

Before AY 2007–08, AE students were advised by either AE or ME faculty. This system resulted in several cases of incorrect advising by ME faculty, who are not familiar with the AE Program. For example, when students come for spring advising in the fall of their junior year, they sometimes fail to list on their Academic Advising Guide one of the required AE core courses, which are offered only in the spring semester; an ME advisor could easily miss such a course. As a result, students would be unable to take their capstone design sequence in their senior year and their graduation was delayed by an entire AY. In a few cases, when it was realized that the problem was incorrect advising rather than negligence on the part of the student, exceptions were made and students were allowed to take their senior design capstone sequence without a prerequisite. This problem was fixed in Spring 2007 when the Dean's Office mandated that only full-time AE faculty would advise AE students.

### A.2 Raising the Minimum Grade Requirement

Prior to Fall 2006, the minimum grade required for graduation was D- in all courses in the major with the exception of selected AE and ME core courses, in which a C- was required. As a result, a few students were graduating without achieving the minimum acceptable level of achievement (70%) for certain outcomes addressed in those courses. To eliminate this problem, the minimum grade requirement for graduation was changed to a C- in Fall 2006 for all courses. Hence, students who started in Fall 2006 or later must achieve a higher minimum level of performance than they did prior to the last ABET visit.

## B. Program Educational Objectives

As mentioned in Criterion 2, the BSAE PEO are normally reviewed periodically every three years, according to the process illustrated in Figure 2.1. Unfortunately, due to a breakdown in the MAE Department administration, this process has not been fully implemented since AY 2004–2005. Regarding the definition of the PEO, student input has been solicited through exit interviews on a regular basis. On the other hand, the first time alumni surveys were sent out since our last ABET visit was Summer 2010 and the AEAB did not convene between 2005 and 2011. A new AEAB was recently formed (Appendix F) and convened on April 6, 2011.

***Student Exit Interviews***

Table 4.1 shows the number of graduating seniors interviewed from Spring 2007 through Spring 2010. The total number of responses summarized below is 41.

Table 4.1 – Number of graduating seniors interviewed

| Spring 07 | Spring 08 | Spring 09 | Spring 10 |
|---|---|---|---|
| 20 | 14 | 02 | 05 |

Three open-ended questions were used in these interviews. Two of the questions pertain to the BSAE curriculum and the BSAE Program in general and are discussed in Section D. The first question pertains to the definition of the BSAE PEO and is included below.

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

A summary of the most frequent student responses to this question is shown in Table 4.2. Whenever possible, student responses were grouped together. For example, if a student identified technical writing as one of the most important skills, his response was counted under "communication skills" as well as under "technical writing". If, on the other hand, the student simply mentioned communication skills, then the response was counted only under "communication skills". This explains why the number of responses in the various sub-categories does not add up to the total number shown next to each major category.

Table 4.2 – Summary of most frequent student responses to exit interview Question #1

| | |
|---|---|
| Communication skills | **24** |
| *Technical Writing* | 9 |
| *Presentation skills* | 7 |
| AE fundamentals | **23** |
| *Aerodynamics* | 5 |
| *Design skills* | 4 |
| *Propulsion* | 2 |
| *Compressible Flow* | 2 |
| Team / interpersonal skills | **23** |
| Problem solving skills - creativity, improvisation, adaptability, critical thinking | **15** |
| Computer skills / Modern Tools | **14** |
| *CFD* | 10 |
| *CAD* | 10 |
| *Programming* | 2 |
| *Matlab* | 2 |
| Professional Development Skills | **8** |
| *Leadership* | 4 |
| *Motivation; taking initiative; drive* | 4 |
| *Time management, planning, multi-tasking* | 3 |
| *Perseverance; determination* | 2 |
| Manufacturing knowledge, skills | **7** |
| *Hands-on, building skills* | 2 |
| Lifelong learning skills | **5** |
| Project skills | **2** |
| Laboratory skills | **2** |

Student responses to Question #1 validate PEO # 1, 2, and 3.

***Alumni Surveys***

Alumni surveys were sent out in Summer 2010. Ninety-two (92) BSAE alumni graduated within the last 5 years and 13 responded to the survey, a return rate of 14%. Two of the respondents were unemployed. A summary of responses related to the PEO is shown below.

*Evaluation of the PEO through Employment Data of BSAE Graduates*

Table 4.3 lists the companies in which the respondents worked at the time of the survey, Tables 4.4 and 4.5 list their current and previous job titles, and Table 4.6 summarizes their job responsibilities using more general descriptors, which match the PEO.

Table 4.3 – Companies, which employ recent BSAE alumni

| *Company Name* | *# of alumni employed* |
|---|---|
| Space Systems / Loral | 3 |
| NASA Ames Research Center | 1 |
| Lockheed Martin | 1 |
| Vibrynt Inc. | 1 |
| PGE | 1 |
| Salas O'Brien | 1 |
| Ford Motor Company | 1 |

Table 4.4 – BSAE alumni current job titles

| *Job Title* | *# of alumni* | *# of years on the job* |
|---|---|---|
| R&D Engineer | 2 | 2 / 1.5 |
| Satellite Operations Engineer | 1 | 2 |
| Small Satellite Intern | 1 | Less than 1 |
| Systems Integration / Test Engineer | 1 | 3 |
| Product Development Engineer | 1 | 5 |
| Project Engineer | 1 | 1.5 |
| Field Engineer | 1 | Less than 1 |
| Operations Engineer | 1 | 3 |
| Mechanical Engineer | 1 | 2 |

Table 4.5 – BSAE alumni previous job titles

| *Job Title* | *# of alumni* | *# of years on the job* |
|---|---|---|
| Operations Engineer | 1 | 2 |
| Entry Level Analyst | 1 | |
| Systems Engineer: Mass Management Lead | 1 | 3 |
| Automation Engineering Intern | 1 | 2 |
| Test Engineer | 2 | 1.5 |
| Mechanical Engineer | 2 | 1 |
| Associate Gas Engineer | 1 | 2 |
| Body Structures – Exterior Lighting | 1 | |
| Operations Clerk | 1 | 1 |

Table 4.6 – BSAE alumni job responsibilities

| | # of alumni | % of respondents |
|---|---|---|
| Development | 9 | 75% |
| Testing | 9 | 75% |
| Design | 6 | 50% |
| Research | 5 | 42% |
| Manufacturing | 4 | 33% |
| Administrative / Management | 4 | 33% |
| Other | 2 | 17% |

The following observations can be made from Table 4.6:

- The largest percentage of our most recent graduates work in development (75%) and testing (75%), followed by design (50%), research (42%) and manufacturing (42%); 33% have administrative / management responsibilities. These data validate PEO#1.
- Although the number of surveys received is small, the types of jobs held by our graduates, indicates that our Program prepares them well for these positions.

Furthermore, 67% of the respondents felt that their engineering education at SJSU prepared them well for their career compared to their co-workers; 22% (2) were not sure and 11% (1) felt that this was not the case.

***Evaluation of PEO through M.S. Degree Enrollment and/or Completion Data***

None of the respondents had completed their M.S. or any other advanced degree at the time of the survey; however, six of them (46%) were enrolled in a graduate program, as follows:

- Three (23%) were enrolled in an MSAE (SJSU) or MS in Aeronautics & Astronautics program (Stanford University)
- One (8%) was enrolled in an MSME program (Santa Clara University)
- One (8%) was enrolled in a MS in General Engineering with emphasis in Materials Engineering (SJSU)
- One (8%) was enrolled in an MS in Engineering Management and Leadership program (Santa Clara University)

Furthermore, six of the respondents (46%) had received training or attended seminars / workshops since their graduation from SJSU. These data validate PEO#2.

Table 4.7 – Summary of alumni comments

| | |
|---|---|
| The BSAE Program has excellent professors | 4 |
| *willing to help students understand complex concepts,*<br>*willing to do whatever it takes to ensure graduates are well prepared,*<br>*emphasize teamwork, a practice incredibly helpful in AE industry,*<br>*compared with students from other campuses, AE grads from SJSU know the material and are willing to stand behind what they present* | |
| The BSAE Program does not have enough full-time faculty | 2 |
| Enjoyed part-time faculty from industry (Murbach, Djordjevic, Swei) | 1 |

Table 4.8 – Summary of alumni recommendations

| | |
|---|---|
| *Set up a fund to provide an initial amount of money to each senior design project ($200-$300)* | 1 |
| *AE labs need to be upgraded; add more labs* | 2 |
| *Introduce a programming course that focuses on general programming concepts rather than a specific language; teach C++, Java, Linux but not LABVIEW* | 2 |
| *Hire more full-time AE faculty; make sure they know how to teach a class* | 1 |
| *Replace CE and ME courses with more courses that focus on spacecraft* | 1 |
| Recommendations for new electives and / or short courses | |
| *The environment of space and its effect on spacecraft (thermal snap, out-gassing, lubrication of equipment, radiation, materials selection)* | 1 |
| *History & current applications of UAV* | 1 |
| *Orbital mechanics* | 1 |
| *Linear algebra* **(already installed as a required course)** | 1 |
| *Vector calculus* | 1 |
| *Optical systems* | 1 |
| *Sensors* | 2 |
| *Aeroacoustics* | 1 |
| *Programming methodology* | 1 |
| *Satellite communications (antenna design)* | 1 |
| *Project management* | 2 |
| *Human factors* | 1 |
| *Aerospace biomedical* | 1 |
| *Machine shop class* | 1 |
| *Satellite design and operation* | 1 |
| *Attitude determination & control systems* | 1 |
| *Electrical systems; lab with electrical budget* | 1 |
| Recommendations for short courses | |
| *ProEngineer* **(has been available as an elective)** | 1 |
| *Matlab* | 1 |
| *Geometric Dimensioning & Tolerance* | 1 |
| *Engineering accounting* | 1 |

Table 4.9 – Summary of alumni responses on the importance and achievement of the PEO

| PEO | | Agree | Not sure | Disagree |
|---|---|---|---|---|
| 1, 3 | The AE Program helped me improve my *interpersonal, team,* and *leadership skills.* | 4 (40%) | 5 (50%) | 1 (10%) |
| 1, 3 | Interpersonal, team, and leadership skills *are important* for the kind of work I do. | 9 (90%) | 1 (10%) | 0 |
| 1 | The AE Program has given me strong *problem-solving skills.* | 7 (70%) | 3 (30%) | 0 |
| 1 | Problem-solving skills *are important* for the kind of work I do. | 9 (90%) | 1 (10%) | 0 |
| 1 | The AE Program has given me strong *design skills.* | 6 (67%) | 2 (22%) | 1 (10%) |
| 1 | Design skills *are important* for the kind of work I do. | 7 (70%) | 2 (20%) | 1 (10%) |
| 1 | The AE Program has given me strong skills for *hands-on laboratory work* and *testing.* | 5 (56%) | 2 (22%) | 2 (22%) |
| 1 | Hands-on laboratory work *is important* for the kind of work I do. | 8 (80%) | 2 (20%) | 0 |
| 2 | The AE Program has given me a strong foundation for *graduate work.* | 7 (78%) | 2 (22%) | 0 |
| 3 | The AE Program has given me a *broad knowledge* as well as *an understanding of multicultural* and *global perspectives* in engineering, that allows me to work effectively with people from around the world. | 4 (44%) | 3 (33%) | 2 (22%) |
| 3 | A broad knowledge as well as an understanding of multicultural and global perspectives in engineering *are important* for the kind of work I do. | 6 (60%) | 3 (30%) | 1 (10%) |
| 3 | The AE Program has given me an *understanding of the ethical choices* inherent in the engineering profession to provide for issues such as public safety, concern for the environment, and respect for intellectual property. | 6 (67%) | 1 (11%) | 2 (22%) |
| 3 | An understanding of the ethical choices inherent in the engineering profession to provide for issues such as public safety, concern for the environment, and respect for intellectual property *is important* for the kind of work I do. | 7 (70%) | 2 (20%) | 1 (10%) |

Alumni responses in Table 4.9 indicate that our PEO are important for the kinds of jobs they have and agree that the BSAE Program has prepared them well in all but three skill areas:

a. Interpersonal, team, and leadership skills (40% agreement rating). A recommendation has been made regarding these skills and will be implemented in AY 2011-2012 (see discussion under assessment of Outcome 3D).
b. A broad knowledge as well as an understanding of multicultural and global perspectives in engineering to work effectively with people from around the world (44% agreement rating). The low rating is rather surprising, as our General Education Program was thought to adequately address this area. Nevertheless this area is also addressed in AE171B (see discussion under assessment of Outcomes 3D and 3G) and will also be addressed in AE172B beginning in AY 2011-2012.
c. Hands-on laboratory work and testing (56% agreement rating). The introduction of AE160 and the acquisition of a new wind tunnel in the Aerodynamics Lab in AY 2010-2011 has allowed the implementation of 5 additional experiments in the BSAE curriculum: four new experiments in the aerodynamics sequence (AE160, AE162) plus one new experiment in static longitudinal and directional stability (AE168), to be implemented for the first time in Fall 2011. Furthermore, Ms. Hunter has developed new experiments for AE114, which were implemented in Spring 2010.

***Evaluation of the PEO through Advisory Board Input***

At our recent AEAB meeting, we asked the members of the Board (Appendix F) to define from their experience the "ideal engineer" in their company / organization, 3–5 years after graduation and in particular, to consider the following questions about this engineer:

1. What are his/her typical assignments, responsibilities and achievements?
2. What kinds of knowledge/skills does one need to be an "ideal engineer"?
3. How much of this knowledge/skill must come from the undergraduate experience?
4. How much of this knowledge/skill is typically acquired in the first few years as a practicing engineer?

A summary of their responses is shown below.

Question 1. *What are his/her typical assignments, responsibilities and achievements?*

- Engineers 3–5 years after graduation perform the majority of the work at any company.
- Responsibilities: Engineering jobs range from analysis (RF, thermal, structural, etc.) to manufacturing / test (top level with spacecraft or "unit/box" level). After 3-5 years in such a position, an engineer typically moves up to higher and higher responsibilities. The life cycle for commercial spacecraft is typically 2-3 years. So, an engineer fresh out of school, after 3-5 years should already have at least one satellite "under his/her belt". Depending on how quickly this engineer has climbed the ladder, they are given a fairly high level of responsibility even after just one program, usually at a point of getting direct customer contact. Those engineers who report to a single spacecraft program typically assist a senior engineer during the first year or so. There after they are gradually given more responsibility and eventually are assigned "their own" program. Those engineers who work on "units" or "boxes" typically assist senior engineers at first and then become "responsible engineers" for a given box/unit within a year or so. In most cases, this type of engineer works with multiple programs, each using the same (or varying option) unit/box. Those engineers that support analysis groups work in the same way. They typically work under a senior engineer at first and then within a year or so, they gradually take over their own program. Most of these engineers support multiple programs. By the 3-5 year mark, the engineer has a good understanding of how the company and our customers work. Again, given the short life cycle of our programs, they are given a fairly high level of responsibility quite early, with access to senior engineers for support.
- Problem solving: Provides solutions to a variety of technical problems of moderate scope and complexity. May participate in, and contribute to, the resolution of problems of high complexity and visibility.
- Discretion and latitude: Expected to work under general supervision. Most work would follow established procedures, but critical thinking regarding the applicability of individual methods and appropriate deviations specific to the individual task are expected. His/her work will be reviewed for soundness of technical judgment and accuracy.
- Impact: Contributes to the completion of milestones associated with specific projects. Errors may cause delays in schedules and cause allocation of additional resources.
- Works independently; able to "pick something up and run with it".

Question 2. *What kinds of knowledge / skills does one need to be an "ideal engineer"?*

- Good practical sense of engineering. There is a good place for theory, but for most of our work at this level, we are in need of application. A personal example: While being responsible for an R&D project, very early in my career, I needed to make a very thin plate. Not thinking much of manufacturability, I specified a 0.0001" plate with tight tolerances and other design features. The drawing looked great. I sent it our for a quote, and received no bids. I talked to one of the subcontractors about why they didn't bid on it, and their response was that my design could not be physically manufactured. Lesson learned... With more experience I have learned what is reasonable, and what can be pushed.
- Lifelong learning skills and the willingness for continuous learning. I still learn to this day. I think it is very hard for engineers to ask questions, as it shows a level of vulnerability, of "not knowing" something. It is hard to learn to overcome this. The old adage of "there is never a dumb question" is really true, especially in our ever-increasing cross-country and cross-cultural industry. Designs, manufacturing, and testing are different in Japan than those in Europe, sometimes even for the same application. So, the "ideal" engineer continues to learn and ask "why", without considering his/her questions a show of weakness.
- Knowledge: Comfortable in the correct application of engineering principles, theories, concepts and techniques. Sufficiently experienced as to spot anomalies in the results and track down potential sources for such anomalies.
- Direction: Is motivated by his/her work. Has sufficient interest in the subject so as to study different ways of doing things. Does not require undue supervision to perform most of his regular work. Such an engineer would regularly contribute in the resolution of complex challenges with more experienced team members.
- Communication: The ability to communicate complex technical information in verbal and written form is paramount. Engineers are expected to communicate with each other as well as with customers and government authorities in order to effectively perform their jobs.
- Technical skills
    - Problem solving / troubleshooting
    - Design skills, including writing requirements, iteration, optimization, systems engineering
    - Design experiments, perform error / statistical analysis
    - Linear algebra
    - Finite Element Analysis
    - Dynamics & control
    - Flight mechanics
    - Solid foundation of fundamentals
    - Computer skills; programming – not important in what language
    - Specialized knowledge is not expected; on-the-job training is provided fro specific applications
    - CAD skills: some of the members indicated that coming to work with CAD skills was important. Some even specified the particular software (ProE, SolidWorks, etc.). On the other hand, some members indicated that CAD knowledge is not

assumed in their company; rather, the company takes responsibility to train engineers in CAD.
    - A feel for numbers
    - Communicate effectively with manufacturing
- Communication skills both written and oral, including presentation skills
- Team / interpersonal skills

Question 3. *How much of this knowledge/skill must come from the undergraduate experience?*

- Engineers coming out of school must have lots of lab and other hands-on experience. It is not necessary that all of this experience should come from their field of study. For example, knowing what a thermocouple does, having experience with an O-scope, a voltmeter, a caliper, really goes a long way. This is not to say that theory is not important. Rather, the theory must provide a strong base for practical knowledge. Further experience with summer coops and student club projects is great.
- Technical abilities: It is desired that students be exposed to an extensive set of common engineering terms and concepts so that they are familiar with them when they encounter them on the job for the first time. The recent graduate should have a broad feel for the subject (orders of magnitude, expected trends, etc.) For Loads and Dynamics, the recent graduate is expected to have a reasonable grasp of flight mechanics and mathematical fundamentals (lack of linear algebra knowledge is a red flag for many in the flight mechanics and structures fields, which rely heavily on linear analysis). If proper fundamentals are taught during undergraduate studies, then the initial job of training a new engineer becomes just another application of the engineering principles that they have practiced and demonstrated repeatedly in school.
- Communication skills: Written and verbal skills can be polished (proper terminology, common phraseology, etc.) during the first few years of on-the-job-training. However, basic writing and presentation skills are expected from the first day of employment.

Question 4. *How much of this knowledge/skill is typically acquired in the first few years as a practicing engineer?*

- With commercial spacecraft life cycles being only 2-3 years, there is a very steep learning curve. In the first few years, the amount of knowledge and skills acquired is tremendous. Because of this, young engineers can get quickly excited about their new career, even fresh out of school.
- It is understood that the specific technical skills required for each specialized job function (CFD, aero-structures, flight simulation, orbital mechanics, design, etc.) is limited to underlying fundamentals upon graduation. During the first 5 years an engineer is expected to produce results, but more importantly, to improve his confidence and be capable of continuous learning. At work, the new engineer will develop an increased feel for the subject. All specialized knowledge related to the specific function he/she performs, is expected to come from his/her work experience. For example, in my work as a Loads and Dynamics Engineer, a great deal of aerodynamics, control systems, structural dynamics, and fundamental mathematics was acquired over the span of employment.

In summary, the AEAB members confirmed that new engineers (3-5 years after earning their BSAE degree) in their companies / organizations are expected to:

a. Work independently with some supervision, undertake a high level of responsibility, participate in multiple projects, and make significant contributions to each project.
b. Have solid fundamentals in their field, design skills, design-of-experiment skills, knowledge of modern tools, design-for-manufacturing experience, and ability to solve problems / troubleshoot.
c. Bring a lifelong learning attitude and lifelong learning skills to allow for continuous learning on the job.
d. Communicate well orally and in writing and have good interpersonal/team skills to work with engineers and customers from around the world.

These comments certainly validate all three of our PEO.

In summary, all our constituents agree that the PEO defined are appropriate for our BSAE Program.  Moreover, alumni input confirms that the AE Program is currently achieving these objectives.

# C. Student Outcomes

## C.1 Process for Outcome Assessment

The process for assessing each outcome is illustrated in Figure 4.1.

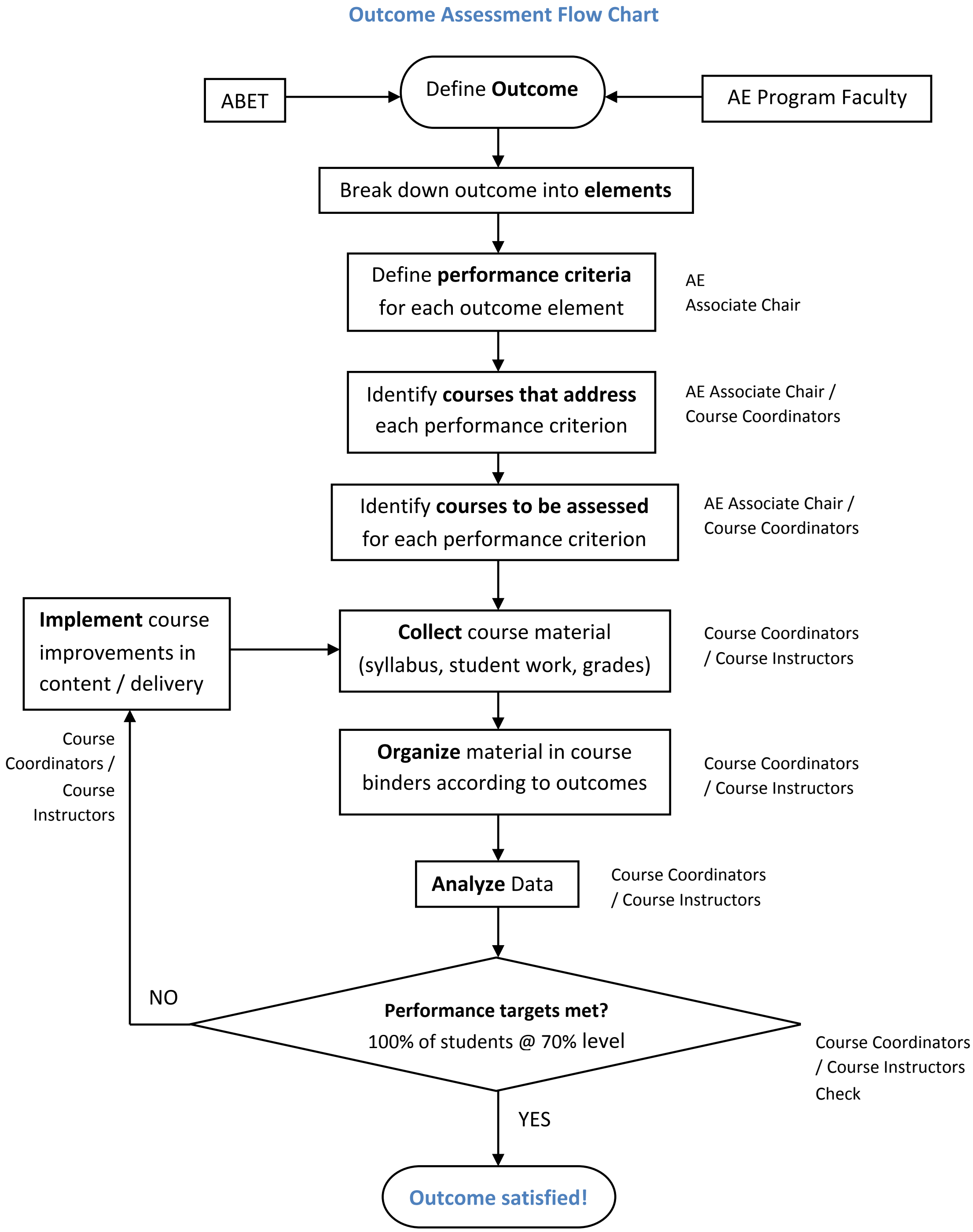



Figure 4.1 – Outcome assessment flow chart.

The AE Associate Chair coordinates the assessment of all the BSAE student outcomes. Because outcomes are rather comprehensive and difficult to assess as stated, we have analyzed each outcome into ***outcome elements***. These elements represent the different abilities specified in a single outcome that would generally require different assessment measures. The process of dividing outcomes into elements allows for sufficient resolution in the assessment of each outcome. Moreover, it makes possible the effective implementation of specific course and curriculum improvements that address areas of concern.

Furthermore, for each outcome element we have defined ***performance criteria***, i.e. student actions that explicitly demonstrate mastery of the abilities specified in an outcome element. These criteria are categorized using the 6 levels of Bloom's taxonomy in the cognitive domain or 5 levels in the affective domain. In several outcomes where the embedded skills were unclear, we introduced rubrics to facilitate the assessment of the performance criteria associated with a particular outcome element. The BSAE Student Outcomes analyzed into elements and performance criteria are shown in Table 4.10.

Table 4.10 – Student outcomes, outcome elements and performance criteria

| 3A: Ability to use mathematics, science, and engineering principles to identify, formulate and solve aerospace engineering problems. | | | |
|---|---|---|---|
| *Outcome Elements: Ability to…* | | | |
| 3A-1: Apply mathematics. | 3A-2: Apply physics. | 3A-3: Apply engineering principles. | 3A-4: Identify, formulate and solve AE problems. |
| *Performance Criteria* | *Performance Criteria* | *Performance Criteria* | *Performance Criteria* |
| 3A-1.1: Apply calculus | 3A-2.1: Draw free–body diagrams | 3A-3.1: Apply structures principles | 3A-4.1: Engage in the solution of problems (spend adequate time on task, ask questions, etc.). |
| 3A-1.2: Derive and use differential equations | 3A-2.2: Apply Newton's laws of motion | 3A-3.2: Apply rigid body dynamics principles | 3A-4.2: Define (open-ended) problems in appropriate engineering terms. |
| 3A-1.2: Use linear algebra | 3A2.3: Apply physics concepts (e.g. angular momentum, friction, thermal / fluid concepts etc.) | 3A-3.3: Apply aerodynamics principles | 3A-4.3: Explore problems (i.e., examine various issues, make appropriate assumptions, etc.). |
| | | 3A-3.4: Apply flight mechanics principles | 3A-4.4: Develop a plan for the solution (i.e., select appropriate theories, principles, approaches). |
| | | 3A-3.5: Apply propulsion principles | 3A-4.5: Implement the solution plan and check the accuracy of calculations. |
| | | | 3A-4-6: Evaluate results and reflect on personal strengths and weaknesses. |

| 3B: Ability to design and conduct water tunnel and wind tunnel experiments, as well as to analyze and interpret data from such experiments. | | | |
|---|---|---|---|
| *Outcome Elements: Ability to…* | | | |
| 3B-1: Design $H_2O$ and wind tunnel experiments. | 3B-2: Conduct $H_2O$ and wind tunnel experiments. | 3B-3: Analyze data from $H_2O$ and wind tunnel experiments. | 3B-4: Interpret data from $H_2O$ and wind tunnel experiments. |
| *Performance Criteria* | *Performance Criterion* | *Performance Criterion* | *Performance Criteria* |
| 3B-1.1: Define goals and objectives for the experiment. | 3B-2.1: Given an experimental setup, become familiar with the equipment, calibrate the instruments to be used, and follow the proper procedure to collect the data. | 3B-3.1: Given a set of experimental data, carry out the necessary calculations and tabulate/plot the results using appropriate choice of variables and software. | 3B-4.1: Given a set of results in tabular or graphical form, make observations and draw conclusions regarding the variation of the parameters involved. |
| 3B-1.2: Research relevant theory and published data from similar experiments. | | | 3B-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. |
| 3B-1.3: Select the dependent and independent variables to be measured. | | | |
| 3B-1.4: Select appropriate methods for measuring/controlling each variable. | | | |
| 3B-1.5: Select a proper range for the independent variables. | | | |
| 3B-1.6: Determine an appropriate number of data points for each type of measurement. | | | |

| 3C: Ability to perform conceptual and preliminary design of aircraft or spacecraft to meet a set of mission requirements within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability. |
|---|
| *Performance Criteria* |
| 3C-1: Research, evaluate, and compare vehicles designed for similar missions. |
| 3C-2: Follow a prescribed process to develop the conceptual / preliminary design of an aerospace vehicle. |
| 3C-3: Develop economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability constraints and design a vehicle that meets these constraints. |
| 3C-4: Select an appropriate configuration for an aerospace vehicle with a specified mission. |
| 3C-5: Apply AE principles (ex. aerodynamics, structures, flight mechanics, propulsion, stability and control) to design various vehicle subsystems. |

| 3D: Ability to collaborate with people from different cultures, abilities, backgrounds, and disciplines to complete aerospace engineering projects. |
|---|
| *Performance Criteria* |
| 3D-1: Committed to the team and the project, dependable, faithful, reliable. Attends all meetings; arrives on time or early. Comes to the meetings prepared and ready to work. |
| 3D-2: Leadership: takes initiative, makes suggestions, provides focus. Creative, brings energy and excitement to the team. Has a "can do" attitude. Sparks creativity in others. |
| 3D-3: Gladly accepts responsibility for work and gets it done; spirit of excellence. |
| 3D-4: Has abilities the team needs. Makes the most of these abilities. Gives fully, doesn't hold back. |
| 3D-5: Communicate ideas clearly when speaking and writing. Understands the direction of the team. |
| 3D-6: Personality: positive attitudes, encourages others, seeks consensus, brings out the best in others. |

| 3E: Ability to communicate effectively through technical reports, memos, and oral presentations as well as in small group settings. | |
|---|---|
| *Outcome Elements: Ability to …* | |
| 3E-1: Communicate in writing | 3E-2: Communicate orally |
| *Performance Criteria* | *Performance Criteria* |
| 3E-1.1: Produce well-organized reports, following guidelines. | 3E-2.1: Give well-organized presentations, following guidelines. |
| 3E-1.2: Use appropriate graphs and tables following published engineering standards to present results. | 3E-2.2: Make effective use of visuals. |
| 3E-1.3: Use clear, correct language and terminology while describing experiments, projects or solutions to engineering problems. | 3E-2.3: Present the most important information about a project / experiment, while staying within allotted time. |
| 3E-1.4: Describe accurately in a few paragraphs a project / experiment performed, the procedure used, and the most important results (abstracts, summaries). | |

| 3F: Understanding of professional and ethical responsibility. |
|---|
| *Performance Criterion* |
| Given a job-related scenario that requires a decision with ethical implications students can identify any ethical issues raised by reference to professional codes of ethics (e.g. NSPE, ASME), identify possible courses of action, discuss the pros and cons of each course of action, decide what is the best course of action, and justify their decision. |

| 3G: Broad education to understand current events, how they relate to aerospace engineering, as well as the impact of aerospace engineering solutions in a global and societal context. |
|---|
| *Performance Criteria* |
| 3G-1: Identify regional, national, or global contemporary problems that involve aerospace engineering. |
| 3G-2: Discuss possible ways aerospace engineering could contribute to the solution of these problems. |
| 3G-3: Discuss the impact of AE in a global and societal context. |

| 3H: Recognition of the need for, and ability to engage in life-long learning. |
|---|
| *Performance Criteria* |
| 3H-1: Develop a process for learning, reflect regularly on this process, identify their strengths and weaknesses, and take the necessary steps to improve their learning process. |
| 3H-2: Access information effectively and efficiently from a variety of sources. |
| 3H-3: Research and learn new material on their own by reading articles, books, contacting experts, etc. |

| 3I: Ability to use the techniques, skills, and modern engineering tools (analytical, experimental, and computational) necessary for aerospace engineering practice. |
|---|
| *Performance Criteria* |
| 3I-1: Use modern software to conduct computer simulations, parametric studies, and 'what if' explorations. |
| 3I-2: Use modern equipment and instrumentation in AE laboratories. |

Although each performance criterion may be addressed in several required BSAE core courses, only a subset of these courses is selected for the assessment of each outcome/performance criterion, as shown in Table 4.11.

Table 4.11 – Required BSAE courses in which outcomes are assessed

| | Student Outcomes | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| *BSAE* | A | B | C | D | E | F | G | H | I |
| *Original ABET Outcomes* | (a), (e) | (b) | (c) | (d) | (g) | (f) | (h), (j) | (i) | (k) |
| **Required Courses** | | | | | | | | | |
| Engr. 100W | | | | | +++ | | | | |
| AE 114 | ++ | ✈ | | ✈ | ✈ | | | ✈ | |
| AE 140 | ++ | | | ✈ | | | | ✈ | |
| AE 160 | ++ | ++ | ✈ | ✈ | +++ | | ✈ | ✈ | +++ |
| AE 162 | ++ | ++ | ✈ | ✈ | +++ | | ✈ | ++ | +++ |
| AE 164 | ++ | ✈ | ✈ | ✈ | ✈ | | ✈ | ✈ | |
| AE 165 | ++ | | ✈ | ✈ | ✈ | | ✈ | ✈ | |
| AE 167 | ++ | | ✈ | ✈ | ✈ | | ✈ | ✈ | |
| AE 168 | ✈ | | | ✈ | | | | ✈ | |
| AE 169 | ++ | | | ✈ | | | | ✈ | +++ |
| AE 171 A, B<br>AE 172 A, B | ✈ | ✈ | +++ | +++ | +++ | +++ | ++ | +++ | +++ |
| Extra Curriculum Activities | | ✈ | ✈ | ✈ | ✈ | ✈ | | | |

+: Skill level 1 or 2 in Bloom's Taxonomy
++: Skill level 3 or 4 in Bloom's Taxonomy
+++: Skill level 5 or 6 in Bloom's Taxonomy
✈ Skill addressed but not assessed

The various levels of competency according to Bloom's Taxonomy are shown in Tables 4.12 and 4.13 respectively for the cognitive (Bloom, 1984) and affective (Bloom, Karthwohl, and Massia, 1984) domains.

Table 4.12 – The 6 levels of competency in the cognitive domain

| Level | Competence | Description |
|---|---|---|
| 1 | Remember | Recognize or recall information (ex. repeat verbatim definitions or principles). |
| 2 | Understand | Understand the meaning of information, so they can explain it to others (ex. share their own examples of how a principle applies in certain situations). |
| 3 | Apply | Use information appropriately to solve well-defined problems. |
| 4 | Analyze | Deal with ambiguity in new, ill-defined situations by formulating models and seeing relationships. |
| 5 | Evaluate | Judge the worth of ideas, theories and opinions, choose among alternatives, and justify their choice based on specific criteria. |
| 6 | Create (Design) | Combine elements in novel ways to generate new products or ideas. |

Table 4.13 – The 5 levels of competency in the affective domain

| Level | Competence | Description |
|---|---|---|
| 1 | Receive (a stimulus) | Go to class, participate in class activities. |
| 2 | Respond (to a stimulus) | Study for their courses, carry out assignments. |
| 3 | Value (a behavior) | Be committed to their education, have positive attitudes about their coursework. |
| 4 | Organize (values into a system) | Balance responsibilities effectively; begin to formulate a systematic approach to learning. |
| 5 | Characterized (by a value system) | Work independently and diligently, practice cooperation when working in teams, act ethically. Their value system reflects consistently in their behavior. |

To satisfy Criterion 3, we have defined our ***performance target*** as follows:

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

***Gateway Assignments***
To ensure that all students meet the minimum performance requirement and thus achieve the performance target of 100% in each outcome, gateway assignments are being implemented in key required courses. Students must receive a minimum score of 70% in these assignments to pass the course, regardless of their performance in other course assignments or exams. The gateway assignments implemented in AY 2010-2011 are shown in Table 4.14.

Table 4.14 – Gateway assignments

| | | |
|---|---|---|
| Outcome 3B | AE 160<br>AE 162 | 4 – Lab Reports<br>4 – Lab Reports |
| Outcome 3C | AE 171A&B<br>AE 172A&B | 12 Design Reports<br>03 Design Briefings |
| Outcome 3E | Engr. 100W | Exit Exam |
| | AE 171A&B<br>AE 172A&B | 03 Design Briefings |
| Outcome 3F | AE 171A&B<br>AE 172A&B | 4 – Case Studies with related assignments |
| Outcome 3G | AE 171A&B<br>AE 172A&B | 2 – Research Papers / Presentations |

## C.2 Course Assessment

Figure 4.1 shows the process for assessing each of the selected courses. Course coordinators assess their courses for the specific outcomes they address, as indicated in table B.3.3. They are responsible for ensuring that performance targets are met for each outcome in each of their courses. If the target for a particular outcome is not met, they make recommendations for improvements in that area and take responsibility for implementing these improvements in the course. If they do not teach the particular course, they coordinate the changes with the faculty who teach the course. After the implementation of the improvements, coordinators re-assess the course and re-evaluate student performance against the targets.

### C.3 Timeline

The intended timeline for the assessment of the BSAE Outcomes is shown in Table 4.15. Each outcome was to be assessed periodically every 3 years. Since BSAE courses are offered once a year, after an outcome is assessed, course and/or curriculum improvements would be implemented for 3 consecutive course offerings, at which time the faculty would have an opportunity to flash out any problems or inefficiencies. Then at the third offering of the outcome would be re-assessed.

Table 4.15 – Intended timeline for BSAE Outcome Assessment

| | Outcomes | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 3A | 3B | 3C | 3D | 3E | 3F | 3G | 3H | 3I |
| Spring 06 | X | | | | | X | | | |
| Fall 06 | | X | | | | | X | | |
| Spring 07 | | | X | | | | | X | |
| Fall 07 | | | | X | | | | | X |
| Spring 08 | | | | | X | | | | |
| Fall 08 | | | | | | X | | | |
| Spring 09 | X | | | | | | X | | |
| Fall 09 | | X | | | | | | X | |
| Spring 10 | | | X | | | | | | X |
| Fall 10 | | | | X | X | | | | |
| Spring 11 | Finalize BSAE Self-Study Report | | | | | | | | |
| Fall 11 | ABET Visit | | | | | | | | |

### C.4 Outcome Assessment

**Outcome 3A – Ability to apply mathematics, science, and engineering principles to identify, formulate and solve AE problems**

***Outcome Assessment Summary:*** The performance target is not met for Outcome 3A.

***Course Statistics***

| *Course* | *Semester* | *Faculty Member* | *Enrollment* | *# of students who passed* | *% of students who passed* |
|---|---|---|---|---|---|
| AE 162 | Spring 2007 | Dr. Nikos J. Mourtos | 24 | 23 | 96% |
| AE 164 | Fall 2009 | Dr. Nikos J. Mourtos | 26 | 25 | 96% |
| AE 114 | Spring 2010 | Ms. Jeanine Hunter | 22 | 21 | 95% |
| AE 140 | Spring 2010 | Ms. Jeanine Hunter | 25 | 23 | 92% |
| AE 162 | Spring 2010 | Dr. Nikos J. Mourtos | 28 | 23 | 82% |
| AE 160 | Fall 2010 | Dr. Nikos J. Mourtos | 24 | 15 | 63% |
| AE 164 | Fall 2010 | Dr. Nikos J. Mourtos | 15 | 14 | 93% |
| AE 165 | Spring 2010 | Dr. Periklis P. Papadopoulos | | | |
| AE 167 | Spring 2010 | Dr. Periklis P. Papadopoulos | | | |

***3A-1: Ability to apply mathematics.***
*Courses Assessed: AE 140, AE 160, AE 162*

***Recommendation***
Following the curriculum change in AY 10-11 to require Linear Algebra (Math 129A) in the BSAE curriculum, the "ability to use linear algebra in the solution of AE problems" should be included as an element of this outcome and assessed in AE169 (CFD), which now has Math 129 as a prerequisite.

***Implementation***: Spring 2011

**Performance Criterion 3A-1.1:** *Ability to apply calculus.*
*Courses Assessed: AE 140, AE 160, AE 162*

***Assessment Summary***
The performance target is not met for Performance Criterion 3A-1.1.

*AE140 – Spring 2010 – Ms. Jeanine Hunter*

***Assessment Summary:*** The performance target is not met.

***Course Activities***
Differentiate a vector in a rotating reference frame to obtain inertial acceleration. This involves calculus and vector algebra.

***Assessment Tools:*** One problem on Exam 1 and one problem on the Final Exam.

***Student Performance Results***

| | Students who scored 70% or higher |
|---|---|
| Exam 1 | 88% |
| Final Exam | 85% |

***Analysis***
Students who fail to apply calculus correctly usually either apply the chain-rule incorrectly or make careless errors, both of which can be easily corrected. Students who are weak in calculus sometimes become overwhelmed with the complexity of dynamics problems and make unnecessary mistakes. Working carefully through many problems will help them to navigate all aspects of these difficult problems.

***Recommendations***
- Employ more opportunities for in-class, co-operative learning exercises, during which I will coach students in a small group setting.
- Give multiple homework assignments, which exercise the concept of writing the equations of motion of a complex system with multiple reference frames. These assignments will help students build their skill of representing vectors in an arbitrary reference frame as well as differentiating and integrating in a rotating reference frame.

***Implementation:*** Spring 2011

*AE160 – Fall 2010 – Dr. Nikos J. Mourtos*
*AE162 – Spring 2007 & 2010 – Dr. Nikos J. Mourtos*

***Assessment Summary:*** The performance target is not met.

***Course Activities*** (AE 160)

a. Integrate surface pressure / shear stress distributions to calculate normal, axial, lift, and drag force coefficients.
b. Use the integral form of the continuity and momentum equation to calculate the average velocity in a cross-section of the flow and the drag of 2-D bodies from wake profiles.
c. In addition to solving problems in class, students use these skills in their lab reports to calculate (a) lift from measured pressure distributions on an airfoil at different angles of attack and (b) drag from measured wake profiles on an airfoil at different angles of attack.

NB: The topics and course learning objectives associated with this outcome element were originally in AE162. Starting in Fall 2010, AE160 was introduced as Aerodynamics I and these topics and associated skills are now taught in AE160.

***Course Activities*** (AE 162)

a. Calculate the divergence and the curl of the velocity vector for various flow fields to determine whether a flow satisfies continuity and / or is irrotational.
b. Differentiate stream functions and velocity potential functions to derive the velocity functions of various flow fields.
c. Integrate velocity vectors around closed paths to calculate circulation.

***Assessment Tools:*** One problem on Midterm 1 and one problem on Midterm 2.

***Student Performance Results***

| | Students who scored 70% or higher | |
|---|---|---|
| | Problem 1, Midterm 1 | Problem 1, Midterm 2 |
| AE 160 – Fall 2010 | 73% | N/A |
| AE 162 – Spring 2007 | 70% | 100% |
| AE 162 – Spring 2010 | 87% | 100% |

***Analysis***

The data show that not all the students who receive a passing grade in the course meet the performance target in this performance criterion. 25% - 30% of our juniors are deficient in their ability to integrate simple functions. The higher success rate of 87% in Spring 2010 occurred only because students were given two consecutive makeup exams for their first midterm, in which performance criterion 3A-1.1 was assessed. It should be noted that when they solve problems that involve the calculation of aerodynamic forces, whether by integration of the pressure and shear stress distribution or application of the momentum equation, students apply the aerodynamics equations correctly. It is their inability to integrate correctly that prevents them from getting the correct answer in various problems.

On the other hand, 100% of the students demonstrate adequate proficiency (score 70% or better) in performing the calculus-related tasks listed above for AE162. Students who do not solve potential flow theory problems correctly fail because of their lack of understanding of the concepts, not because of their inability to perform the calculus. This is further discussed under performance criterion 3A-3.3 below.

***Recommendation***
AE faculty should meet with the coordinator of the Calculus series to discuss ways for improving student performance in this area.

***Implementation:*** AY 2011-2012

**Performance Criterion 3A-1.2:** *Ability to derive and solve ODE.*
*Course Assessed: AE140 – Spring 2010 – Ms. Jeanine Hunter*

***Assessment Summary:*** The performance target is not met.

***Course Activities***
a. Derivation of 2nd-Order ODE for the position of a particle moving over the surface of the rotating Earth. Students derive coupled 2nd-Order ODE in the translational positions relative to a reference frame fixed to the surface of the Earth. Then they simplify the equations so they can be solved closed-form.
b. Numerical integration of rigid body (differential) equations of motion using various algorithms and integration step sizes.

***Assessment Tool:*** One problem on Exam 1.

***Student Performance Results:*** 75% of the students scored 70% or higher.

***Analysis***
Derivation of the differential equations which model the motion of a particle with respect to the Earth is a complex, multi-step problem. It takes some students a while to fully grasp the concept; then it is another big step to write the differential equations; and yet another leap to carefully perform all of the steps necessary to decouple and solve the equations. Strong students grasp these ideas immediately and competently carry out the steps. Although I work through examples in class and give homework on this topic, some students fail to learn sufficiently well to be able to carry out the integration correctly.

***Recommendation***
Have the students work this type of problem as a small group exercise, so I can evaluate their individual needs for remedial work.

***Implementation:*** Spring 2011

***3A-2: Ability to apply physics.***
*Courses Assessed: AE 114, AE140,*

**Performance Criterion 3A-2.1:** *Ability to draw free–body diagrams.*
*Course Assessed: AE114 – Spring 2010 – Ms. Jeanine Hunter*

***Assessment Summary***
The performance target is not met for Performance Criterion 3A-2.1.

***Course Activities***

a. Construction of the shear force and bending moment diagrams by making imaginary cuts in the beam and drawing a free-body diagram of each beam section (method of sections).
b. Creating a free-body diagram of each node of a spacecraft truss (pin joints carry no moment, so this diagram includes only applied and reaction forces).

***Assessment Tool:*** One problem on the Final Exam.

***Student Performance Results:*** 91% of the students scored 70% or higher.

***Analysis***
Students who failed to meet this criterion did not construct the free body diagram correctly, i.e. did not include all the forces / moments or the appropriate forces / moments in the diagram. Students who constructed the free body diagram correctly usually solved it correctly. The perception of the conditions of static equilibrium seems to be the stumbling block in this type of problem, not the ability to do the arithmetic to solve for the unknown forces / moments. This is a high level concept, but one that is usually well taught in the Strength of Materials prerequisite.

***Recommendation***
Spend some extra time in review, specifically requiring students to solve this type of problem in class, so I can reinforce the concepts as needed.

***Implementation:*** Spring 2011

**Performance Criterion 3A-2.2:** *Ability to apply Newton's laws of motion.*
*Course Assessed: AE140 – Spring 2010 – Ms. Jeanine Hunter*

***Assessment Summary***
The performance target is not met for Performance Criterion 3A-2.2.

***Course Activities***
a. Derive the translational equations of motion (of a particle or center of mass of a rigid body) moving in inertial space and observed in either a Newtonian or non-Newtonian reference frame.
b. Identify n and use Coriolis and centripetal acceleration components in solving problems of particle motion over the surface of the Earth.
c. Predict the difference between inertial and relative motion and model this motion with Newton's Laws.
d. Derivate the rotational equations of motion of a spinning rigid body in two cases: a spinning spacecraft (no gravity – angular momentum conserved); a gyroscope or top with the forcing function of gravity torque: (angular momentum not conserved).
e. Use the equations of rotational motion to model a spin-stabilized missile.

***Assessment Tools***
One problem on Exam 1, one problem on Exam 2, and one problem on the Final Exam.

***Student Performance Results***

| Students who scored 70% or higher | | |
|---|---|---|
| Problem on Exam 1 | Problem on Exam 2 | Problem on the Final Exam |
| 63% | 55% | 50% |

***Analysis***
Failures in this area of learning fall into two categories: First, students are sometimes deficient in their understanding of the physics concepts which underlie rigid body dynamics. Second, even though they understand physics and elementary dynamics, some students have difficulty with complex, three-dimensional dynamics problems – especially those which model rotational motion.

***Recommendations***
- Employ more opportunities for in-class, co-operative learning exercises, during which I will coach students in a small group setting.
- Give multiple homework assignments, which exercise the concept of writing the equations of motion of a complex system with multiple reference frames.  These assignments will help students build their skill of representing vectors in an arbitrary reference frame as well as differentiating and integrating in a rotating reference frame.

***Implementation:*** *Spring 2011*

**Performance Criterion 3A-2.3:** *Ability to apply physics concepts (ex. angular momentum, friction, thermal / fluid concepts etc.).*
*Course Assessed: AE 140 – Spring 2010 – Ms. Jeanine Hunter*

***Assessment Summary***
The performance target is not met for Performance Criterion 3A-2.3.

***Course Activities***
a. Use conservation of angular momentum to model the despinning of a satellite.
b. Use the change in angular momentum to derive Newton's rotational equations of motion.
c. Explain the role of friction and gravitational torque in maintaining the steady precession of a top.
d. Apply the principle of impulse and momentum to derive the equations of motion of a spacecraft struck by a micro-meteorite.

***Assessment Tool:*** One problem on Exam 2.

***Student Performance Results:*** 89% of the students scored 70% or higher.

***Analysis***
Students who failed to meet this criterion did not understand the relationship between moments / forces and dynamic response. For example, in the problem of a spacecraft struck by a micrometeorite, the students write an expression for the impulse of the micrometeorite strike and the resulting moment on the spacecraft. From that expression, they then derive the change in angular momentum and the ensuing coning motion. Though the mathematics of this kind of problem is fairly straightforward, the spacecraft dynamics are complex physically. For the students, the difficulty is usually in visualizing the three dimensional motion.

***Recommendation***
Do more visualization exercises using well-constructed diagrams and 3-D models.

***Implementation:*** Spring 2011

***3A-3: Ability to apply aerospace engineering principles.***
*Courses Assessed: AE 114, AE140, AE160, AE162, AE164, AE165, AE167*

**Performance Criterion 3A-3.1:** *Ability to apply principles of aerospace structures.*
*Course Assessed: AE114 – Spring 2010 – Ms. Jeanine Hunter*

***Assessment Summary***
The performance target is not met for Performance Criterion 3A-3.1.

***Course Activities***
a. Use area properties of a wing section to calculate the orientation of the principal axes, and thereby the principal stresses.
b. Calculate shearing strain/stress and angle of twist of a beam / circular shaft / aircraft tail section subject to a torsional load. Use the torsional beam in the lab to verify this result experimentally.
c. Calculate shear flow in a multiple cell wing section, satisfying both the angle of twist compatibility condition and the equations for static equilibrium.
d. Compute the symmetrical and nonsymmetrical bending stresses on a wing section. Symmetrical bending stresses are also determined experimentally on the cantilever beam.
e. Calculate the stiffness matrix, nodal displacements and axial force for a three-bar truss element of a spacecraft structure.

***Assessment Tools:*** 3 problems on the Final Exam.

***Student Performance Results***

| Students who scored 70% or higher | | |
|---|---|---|
| Final Exam, Problem 1 | Final Exam, Problem 2 | Final Exam, Problem 3 |
| 91% | 73% | 91% |

***Analysis***
Most of the failures in this criterion were the result of students not completely learning concepts presented in AE114, rather than a lack of preparation from the prerequisites. For example, the idea of shear flow is a new concept in AE114 and incorporating shear flow into a force / moment balance can be challenging for the students. Failures usually occurred when analyzing the more complex structural elements, e.g. a multi-cell wing section subjected to torsion in which compatibility must be maintained.

***Recommendation***
Assign more homework problems preceded by more focused discussion during class time.

***Implementation:*** Spring 2011

**Performance Criterion 3A-3.2:** *Ability to apply rigid body dynamics principles.*
*Course Assessed: AE 140 – Spring 2010 – Ms. Jeanine Hunter*

***Assessment Summary***
The performance target is not met for Performance Criterion 3A-3.2.

***Course Activities***

Derive the equations of motion of a particle or rigid body using the energy methods or Lagrange's Method. This involves finding the translational / rotational kinetic and potential energies of the particle / rigid body.

***Assessment Tools:*** One problem on the Final Exam.

***Student Performance Results:*** 81% of the students scored 70% or higher on this problem.

***Analysis***
Since Lagrange's Method is an energy formulation, failure to write the Lagrangian correctly (the difference between kinetic and potential energies) accounted for the majority of the misunderstandings of this topic. Writing equations of motion using energy methods is a minority topic in AE140. I use the Newtonian formulations for almost the entire course since they are much more intuitive (i.e. position and velocity are more straightforward to visualize than kinetic energy) and therefore more appropriate for an undergraduate class. Nonetheless, undergraduate students should be able to formulate energy correctly and differentiate it to derive the equations of motion.

***Recommendation***
Work more problems using multiple methods, Newton's Laws and Lagrange's formulation, so that students will have confidence using either method. Doing more problems will also result in students developing better technical intuition about the correct equations of motion (regardless of method) for a particular problem.

***Implementation:*** Spring 2011

**Performance Criterion 3A-3.3:** *Ability to apply aerodynamics principles.*
*Courses Assessed: AE160, AE162, AE164 – Dr. Nikos J. Mourtos*

***Assessment Summary***
The performance target is not met for Performance Criterion 3A-3.3.

***Course Activities*** (AE160)
a. Calculate aerodynamic forces and moments on bodies by integrating surface pressure and shear stress distributions.
b. Use flow similarity to design wind tunnel tests.
c. Use the momentum equation to calculate (a) lift from given pressure distributions on the top and bottom of an aerodynamic body and (b) drag from given velocity profiles ahead and downstream of an aerodynamic body.
d. Predict transition from laminar to turbulent flow on an aerodynamic surface.
e. Calculate the skin friction drag and estimate the pressure drag of aerodynamic bodies.

NB: The topics and course learning objectives shown above, which pertain to this outcome element were originally in AE162. Starting in Fall 2010, AE160 was introduced as Aerodynamics I and these topics and associated skills are now taught and assessed in AE160.

***Course Activities*** (AE162)
a. Analyze the elementary flows (uniform, source / sink, doublet, vortex, corner) as well as combinations of them.

b. Use experimental data, thin airfoil theory results, and computer programs to predict aerodynamic characteristics of airfoils (ex. lift and drag at various angles of attack, pitching moment about various points, ac location, etc.)
c. Use the Biot-Savart law to calculate induced velocities in the vicinity of line vortices.
d. Apply Prandtl's lifting-line theory to calculate the aerodynamic characteristics of airplane wings.
e. Use the method of images to discuss and calculate aerodynamic interference for (a) wings flying in the vicinity of each other, (b) wind-tunnel boundaries, and (c) ground effects.

***Course Activities*** (AE164)

a. Use thermodynamics and conservation equations to calculate flow parameters at various points of a flow field.
b. Calculate stagnation and critical conditions at various points of a flow field for isentropic flow, adiabatic flow, flow with heat addition and flow with friction.
c. Calculate the flow properties downstream of a Mach wave, an oblique shock wave, a Prandtl-Meyer expansion wave, and a normal shock wave.
d. Calculate the lift and drag coefficients on supersonic airfoils using shock - expansion theory.
e. Calculate the flow properties downstream of a reflected / refracted shock wave.
f. Calculate the flow conditions in a shock tube behind the incident and the reflected shock waves.
g. Calculate the speed of the incident and the reflected shock waves in a shock tube.
h. Calculate the location of a shock in a Laval nozzle (assuming there is one).

***Assessment Tools:*** Midterm and final exams in each course.

***Student Performance Results***

| | Students who scored 70% or higher | | |
|---|---|---|---|
| | Midterm 1 | Midterm 2 | Final Exam |
| AE 160 – Fall 10 | 12 (80%) | N/A | 8 (53%) |
| AE 162 – Spring 07 | 18 (78%) | 17 (74%) | 13 (57%) |
| AE 162 – Spring 10 | 21 (91%) | 15 (65%) | 8 (35%) |
| AE 164 – Fall 09 | 25 (100%) | N/A | 18 (72%) |
| AE 164 – Fall 10 | 11 (79%) | N/A | 14 (100%) |

Although all students need to demonstrate a minimum level of competence in each and every course to earn a passing grade, it appears that a large percentage of students fail to meet the 70% performance target in their exams. Several students compensate for their poor exam performance with a much better performance in their lab and project reports, both of which are required in all three courses. Since these assignments are performed in teams, however, they are not included in this analysis. Reasons contributing to students' low performance on tests include:

- Poor understanding of the material / poor problem-solving skills.
- Inadequate preparation for the test.
- Poor study / test-taking skills.

It should be noted that at least 50% of the class time is dedicated to problem solving, including presentation of numerous example problems as well as problem solving in small groups. However, students either do not always follow up with further studying after each class and they do not practice additional problem solving on their own.

***Recommendation***
Offer weekly problem solving workshops to give students additional opportunities for practice. These workshops can be offered by Sigma Gamma Tau students, who will be trained by faculty, with an emphasis on coaching students to solve problems on their own rather than presenting solutions. These workshops will be mandatory for students at risk (e.g. low grades in prerequisites) or students who perform below the target (70%) at any test during the course of the semester.

***Implementation:*** AY 2011-2012

**Performance Criterion 3A-3.4:** *Ability to apply flight mechanics principles.*
*Course Assessed: AE165 – Spring 2010 – Dr. Periklis P. Papadopoulos*

***Assessment Summary***
The performance target is not met for Performance Criterion 3A-3.4.

***Course Activities***
a. Estimate aircraft performance.
b. Use performance characteristics of propulsion systems to predict aircraft performance.
c. Quantify the impact of aircraft design characteristics on performance.
d. Analyze hypersonic vehicle reentry.
e. Calculate satellite orbits.
f. Compute multi-stage launch vehicle performance.

***Assessment Tools:*** Midterm exam and final project report.

***Student Performance Results***

| Students who scored 70% or higher | |
|---|---|
| Midterm Exam | Final Project Report |
| 77% | 83% |

***Recommendation***
Offer weekly problem solving workshops to strengthen student understanding of flight mechanics. These workshops will be offered by the AIAA Student Chapter and recommended for students at risk (e.g. low grades in prerequisites) or students who perform below the target (70%) at any test during the course of the semester.

***Implementation:*** Spring 2011

**Performance Criterion 3A-3.5:** *Apply propulsion principles.*
*Course Assessed: AE167 – Fall 2010 – Dr. Periklis P. Papadopoulos*

***3A-4: Ability to identify, formulate and solve AE problems.***
*Courses Assessed:*
*AE162 – Spring 2008 & 2009 – Dr. Nikos J. Mourtos*
*AE165 – Spring 2008 & 2009 – Dr. Periklis P. Papadopoulos*

***Course Design to Address Outcome Element 3A-4***

Several core BSAE courses have been re-designed in an effort to help students develop problem-solving skills. This re-design includes:

a. Explicit definition of skills and attributes that students need to develop to become capable problem-solvers.
b. Inclusion of open-ended problems (OEP) in each of several key, junior-level, core courses.
c. Coaching students in the use of Wood's Problem-Solving Methodology (PSM). This process includes seven steps (Woods, 1994):

Step 1: Engage
Step 2: Define

Students try to understand the problem and re-state it in their own terms. They make a comprehensive list of what is given but also what may be known from other sources, and determine any applicable constraints. This step requires some research on the background of the problem. This may include reading various sections of the textbook, a visit to the library or searching online (students' favorite method). Students are expected to draw a sketch of how they visualize the problem including any parameters they think relevant. The most important outcome of this step is the criterion to be used in answering the question in the problem.

Step 3: Explore
Students explore relevant questions and brainstorm possible ways to model the physical situation described in the problem by making appropriate assumptions. To develop intuition, students attempt to predict the answer to the problem.

Step 4: Plan
Students select an appropriate model (usually the simplest available) for developing a solution. They break down the problem into smaller sub-problems, each involving the calculation of various parameters, which serve as stepping-stones towards the final answer. It is important that students develop an algorithm (flow chart) for the solution of the problem and not substitute any numerical values. This algorithm may involve, for example, identifying appropriate equations or graphs for calculating various parameters in each sub-problem.

Step 5: Implement
This is the most straightforward step of the PSM. Students substitute the values of known and assumed quantities into their model (equations) and develop the solution, checking for accuracy and consistency of units. The outcome of this step includes numerical answers for various parameters and usually includes additional sketches, figures or drawings.

Step 6: Check
Students check their calculations for errors and make sure the units in all parameters are correct. No rubric is used to evaluate student performance in this step. Unchecked calculation errors simply result in lower scores in Step 5.

Step 7: Reflect.
Making an unrealistic assumption in Step 3 or choosing an inappropriate model in Step 4 often results in numbers that do not make sense. This is a common occurrence in OEP solving even among experienced problem solvers. Students are expected to identify the cause of the problem and correct it or suggest a more sophisticated approach to solve the problem. Furthermore, they compare their answer to their guestimate from Step 3. If their guestimate was incorrect they provide an explanation as a way of developing intuition. In addition to discussing the solution of the problem itself students reflect on their own strengths and weaknesses in the problem solving process.

d. Development of rubrics to evaluate student performance for each step of this methodology (Mourtos, 2010)

***Course Activities***
In each of these courses students:
a. Are presented with an example of an OEP and its detailed solution following the PSM.
b. Work in teams to solve two OEP, using the PSM.
c. Work in teams to identify, research, formulate, and solve a current multi-disciplinary problem that involves applications from at least two courses, AE162 / AE165 in the spring of their junior year and AE164 / AE167 in the fall of their senior year. Students typically take each course pair concurrently. Students are encouraged to integrate applications from other courses that are taking or have completed in previous semesters (Mourtos, Papadopoulos, and Agrawal, 2006).

***Performance Criterion* 3A-4.1:** *Willingness to engage in the solution of problems (spend adequate time on task, ask questions, etc.).*

***Assessment Summary:*** The performance target is met for Performance Criterion 3A-4.1.

***Assessment Tool & Student Responses*** (N = 22)
Rubric for measuring student engagement (Step 1 of the PSM)

| How often have you done each of the following in connection with one of the OEP or course project? | Never | 1 or 2 times | 3 to 5 times | More than 5 times |
|---|---|---|---|---|
| 1. Asked questions related to an OEP during class | 22% | 55% | 14% | 9% |
| 2. Contributed to a class discussion related to an OEP | 28% | 41% | 27% | 4% |
| 3. Prepared two or more drafts of the solution of these problems before turning them in | 41% | 36% | 23% | 0 |
| 4. Worked with classmates outside of class to prepare OEP solutions | 14% | 9% | 36% | 41% |
| 5. Helped other students with the solution of OEP | 23% | 50% | 18% | 9% |
| 6. Used an electronic medium (listserv, chat group, Internet, instant messaging, etc.) to discuss OEP solutions | 32% | 0 | 23% | 45% |
| 7. Used email to communicate with the course instructor regarding OEP | 50% | 19% | 27% | 4% |

<table>
<tr><td>8. Visited the course instructor in his office to discuss OEP</td><td>28%</td><td colspan="3">36%</td><td colspan="2">27%</td><td colspan="2">9%</td></tr>
<tr><td>9. Discussed ideas related to OEP with others outside of class (students, family members, coworkers, etc.)</td><td>46%</td><td colspan="3">18%</td><td colspan="2">18%</td><td colspan="2">18%</td></tr>
<tr><td rowspan="2">10a. I found the wing / tail problem:</td><td>Not at all interesting</td><td colspan="4">So – so (lukewarm about it)</td><td colspan="3">Very Interesting / Engaging</td></tr>
<tr><td>14%</td><td colspan="4">68%</td><td colspan="3">18%</td></tr>
<tr><td>10b. I found my project:</td><td>9%</td><td colspan="4">50%</td><td colspan="3">41%</td></tr>
<tr><td rowspan="2">11. I worked harder than I normally do to solve the OEP in AE162</td><td>Never / Rarely</td><td colspan="4">Sometimes</td><td colspan="3">Very Often</td></tr>
<tr><td>4%</td><td colspan="4">45%</td><td colspan="3">46%</td></tr>
<tr><td rowspan="2">12. I spent a total of ___ hours working on the wing/tail problem (alone, with my teammates, with the instructor)<br>[Average =6.6 hours]</td><td># of hours</td><td>1-2</td><td>3-4</td><td colspan="2">5-7</td><td colspan="2">8-12</td><td>15-30</td></tr>
<tr><td># of students</td><td>27%</td><td>14%</td><td colspan="2">32%</td><td colspan="2">14%</td><td>13%</td></tr>
<tr><td rowspan="2">13. How interested are you in learning the AE162 material?</td><td>Uninterested</td><td colspan="4">So-so (lukewarm about it)</td><td colspan="3">Very interested</td></tr>
<tr><td>0</td><td colspan="4">14%</td><td colspan="3">86%</td></tr>
<tr><td rowspan="2">14. How difficult is the course material for you?</td><td>Difficult</td><td colspan="4">Average Difficulty</td><td colspan="3">Easy</td></tr>
<tr><td>32%</td><td colspan="4">68%</td><td colspan="3">0</td></tr>
</table>

***Analysis***

The Table above shows a fairly good level of student engagement (students averaged 6–7 hours on each OEP). Students averaged 38 hours on their open-ended project, which represents a significant investment of time. There are three possible explanations for this: (a) the project requires integration of two subjects, aerodynamics (AE162) and flight mechanics (AE165), hence it affected student grades in more than one course; (b) the project carries a greater weight towards the course grade (20% vs. 5% for each of the rest OEPs; (c) a much higher level of engagement is achieved when students work on a problem of their choice.

It is also worth noting that 32% of the students found the course material difficult. The main reason for this perception is inadequate preparation in the course prerequisites (calculus, physics, and fluid mechanics). This fact is confirmed by student test scores on the Fluid Mechanics Concept Inventory, given to them at the beginning of the course. Students typically average 45-50% on this test. The deficiency with respect to Fluid Mechanics was addressed by replacing ME111 with AE160 in the BSAE curriculum, effective Fall 2010.

***Performance Criterion* 3A-4.2:** *Define (open-ended) problems in appropriate engineering terms.*

***Assessment Summary:*** The performance target is met for Performance Criterion 3A-4.2.

***Assessment Tool***
Rubric for measuring student performance on Step 2 of the PSM

| Score | Performance Criterion:<br>Define one or more criteria (measures) for answering the question. |
|---|---|
| 10 | Identifies a proper "measure". Includes appropriate sketches illustrating all relevant parameters. |
| 7 - 9 | Identifies a "measure" that can indirectly lead to a more appropriate one. Sketches illustrate some of the relevant parameters. |
| 5 - 6 | Identifies what may at first appear as a reasonable "measure" but which may later be shown to be inappropriate. Sketches illustrate some of the relevant parameters. |
| 1 - 4 | Does not specify a useful "measure" for the comparison. No sketches included. |
| 0 | Does not attempt. |

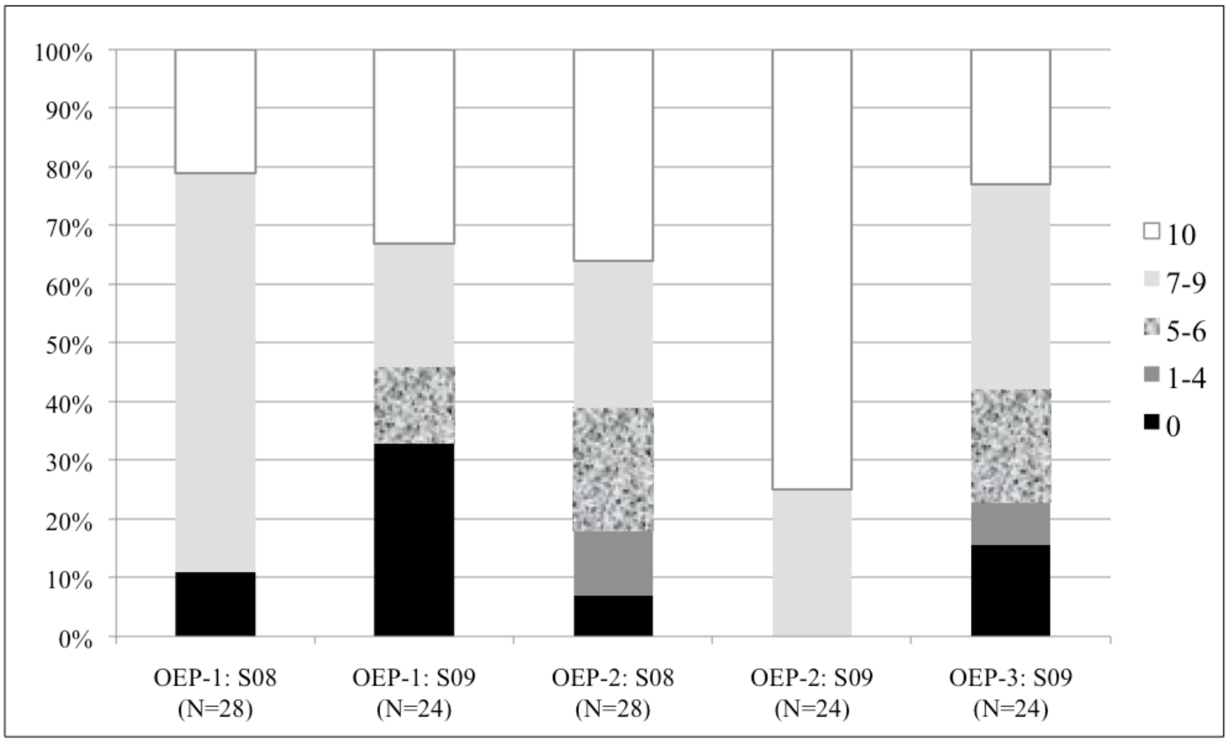



Figure 4.1 – Student performance on Step 2 of the PSM in AE162

***Analysis***
Figure 4.1 shows that in Spring 2008 students performed better in Step 2 in OEP-1 (89% scored 7 or higher vs. 61% for OEP-2). However, OEP-1 was team homework while OEP-2 was a final exam problem. In Spring 2009, 67% received passing scores in OEP-1 and 100% in OEP-2. In fact, all students scored 7 or higher in Step 2. Students also performed very well in the much more challenging OEP-3, although 25% did not receive a passing grade in Step 2. Forty one (41%) percent of the students in AE162 identified Step 2 as the greatest challenge in solving OEPs, expressing discomfort with the fact that so little information was given about each problem, unlike typical homework problems and exam questions.

**Performance Criterion 3A-4.3:** *Explore problems (i.e., examine various issues, make appropriate assumptions, etc.).*

***Assessment Summary***
The performance target is not met for Performance Criterion 3A-4.3.

***Assessment Tool***

Rubric for measuring student performance on Step 3 of the PSM

| Score | Performance Criterion: Generate appropriate questions related to the "measures" you defined in Step 2, identify possible approaches (models) for solving the problem, and make reasonable assumptions. |
|---|---|
| 10 | Generates at least two relevant questions, identifies at least two different approaches, and makes all necessary assumptions for each approach. |
| 7 - 9 | Generates at least one relevant question, identifies at least two different approaches, and makes most of the necessary assumptions for each approach. |
| 5 - 6 | Generates at least one relevant question, identifies at least one approach, and makes most of the necessary assumptions for this approach. |
| 1 - 4 | Generates one or two relevant questions, does not identify an approach, does not make some or all of the necessary assumptions. |
| 0 | Does not attempt. |

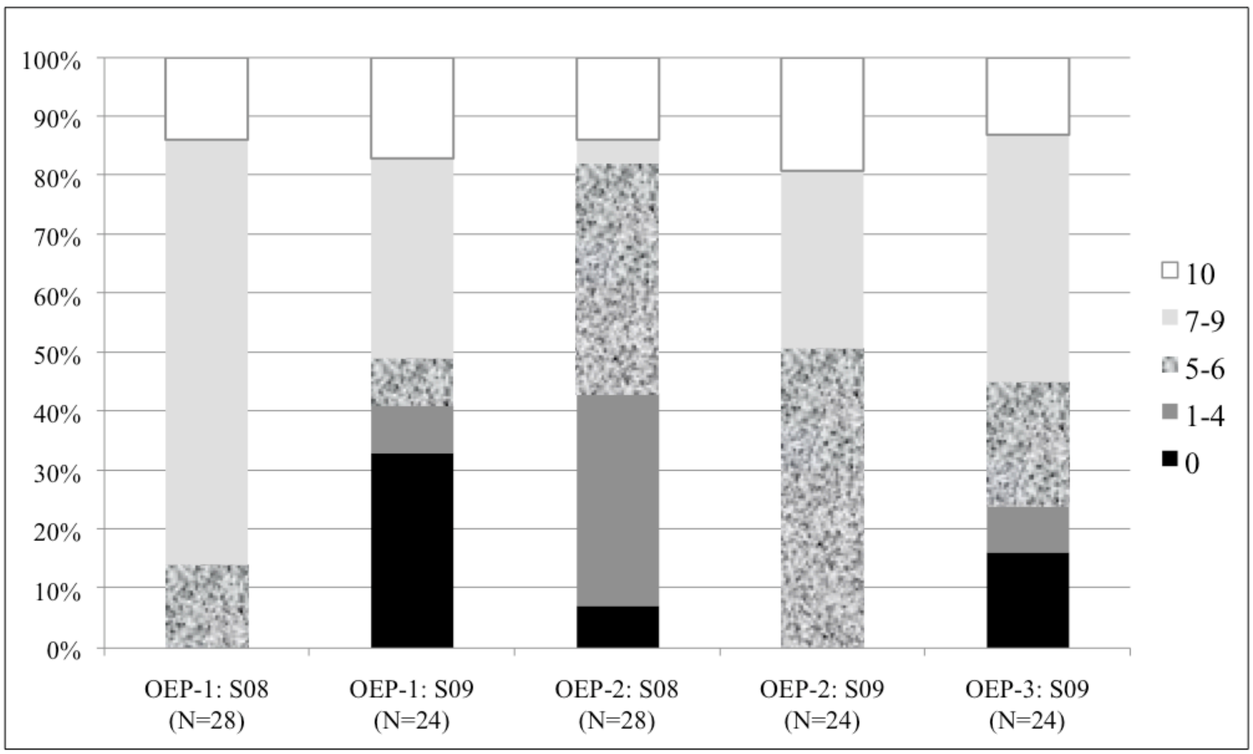



Figure 4.2 – Student performance on Step 3 of the PSM in AE162

***Analysis***
Figure 4.2 shows that student performance benefited from the team-effort in OEP-1 (Spring 2008) while 43% of the students did not perform adequately in this step in OEP-2 (individual effort, final exam). This trend, however, was reversed in Spring 2009 when 41% of the students did not receive a passing score in OEP-1 while all students performed adequately on

OEP-2. As was the case with Step 2 students performed very well in the much more challenging OEP-3 although 24% did not receive a passing grade in Step 3.

Nine (9%) percent of the students identified Step 3 as the greatest challenge in solving OEP. An additional 18% identified Step 3 as the second greatest challenge in tackling OEP. By far the greatest difficulty expressed by students was making appropriate assumptions to simplify the problem. In their own words: "We didn't know if our assumptions would lead to the right answer. We were trying to avoid making the problem too big (on one hand) versus oversimplifying it (on the other). Nevertheless students acknowledged that this ambiguity led to a better understanding of the material.

**Performance Criterion 3A-4.4:** *Develop a plan for the solution (i.e., select appropriate theories, principles, approaches).*

***Assessment Summary:*** The performance target is met for Performance Criterion 3A-4.4.

***Assessment Tool***

Rubric for measuring student performance on Step 4 of the PSM

| Score | Performance Criterion:<br>Select an appropriate model for developing a solution, break down the problem into sub-problems, and determine what needs to be found in each sub-problem. |
|---|---|
| 10 | Selects the most appropriate model for developing a solution, breaks down the problem into appropriate sub-problems; provides complete list of what needs to be found in each sub-problem. |
| 7 - 9 | Selects an appropriate model for developing a solution, breaks down the problem into appropriate sub-problems; incomplete list of what needs to be found in each sub-problem. |
| 5 - 6 | Selected model for developing a solution is not described adequately; breakdown of problem into sub-problems is not appropriate or helpful; list of what needs to be found is incomplete. |
| 1 - 4 | Does not identify a model for developing a solution or does not break down the problem into sub-problems and / or does not list what needs to be found. |
| 0 | Does not attempt. |

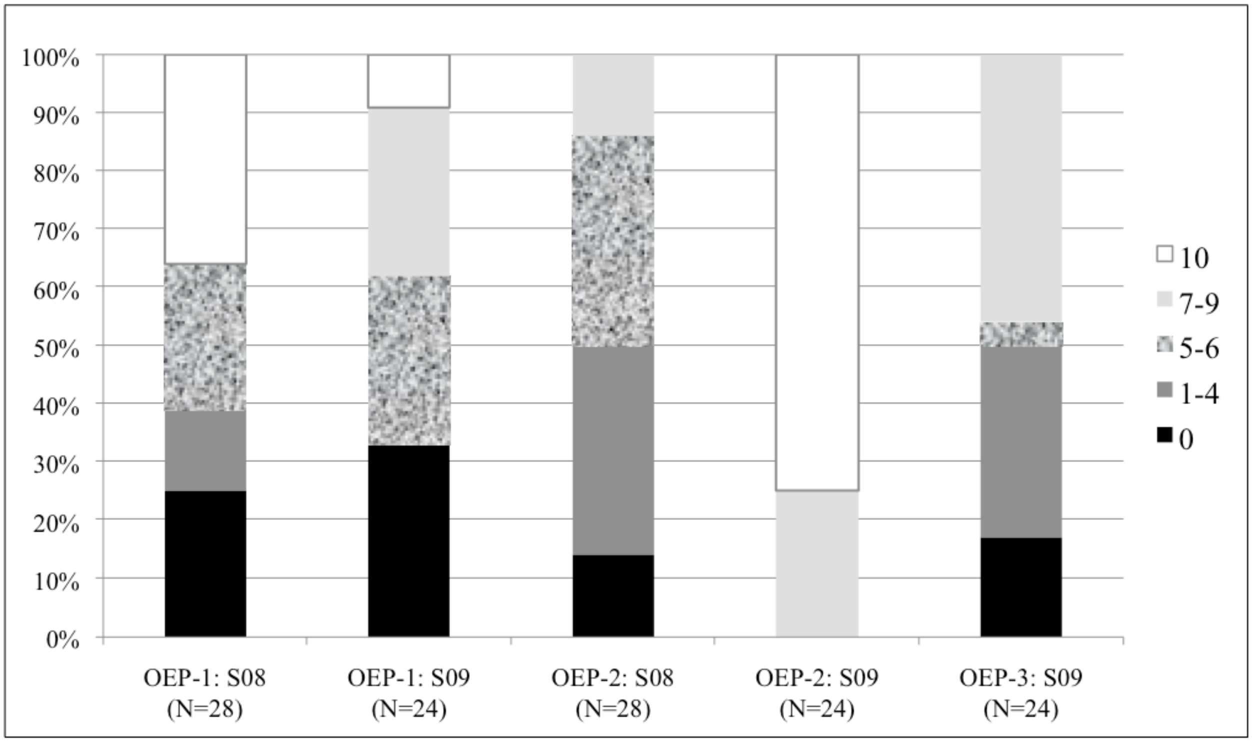



Figure 4.3 – Student performance on Step 4 of the PSM in AE162

***Analysis***

Figure 4.3 (Spring 2008) shows again that performance may improve when students work in teams. This trend is again reversed in Spring 2009 when students performed significantly better on OEP-2 on the final exam. However, a larger percentage of students (50%) performed poorly in Step 4 of OEP-3.

14% percent of the students in AE162 identified Step 4 as the greatest challenge in solving OEP. An additional 5% identified this step as the second greatest challenge in tackling OEP. Students find it difficult "figuring out which equations / principles to use".

**Performance Criterion 3A-4.5:** *Implement their solution plan and check the accuracy of their calculations.*

***Assessment Summary:*** The performance target is met for Performance Criterion 3A-4.5.

***Assessment Tool***

Rubric for measuring student performance on Step 5 of the PSM

| Score | Performance Criterion:<br>Substitute appropriate values of known and assumed quantities in the equations and carry out calculations correctly. Produce sketches, figures, and drawings as necessary. |
|---|---|
| 10 | All calculations are correct. Appropriate sketches, figures, and drawings included in the solution. |
| 7 – 9 | Most calculations are correct. Appropriate sketches, figures, and drawings included in the solution. |
| 5 – 6 | Some calculations are correct. Some sketches, figures, and drawings included in the solution. |
| 1 – 4 | Several of the calculations are incorrect. Important sketches, figures, and drawings are missing from the solution. |
| 0 | Does not attempt. |

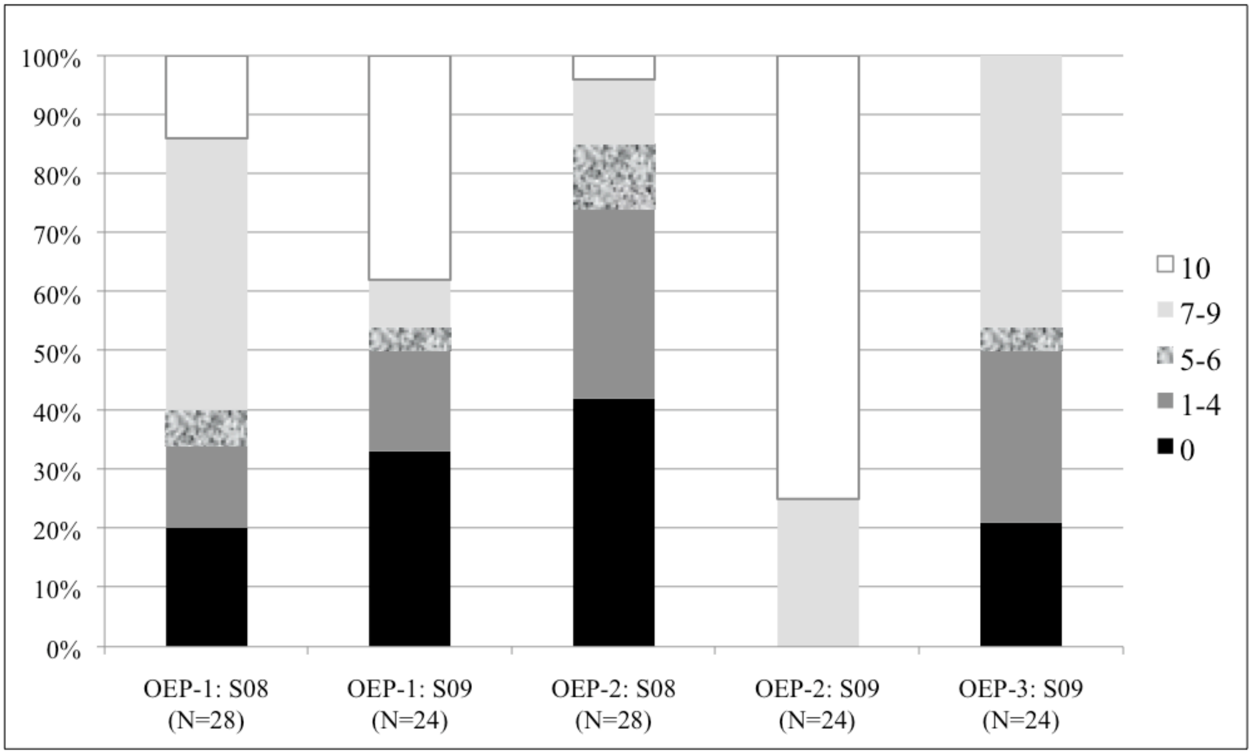



Figure 4.4 – Student performance on Step 5 of the PSM in AE162

***Analysis***

Figure 4.4 shows similar trends with Figure 4.3. This is to be expected, as student performance in Step 5 very much depends on their problem setup from Step 4. The large percentage of students (74%) who performed inadequately in Step 5 of OEP-2 (AE162, Spring 08) indicates again that many students were not ready to tackle an OEP on their own. Students did not identify any particular challenges in relation to Step 5.

**Performance Criterion 3A-4.6:** *Evaluate their results and reflect on their strengths and weaknesses in the process.*

***Assessment Summary***

The performance target is not met for Performance Criterion 3A-4.6.

***Assessment Tool***

Rubric for measuring student performance on Step 7 of the PSM

| Score | Performance Criterion: Discuss whether answer makes sense, evaluate appropriateness of models used and any assumptions made. Reflect on personal problem solving process. |
|---|---|
| 10 | A. Comments on whether the answer is reasonable and why. Evaluates the appropriateness of any models used and any assumptions made.<br>B. Reflects in depth on his/her personal problem solving process; identifies several strengths and several areas for improvement. |
| 7 – 9 | A. Comments on whether the answer is reasonable but does not explain why. Evaluates the appropriateness of any models used and some of the assumptions made.<br>B. Reflects on the personal problem solving process. Identifies at least one strength and one area for improvement. |
| 5 – 6 | A. Comments on whether the answer is reasonable but does not explain why. Does not evaluate the appropriateness of any models used and/or some of the assumptions made.<br>B. Inadequate reflection on the personal problem solving process. One strength and/or one area for improvement identified. |
| 1 – 4 | A. No comment on whether the answer is reasonable. No evaluation of the appropriateness of any models used and/or any assumptions made, based on the answer received.<br>B. No reflection on the personal problem solving process. No strengths or areas for improvement identified. |
| 0 | Does not attempt. |

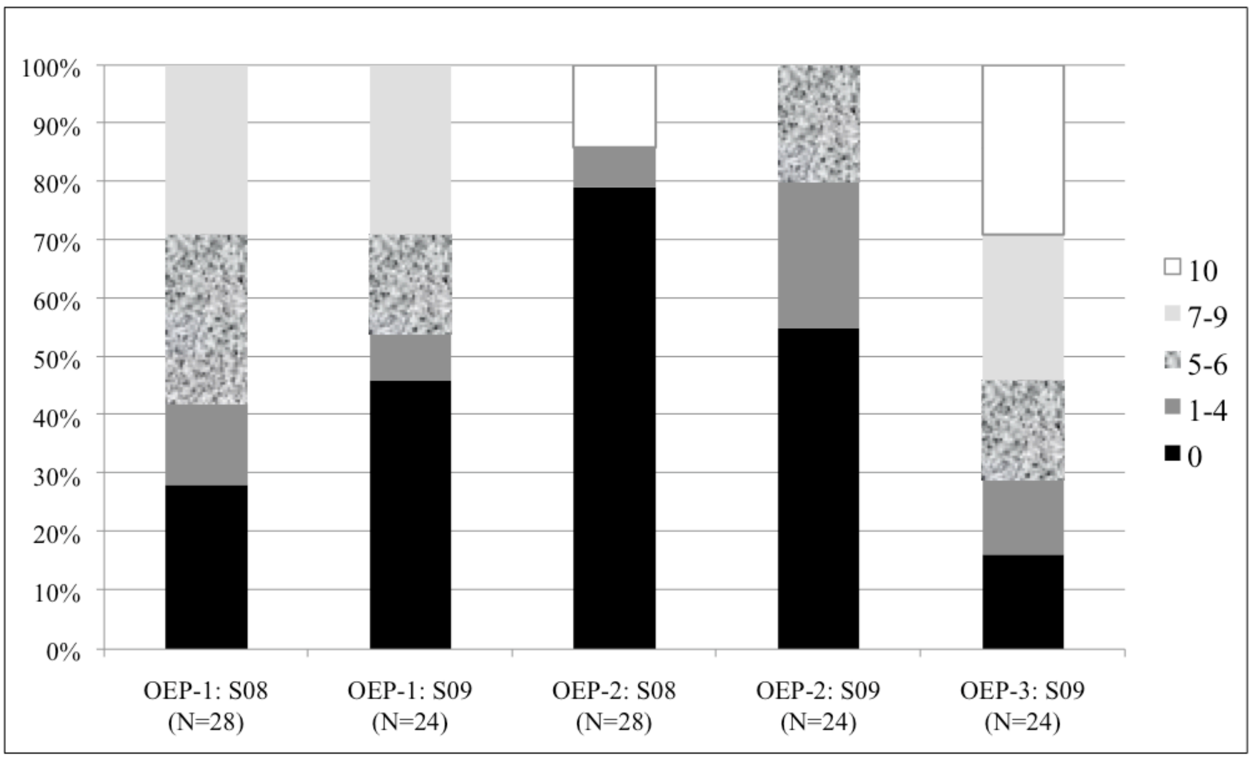



Figure 4.5 – Student performance on Step 7 of the PSM in AE162

Step 7 is critical for self-assessment and self-improvement. The large number of students who receive non-passing scores (0 – 4) confirms that students have great difficulty with this final step. Nevertheless, very few students mentioned reflection as one of their major challenges.

Students included two separate reflections in their report for each problem. The first reflection involves the technical aspects of the problem and is performed by the team. The second reflection involves each member's personal problem solving process and is carried out individually. As part of this personal reflection students were reminded to answer the following questions in their report for the last OEP in each class.

(a) What was the greatest challenge you faced in solving OEP in this class?
(b) What other difficulties did you experience in solving OEP?
(c) What general skills did you learn (applicable to other classes / situations) from solving OEP in this class?
(d) Do you have any specific suggestions for the instructor on how he can help students improve their problem solving skills?
(e) Do you have any specific suggestions for students who try to solve OEP?

A qualitative analysis of student responses was conducted and the main conclusions are presented below.

Summary of student performance in the three OEP

| | OEP-1 | OEP-2 | OEP-3 |
|---|---|---|---|
| | Students Receiving Passing Grades in OEP with *min score = 5* | | |
| Spring 2008 | 14/25 (56%) | 5/25 (20%) | N/A |
| Spring 2009 | 14/24 (58%) | 3/24 (13%) | 17/24 (71%) |
| | Students Receiving Passing Grades in OEP with *min score = 7* | | |
| Spring 2008 | 4/25 (16%) | 0/25 (0%) | N/A |
| Spring 2009 | 13/24 (54%) | 2/24 (8%) | 12/24 (50%) |

Transferable Skills

Students identified the following skills, acquired in the process of solving OEP, as transferable:

- The ability to use the PSM. They found the PSM to be "very effective", as it gave them "a logical, systematic approach for solving problems", "a scientific way of thinking", and helped them to "be organized". Furthermore, they stated that the PSM made it easier for them to "reflect on their mistakes or weaknesses in the problem solving process".
- Confidence in solving real-world problems. This shows that it is possible to increase student confidence level with a systematic teaching of problem solving skills. "I can now look at real-world problems and apply basic principles to solve them", said one student. Student confidence in their cognitive problem-solving skills is summarized in Table 8.
- Making reasonable assumptions.
- Team skills, such as ability to discuss a problem effectively and reach consensus.

Student Difficulties in Solving OEP

It is important to distinguish between cognitive and affective difficulties in problem solving. The cognitive domain is concerned with intellectual outcomes, such as knowledge, understanding, and skills. The affective domain involves emotional outcomes, such as interests, attitudes, and values. Emotional outcomes are very important when considering some of the attributes needed for problem solving, such as, for example, willingness to risk and cope with ambiguity, welcoming change and managing stress.

Top cognitive difficulties as identified by students as well as by the course instructors:

- Applying first principles in the solution of problems.
- Integrating knowledge from the entire course / more than one course.
- Reflecting on the problem solving process.
- Self-assessment of their problem solving skills.
- Defining a problem in engineering terms.
- Selecting a valid model for a problem (making appropriate assumptions).
- Following the PSM in its entirety.

Top affective difficulties as identified by students as well as by the course instructors:

- Unwillingness to spend sufficient time on task.
- Reluctance to write down ideas and create sketches while solving a problem.
- Dealing with ambiguity and uncertainty (lack of confidence).
- Working effectively in teams (coordinating meetings outside of class, dysfunctional teams, and agreeing on an approach to solve each problem).

It is evident that no improvement in cognitive problem solving skills can take place unless students bring with them the right attitudes and values when approaching OEP. For example, one must stay flexible while brainstorming possible ways to model a physical situation (Step 3) and value accuracy more than speed while implementing a mathematical model (Step 5). Needless to say being organized and systematic is a requirement throughout the PSM. It is clear that with the exception of Step 1, which is entirely affective, the rest of the steps require a mix of affective and cognitive skills.

Student Confidence in Problem Solving

A survey was distributed at the end of the semester, after completion of the last OEP, and included questions related to student confidence in their cognitive skills (Table 8) as well as student attitudes and habits during problem solving. The tables below summarize student responses.

Student confidence in their cognitive problem solving skills (N=22)

| Indicate your level of confidence in each of the following: | I am very confident | I am somewhat confident | I am not at all confident |
|---|---|---|---|
| Following the PSM to solve OEP | 18% | 73% | 9% |
| Following the PSM to solve well-defined problems (examples in the book, homework problems) | 55% | 45% | 0 |
| Monitor my problem solving process and reflect upon its effectiveness | 37% | 59% | 4% |
| Draw upon my knowledge of the material when I solve practical, real world problems in new situations | 41% | 55% | 4% |
| Use an approach that emphasizes fundamentals rather than trying to combine memorized sample solutions | 50% | 50% | 0 |

Student affective skills as they relate to problem solving (N=22)

| Indicate how often you do each of the following when you solve problems: | Never / Rarely | Sometimes | Very often / Always |
|---|---|---|---|
| I am more concerned about accuracy than speed | 0 | 36% | 64% |
| I sketch a lot, write down ideas, and create charts / figures to help me visualize the problem | 9% | 55% | 36% |
| I am organized and systematic | 14% | 64% | 22% |
| I stay flexible (I keep my options open, I can view a situation from different perspectives) | 14% | 45% | 41% |
| I am willing to take risks (try new things even though I am not be sure about the outcome) | 14% | 41% | 45% |
| I cope well with ambiguity, welcoming change and managing stress | 9% | 73% | 18% |

While grading the various OEP it became apparent that lack of affective skills was a primary cause for low performance. The most common reason for a low score was a sloppy report with incomplete steps, indicating inadequate time spent on the problem. For example, in many cases where students set up and solved an incorrect model for a problem, they had failed to include necessary sketches in steps 2, 3, and 4. As a result they did not visualize the problem correctly. On the other hand, students who performed well were usually meticulous about completing each step of the PSM (i.e. they took time to research and read, explored various possibilities before settling on an approach, sketched a lot in their effort to visualize the problem, and presented everything they did in a clear, organized, and systematic way).

***Recommendations***

Students were asked to make anonymously specific suggestions for the instructor on how he can help improve their problem solving skills. They were also asked to make specific suggestions for other students who try to solve OEP. The following is a summary of their recommendations:

Suggestions for the instructor:

- 32% of the students felt that there was no need to change the way OEP were introduced and problem solving skills taught. Students wrote that "the class is very interesting", "problems are explained clearly", "the guidelines are very structured", "examples are covered very thoroughly", and "I like the way we did it!".
- 32% of the students suggested more in-class examples of how to solve OEP.

Suggestions for other students:

- 14% of the students made suggestions related to time management: "Start working on each problem early; don't try to do it all in one day!", "give yourself time to study, understand, and visualize each problem".
- 19% of the students urged fellow students to "follow the PSM and you will do just fine". "It helps a great deal in seeing what you have and where you need to go", one student said. "Think about the problem holistically, sketch and research before attempting any calculations". Another suggested "first tackle problems in a way that makes sense to you, then follow the PSM to organize your ideas".
- "Work with your team" and "find teammates you can work with" was a suggestion made by 15% of the students. "Don't be afraid to argue with your teammates" but also "listen

to your teammates and be open to their views", wrote one student. "Different minds bring different ideas and knowledge to the table", said another.

- "Talk to the instructor", suggested 18% of the students. "Ask for as much help as possible". On the balancing side a student urged to "try to solve the problem by yourself first, without talking to anyone. Ask for help only when you can't figure out something".
- "Keep an open mind and explore different approaches" was a suggestion made by 10% of the students.

***Implementation:*** AY 2010 - 2011

***Outcome 3B* – Ability to design and conduct water / wind tunnel experiments as well as to analyze and interpret data from such experiments.**

***Course Statistics***

| *Course* | *Semester* | *Faculty Member* | *Enrollment* | *# of students who passed* | *% of students who passed* |
|---|---|---|---|---|---|
| AE 162 | Spring 2008 | Dr. Nikos J. Mourtos | 28 | 22 | 79% |
| AE 160 | Fall 2010 | Dr. Nikos J. Mourtos | 24 | 15 | 63% |

***Course Design to Address Outcome 3B***

The laboratory experience in these courses has been re-designed to include:

a. Instruction on how to design experiments.
b. Modification of the original experiments from 'cook-book' to open-ended: students design their own experiments, given a general goal.
c. Introduction of a Design-of-Experiment (DoE) process (Du, Furman, and Mourtos, 2005), which students are required to use:

   Step 1 – Define specific and measurable objectives for the experiment.
   Step 2 – Research the relevant theory and previously published data from similar experiments. Perform computer simulations if appropriate software is available. The purpose of this step is to prepare students on what to expect from the experiment.
   Step 3 – Select the dependent and independent variable(s) to be measured.
   Step 4 – Select appropriate methods for measuring / calculating each variable.
   Step 5 – Select the proper range for the independent variable(s).
   Step 6 – Determine an appropriate number of data points needed for each type of measurement.

d. Development of rubrics to evaluate student performance in each step of this process (Anagnos, Komives, Mourtos, and McMullin, 2007).
e. In both courses, students write extensive lab reports for each lab experiment, in which they present their design, results, and discussion (interpretation) of their results. Their lab reports are graded using the rubric below.

Lab Report Grading Rubric[6]

| | | |
|---|---|---|
| Total Score | **112** | |
| 1. Abstract | | ***10*** |
| 2. Experimental Design | | ***42*** |
| • Practical importance of this experiment | | 4 |
| • (1) Define goals and objectives | | 4 |
| • (2a) Research / summarize relevant theory | | 10 |
| • (2b) Research / summarize previous data | | 4 |
| • (2c) Computer simulations (if available) | | 4 |
| • (3) Select dependent and independent variables | | 4 |
| • (4) Select appropriate methods to measure these variables | | 4 |
| • (5) Select proper range for independent variables | | 4 |
| • (6) Determine appropriate number of data points for each type of measurement. | | 4 |
| 3. Experimental results | | ***20*** |
| 4. Discussion<br>• Interpretation of results<br>• Explanation of any discrepancies with theory and / or published data and / or computer simulations | | ***20*** |
| 5. References | | ***10*** |
| 6. Appendices<br>• Raw data<br>• Data Analysis - Calculations<br>• Published data<br>• Other | | ***10*** |

***Course Activities*** (AE 160)

a. Design and perform a water tunnel experiment to study the effects of shape and angle of attack on the flow pattern around an airfoil, a forebody, and a delta-wing aircraft model and report the results. As part of the study students distinguish basic flow features, such as laminar or turbulent flow, attached or separated flow, etc.
b. Design and perform a wind tunnel experiment to study the effects of shape and Reynolds number on the aerodynamic drag of 2-D and 3-D bodies and analyze the results.
c. Design and perform a wind tunnel experiment to study the drag of an airfoil from wake measurements and analyze the results.
d. Design and perform a wind tunnel experiment to study boundary layer characteristics on an aerodynamic surface and analyze the results from such experiments.

***Course Activities*** (AE 162)

a. Design and perform a wind tunnel experiment to study the effects of Reynolds number on the pressure distribution of a circular cylinder and compare with potential flow theory results (new experiment, implemented in Spring 2011).
b. Design and perform a wind tunnel experiment to study the effect of angle-of-attack and Reynolds number on the pressure distribution of an airfoil and compare the results with published and computational data.
c. Design and perform a wind tunnel experiment to study the effect of angle-of-attack and Reynolds number on the lift and drag characteristics of an airfoil and compare the results with theoretical, published and computational data.

[6] < http://www.engr.sjsu.edu/nikos/courses/Common/Labs/Lab.rubric.htm>

d. Design and perform a wind tunnel experiment to study the effect of high-lift devices on the lift and drag characteristics of an airfoil and compare the results with published and computational data (new experiment, implemented in Spring 2011).

***3B.1 – Ability to design water / wind tunnel experiments***

Outcome Element 3B.1 is assessed in the "design of experiment" section of each lab report and accounts for 40% of the grade for each experiment.

***Assessment Summary:*** The performance target is met for Outcome Element 3B.1.
100% of the students met the performance target in all the performance criteria for Outcome Element 3B.1, in one experiment in AE160.

**Performance Criterion 3B-1.1:** *Define goals and objectives for the experiment.*

***Assessment Summary:*** The performance target is met for Performance Criterion 3B-1.1.

***Assessment Tool***

Rubric for measuring student performance on Step 1 of the DoE process

| | | |
|---|---|---|
| NOT PASS | 0 | No objectives identified |
| | 1 | Objective identified but<br>• Not relevant to experiment OR<br>• Contains technical or conceptual errors OR<br>• Not measurable |
| PASS | 2 | Objectives are conceptually correct; correct technical terminology but may be incomplete in scope or have grammatical errors. |
| | 3 | Objective are complete, conceptually correct, concise; correct technical terminology but may have grammatical errors. |
| | 4 | Objectives are complete, conceptually correct, concise, specific and clear; correct technical terminology and grammar. |

***Student Performance Results***

| | Students who scored "2" or higher on the rubric | |
|---|---|---|
| | AE 162 (Spring 08) | AE 160 (Fall 10) |
| Experiment 1 | 22 / 22 (100%) | 15 / 15 (100%) |
| Experiment 2 | 19 / 22 (86%) | 15 / 15 (100%) |
| Experiment 3 | 14 / 22 (64%) | 15 / 15 (100%) |
| Experiment 4 | 20 / 22 (91%) | 15 / 15 (100%) |

**Performance Criterion 3B-1.2:** *Research relevant theory and published data from similar experiments.*

***Assessment Summary:*** The performance target is met for Performance Criterion 3B-1.2.

***Assessment Tool***

Rubric for measuring student performance on Step 2 of the DoE process

| | | |
|---|---|---|
| NOT PASS | 0 | No theory.<br>Previously published data not included.<br>No computer simulations. |
| | 1 | Theory section, published experimental data, and computer simulations included but not relevant to the experiment. |
| PASS | 2 | Theory section includes some of the relevant equations and some discussion relevant to the experiment. Published experimental data or computer simulations relevant to the experiment are included but not used to predict experimental results. |
| | 3 | Theory section is well written, with equations and some discussion relevant to the experiment. Published experimental data and / or computer simulations relevant to the experiment are included but not used to predict experimental results. |
| | 4 | Theory section is well written, with equations and discussion relevant to the experiment. Published experimental data are included as well as computer simulations relevant to the experiment. Theory, published data, and simulations are used to predict experimental results. |

***Student Performance Results***

| | Students who scored "2" or higher on the rubric | | | | | |
|---|---|---|---|---|---|---|
| | AE 162 (Spring 08) | | | AE 160 (Fall 10) | | |
| | Theory | Published Data | Computer Simulations | Theory | Published Data | Computer Simulations |
| Experiment 1 | 22 / 22 (100%) | 18 / 22 (64%) | N/A | 15 / 15 (100%) | 15 / 15 (100%) | 15 / 15 (100%) |
| Experiment 2 | 22 / 22 (100%) | 15 / 22 (68%) | 13 / 22 (59%) | 15 / 15 (100%) | 15 / 15 (100%) | 15 / 15 (100%) |
| Experiment 3 | 15 / 22 (68%) | 15 / 22 (68%) | 22 / 22 (100%) | 15 / 15 (100%) | 13 / 15 (87%) | 15 / 15 (100%) |
| Experiment 4 | 22 / 22 (100%) | 18 / 22 (64%) | 22 / 22 (100%) | 15 / 15 (100%) | 13 / 15 (87%) | N / A |

**Performance Criterion 3B-1.3:** *Select the dependent and independent variables to be measured.*

***Assessment Summary:*** The performance target is met for Performance Criterion 3B-1.3.

***Assessment Tool***

Rubric for measuring student performance on Step 3 of the DoE process

| | | |
|---|---|---|
| NOT PASS | 0 | Did not identify variables |
| | 1 | Identified variables but did not distinguish dependent and independent |
| PASS | 2 | Identified dependent and independent variables and relationship between them<br>Identified range for one variable |
| | 3 | Identified dependent and independent variables and relationship between them<br>Identified ranges for both |
| | 4 | Identified dependent and independent variables and relationship between them<br>Identified ranges for both<br>Identified appropriate increments for measurements |

***Student Performance Results***

| | Students who scored "2" or higher on the rubric | |
|---|---|---|
| | AE 162 (Spring 08) | AE 160 (Fall 10) |
| Experiment 1 | 18 / 22 (82%) | 11 / 15 (73%) |
| Experiment 2 | 14 / 22 (64%) | 15 / 15 (100%) |
| Experiment 3 | 22 / 22 (100%) | 13 / 15 (87%) |
| Experiment 4 | 10 / 22 (45%) | 13 / 15 (87%) |

**Performance Criterion 3B-1.4:** *Select appropriate methods for measuring / controlling each variable.*

***Assessment Summary:*** The performance target is met for Performance Criterion 3B-1.4.

***Assessment Tool***

Rubric for measuring student performance on Step 4 of the DoE process

| | | |
|---|---|---|
| NOT PASS | 0 | Did not identified methods for measuring/controlling variables |
| | 1 | Identified inappropriate method(s) |
| PASS | 2 | Method(s) listed with no description or incomplete description OR<br>Complete description of method(s) presented, but list is not comprehensive |
| | 3 | Comprehensive list of possible methods of measurement and instrumentation with complete descriptions but no discussion of limitations and dynamic range |
| | 4 | Comprehensive list of possible methods of measurement and testing instrumentation and equipment based on available resources with complete descriptions including a discussion of limitations and dynamic range |

***Student Performance Results***

| | Students who scored "2" or higher on the rubric | |
|---|---|---|
| | AE162 (Spring 08) | AE160 (Fall 10) |
| Experiment 1 | 18 / 22 (82%) | 11 / 15 (73%) |
| Experiment 2 | 18 / 22 (82%) | 15 / 15 (100%) |
| Experiment 3 | 14 / 22 (64%) | 13 / 15 (87%) |
| Experiment 4 | 7 / 22 (32%) | 13 / 15 (87%) |

**Performance Criterion 3B-1.5:** *Select a proper range for the independent variables.*

***Assessment Summary:*** The performance target is met for Performance Criterion 3B-1.5.

***Assessment Tool***

Rubric for measuring student performance on Step 5 of the DoE process

| | | |
|---|---|---|
| NOT PASS | 0 | Ranges not identified |
| | 1 | Ranges grossly unreasonable*** OR<br>Ranges provided with no justification |
| PASS | 2 | Range is reasonable* but not adequately justified OR<br>Range is unreasonable but based on correct theory with mathematical errors |
| | 3 | Reasonable* range for all independent variables that are justified based on appropriate but possibly incomplete use of literature, correct theoretical calculations, and equipment/instrumentation limitations. |
| | 4 | Optimal** range for all independent variables that are justified based on appropriate use of literature, theoretical calculations, and equipment/instrumentation limitations. |

*Reasonable – pushing the limits of equipment, instrumentation or specimens, or captures some aspects of system behavior but is inadequate for complete analysis.

**Optimal – range will capture full response of system, is within limitations of equipment, instrumentation, and specimens, and will provide sufficient data for a statistically valid and complete analysis.
***Unreasonable – theoretically impossible, or significantly outside the limits of the equipment, instrumentation, or specimens.

***Student Performance Results***

| | Students who scored "2" or higher on the rubric | |
|---|---|---|
| | AE 162 (Spring 08) | AE 160 (Fall 10) |
| Experiment 1 | 18 / 22 (82%) | 10 / 15 (67%) |
| Experiment 2 | 22 / 22 (100%) | 15 / 15 (100%) |
| Experiment 3 | 22 / 22 (100%) | 13 / 15 (87%) |
| Experiment 4 | 15 / 22 (68%) | 13 / 15 (87%) |

**Performance Criterion 3B-1.6:** *Determine an appropriate number of data points for each type of measurement.*

***Assessment Summary:*** The performance target is met for Performance Criterion 3B-1.6.

***Assessment Tool***
Rubric for measuring student performance on Step 6 of the DoE process

| | | |
|---|---|---|
| NOT PASS | 0 | Number of data points not identified |
| | 1 | Number of points grossly unreasonable OR<br>Number of points provided with no justification |
| PASS | 2 | Number of points is sufficient to capture mathematical properties in an ideal world, but insufficient in the presence of experimental error or other confounding factors |
| | 3 | Reasonable* number of points for measurements, justified based on some but not all of the following: theory, equipment limitations, and potential error |
| | 4 | Reasonable* number of points for all measurements, justified based on consideration of theory, equipment limitations, and potential error |

*Reasonable – a sufficient number of points to capture the mathematical properties of the relationship (e.g. linear versus logarithmic).and account for possible measurement error.
***Unreasonable – insufficient number of points to capture the mathematical properties of the relationship.

***Student Performance Results***

| | Students who scored "2" or higher on the rubric | |
|---|---|---|
| | AE 162 (Spring 08) | AE 160 (Fall 10) |
| Experiment 1 | 22 / 22 (100%) | 11 / 15 (73%) |
| Experiment 2 | 22 / 22 (100%) | 13 / 15 (87%) |
| Experiment 3 | 22 / 22 (100%) | 15 / 15 (100%) |
| Experiment 4 | 15 / 22 (68%) | 13 / 15 (87%) |

***Analysis***

- Overall, student ability to design experiments improved significantly from Spring 2008 to Fall 2010, as indicated by the improved scores in AE160 shown in the student performance results tables above. This is the result of spending considerably more time in class as well as in the lab coaching students on the skills pertaining to Outcome Element 3B.1.
- The lowest scores in AE162 were in the last experiment. This may be explained by the fact that this experiment was performed rather late in the semester and students did not

have as much time to prepare their lab reports. As a result, some teams submitted incomplete reports. This problem has now been addressed in two ways:
  - The schedule for the four experiments has been adjusted, so students have more time to write their last lab report.
  - Students must average at least 70% in their lab reports to earn a passing grade in each course (AE160 and AE162), regardless of their performance on exams and other assignments.
- The lowest scores in AE160 were in the first experiment. This may be explained by the fact that students were in the process of calibrating their efforts with the new standards and expectations presented to them in a new course.

***Recommendation:*** None.

***3B.2 – Ability to conduct water tunnel / wind tunnel experiments***

***Assessment Summary:*** The performance target is met for Outcome Element 3B.2.

**Performance Criterion 3B.2:** *Given an experimental setup, become familiar with the equipment, calibrate the instruments to be used, and follow the proper procedure to collect the data.*

***Assessment Summary:*** The performance target is met for Performance Criterion 3B.2.

***Laboratory Activities***
- Students prepare for their experiments beforehand. The equipment manuals as well as questions pertaining to each experiment are posted on the courses' website.
- Students turn in written answers to these questions and must score a minimum of 70% before they are allowed to perform their experiment.
- Students turn in their design-of-experiment for approval before they are allowed to use the equipment in the Aerodynamics Lab.
- For safety reasons students conduct their experiments under the supervision of a lab assistant, who is usually an MSAE student familiar with the equipment. He/she (a) demonstrates all the equipment and instrumentation in the Aerodynamics Lab, (b) ensures that students are indeed familiar with the equipment before allowed to operate the wind and the water tunnel, and (c) supervises all experiments to ensure students follow proper procedures.

***Assessment Process:*** Following each experiment, the Lab Assistant certifies that each student is capable of conducting the experiment.

***Recommendation:*** None.

***3B.3 – Ability to analyze data from water / wind tunnel experiments***

***Assessment Summary:*** The performance target is met for Outcome Element 3B.3.

***Assessment Tool***

Outcome Element 3B.3 is assessed in the results section of each lab report and accounts for 20% of the grade for each experiment.

**Performance Criterion 3B.3:** *Given a set of experimental data, carry out the necessary calculations, tabulate and plot the results using appropriate choice of variables and software.*

***Assessment Summary:*** The performance target is met for Performance Criterion 3B.3.

***Student Performance Results***

| | Students who scored 70% or higher | |
|---|---|---|
| | AE 162 (Spring 08) | AE 160 (Fall 10) |
| Experiment 1 | 15 / 22 (68%) | 15 / 15 (100%) |
| Experiment 2 | 9 / 22 (41%) | 15 / 15 (100%) |
| Experiment 3 | 12 / 22 (55%) | 13 / 15 (87%) |
| Experiment 4 | 11 / 22 (50%) | 11 / 15 (73%) |

***Analysis***

A large percentage of students did not perform adequately in this area in Spring 2008. In many cases, students knew what they were supposed to do, however, they chose not to do it simply because it was time consuming (e.g. presenting theoretical predictions, published experimental data, computer simulation data, and their own experimental results all on one and the same graph, allowing a comparison for discussion purposes). The requirement to average 70% in their lab reports, imposed for the first time in AE160 in Fall 2010 made for a significant improvement in student performance in this area.

***Recommendation:*** None.

***3B.4 – Ability to interpret data from water / wind tunnel experiments***

***Assessment Summary:*** The performance target is met for Outcome Element 3B.4.

***Assessment Tool***

Outcome Element 3B.4 is assessed in the discussion section of each lab report and accounts for 20% of the grade for each experiment.

**Performance Criterion 3B-4.1:** *Given a set of results in tabular or graphical form, make observations and draw conclusions regarding the variation of the parameters involved.*
**Performance Criterion 3B-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.*

***Student Performance Results***

| | Students who scored 70% or higher | |
|---|---|---|
| | AE 162 (Spring 08) | AE 160 (Fall 10) |
| Experiment 1 | 18 / 22 (82%) | 12 / 15 (80%) |
| Experiment 2 | 6 / 22 (27%) | 15 / 15 (100%) |
| Experiment 3 | 9 / 22 (41%) | 15 / 15 (100%) |
| Experiment 4 | 12 / 22 (55%) | 11 / 15 (73%) |

***Analysis***

A large percentage of students did not perform adequately in this area in Spring 2008. In general, students are capable of making observations and drawing conclusions regarding the variation of parameters, however, they have difficulties explaining discrepancies between theory and experiment, experiment and published data or experiment and computer simulations. The requirement to average 70% in their lab reports, imposed for the first time in AE160 in Fall 2010 made for a significant improvement in student performance in this area, however, students still need help in this area.

***Recommendation***

Dedicate more class time to discuss reasons why experimental results may differ from theoretical predictions, previously published data or computer simulations.

***Implementation:*** AY 2011-2012

***Outcome 3C* – Ability to perform conceptual and preliminary design of aircraft or spacecraft to meet a set of mission requirements within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability**

***Courses Statistics***

| *Course* | *Semester* | *Faculty Member* | *Enrollment* | *# of students who passed* | *% of students who passed* |
|---|---|---|---|---|---|
| AE 171A&B | Fall '06 / Spring '07 | Dr. Nikos J. Mourtos | 15 | 15 | 100% |
| AE 171A&B | Fall '08 / Spring '09 | Dr. Nikos J. Mourtos | 16 | 15 | 94% |

**Performance Criterion 3C-1:** *Research, evaluate, and compare vehicles designed for similar missions.*

***Assessment Summary:*** The performance target is met for Performance Criterion 3C-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 "Jane's All the World Aircraft" and the internet 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.

***Assessment Tool***
Section 3 of Design Report 1 – Mission specification and comparative study

***Student Performance Results***

| | Students who scored 70% or higher |
|---|---|
| AE 171 A – Fall 2006 | 15 (100%) |
| AE 171 A – Fall 2008 | 15 (100%) |

***Analysis***
Students typically do very well on this assignment; no improvements are needed.

***Recommendation:*** None

**Performance Criterion 3C-2:** *Follow a prescribed process to develop the conceptual / preliminary design of an aerospace vehicle.*

***Assessment Summary:*** The performance target is met for Performance Criterion 3C-2.

***Course Activities*** (AE 171A&B)
Students follow an iterative process (Roskam, 1985) 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.

***Assessment Tool***
3 individual oral exams (two in AE171A, one in AE171B) during design briefings.

***Student Performance Results***

| | Students who scored 70% or higher | | |
|---|---|---|---|
| | 1st Exam (F06) | 2nd Exam (F06) | 3rd Exam (S07) |
| AE171A&B – F06/S07 | 7 (47%) | 2 (13%) | 10 (67%) |
| AE171A&B – F08/S09 | 9 (60%) | 14 (93%) | 15 (100%) |

***Analysis***
Student performance was poor in AY 06-07, especially in the first semester, despite the fact that student teams produced reasonably good designs. The reason for this is that when students work in teams they do not always take the time to learn from each other all the parts of the design process. 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 tested individually during each of their design briefings in class. As the data for AY 06-07 show, this process alone did not produce satisfactory results. To help students prepare for these oral exams, design questions[7] have been posted on the course website. The answers to these questions are discussed in class and many (not all) are also found in the textbook. Additional references are also given for each question. Students are responsible for researching the answers to these questions in their textbook as well as in other sources to prepare for their oral exams. This approach improved student performance significantly in AY 08-09. As a result, all students met the performance target during the third oral exam in Spring 2009.

***Recommendation***
Post answers to the design questions on the course website for easy reference.

***Implementation:*** AY 2011-2012

**Performance Criterion 3C-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 Criterion 3C-3.

***Course Activities*** (AE 171A&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.

***Assessment Tools:*** Design Report 1, Section 2 and Design Report 12.

[7] < http://www.engr.sjsu.edu/nikos/courses/ae171/design.questions.htm>

***Student Performance Results***

| | Students who scored 70% or higher | |
|---|---|---|
| | Design Report 1, Section 2.3 | Design Report 12 |
| AE170A&B.1 – F06/S07 | 15 (100%) | 15 (100%) |
| AE171A&B – F08/S09 | 16 (100%) | 15 (100%) |

***Analysis***
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 (see discussion below) are particularly 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.

***Recommendation:*** None

**Performance Criterion 3C-4:** *Select an appropriate configuration for an aerospace vehicle with a specified mission.*

***Assessment Summary:*** The performance target is met for Performance Criterion 3C-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.

***Assessment Tool***: Design Report 2 – Configuration Design

***Student Performance Results***

| | Students who scored 70% or higher |
|---|---|
| AE 171 A – Fall 2006 | 15 (100%) |
| AE 171 A – Fall 2008 | 15 (100%) |

***Analysis***
Students typically do very well on this assignment; no improvements are needed.

***Recommendation:*** None

**Performance Criterion 3C-5:** *Apply AE principles (ex. aerodynamics, structures, flight mechanics, propulsion, stability and control) to design various vehicle subsystems.*

***Assessment Summary:*** The performance target is met for Performance Criterion 3C-5.

***Course Activities*** (AE171A&B)
Students apply AE principles throughout their conceptual and preliminary design of their airplane.

***Assessment Tools***
The following design reports[8]: weight sizing (Report 3, AE171A), performance sizing (Report 4, AE171A), fuselage design (Report 5, AE171A), wing, high-lift system, and lateral controls design (Report 6, AE171A), empennage, longitudinal and directional controls design (Report 7, AE171A), landing gear design (Report 8, AE171A), weight and balance analysis (Report 9, AE171B), stability and control analysis (Report 10, AE171B), and drag polar estimation (Report 11, AE171B).

***Student Performance Results***

| | Students who performed at 70% or higher | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Rep.3 | Rep.4 | Rep.5 | Rep.6 | Rep.7 | Rep.8 | Rep.9 | Rep.10 | Rep.11 |
| AY 06-07 | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 67% |
| AY 08-09 | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% |

***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 or even a No-Credit in one of their reports. When this happens, I meet with the students and discuss areas for improvement. Students correct and re-submit their reports within two weeks. This explains how the performance criterion is met in Reports 3 through 11. In AY 06-07 one team did not re-submit their corrected Report 11 following my discussion with them.

***Recommendation:*** None

[8] The specific content for each report is described at <http://www.engr.sjsu.edu/nikos/courses/ae171/project.htm>

***Outcome 3D* – Ability to collaborate with people from different cultures, abilities, backgrounds, and disciplines to complete AE projects**

***Assessment Summary:*** The performance target is met for Outcome 3D.

***Courses Statistics***

| *Course* | *Semester* | *Faculty Member* | *Enrollment* | *# of students who passed* | *% of students who passed* |
|---|---|---|---|---|---|
| AE 171A&B | Fall '07 / Spring '08 | Dr. Nikos J. Mourtos | 11 (2 teams) | 11 | 100% |
| AE 171A&B | Fall '10 / Spring '11 | Dr. Nikos J. Mourtos | 12 (2 teams) | 12 | 94% |

***Course Activities*** (AE171A&B)

- Engage in team building activities.
- Present and discuss the *"17 laws of teamwork"* (Maxwell, 2001).
- Work in teams (typically 4–6 students) to design an aircraft. For some projects students also work in teams to build and test fly their aircraft. The multicultural aspect of teamwork is inherent in all teams in our capstone, senior design experience, simply by virtue of our multicultural student population[9]. Nevertheless, an additional effort is made to create teams that are as diverse as possible in terms of cultural background as well as abilities.
- Individuals and teams are coached throughout the year on how to improve their team skills.
- Evaluate the performance of teammates at the end of each semester based on 7 specific criteria. Peer reviews are taken into consideration when individual grades are assigned.

**Performance Criterion 3D-1:** *Committed to the team and the project, dependable, faithful, reliable. Attends all meetings; arrives on time or early. Comes to the meetings prepared and ready to work.*
**Performance Criterion 3D-2:** *Leadership: takes initiative, makes suggestions, provides focus. Creative, brings energy and excitement to the team. Has a "can do" attitude. Sparks creativity in others.*
**Performance Criterion 3D-3:** *Gladly accepts responsibility for work and gets it done; spirit of excellence.*
**Performance Criterion 3D-4:** *Has abilities the team needs. Makes the most of these abilities. Gives fully, doesn't hold back.*
**Performance Criterion 3D-5:** *Communicates clearly when speaking and writing. Understands the direction of the team.*
**Performance Criterion 3D-6:** *Personality: positive attitudes, encourages others, seeks consensus, brings out the best in others.*

***Assessment Summary:*** The performance target is met for all the Performance Criteria.

***Assessment Tool***

Students use the following rubric to evaluate the performance of their teammates as well as their own at the end of each semester.

---

[9] For example, an aircraft design team in a recent year included members with cultural backgrounds from Singapore, El Salvador, Philippines, Mexico, and Tibet.

Team Member Report Card

| Project Title: | | | | | |
|---|---|---|---|---|---|
| | Criteria | Filled out by: | | | |
| | | Member 2 | Member 3 | Member 4 | Self |
| 1 | *Quality of Technical Work:* Work is correct, clear, complete, and relevant to the problem. Equations, graphs, and notes are clear and intelligible. | | | | |
| 2 | *Commitment to Team / Project:* Attends all meetings. Arrives on time or early. Prepared. Ready to work. Dependable, faithful, reliable. | | | | |
| 3 | *Leadership:* Takes initiative, makes suggestions, provides focus. Creative. Brings energy and excitement to the team. Has a "can do" attitude. Sparks creativity in others. | | | | |
| 4 | *Responsibility:* Gladly accepts work and gets it done. Spirit of excellence. | | | | |
| 5 | Has abilities the team needs. Makes the most of these abilities. Gives fully, doesn't hold back. | | | | |
| 6 | Communication: Communicates clearly when he/she speaks and when she/he writes. Understands the team's direction. | | | | |
| 7 | *Personality:* Positive attitude, encourages others, seeks consensus. Brings out the best in others. | | | | |
| | *Average score* | | | | |

Grading scale:

5 – Always, 4 – Most of the time, 3 – Sometimes, 2 – Rarely, 1 – Never

Keep in mind that if you award high scores to everyone, regardless of their contribution, team members who have worked unduly hard or provided extraordinary leadership will go unrecognized, as will those at the other end of the scale who need your corrective feedback.

Please write below and on the back of this form one (**minimum**) or more paragraphs about the work of **each member** of your team, including your own. These narratives should amplify the ratings you gave in the table, by (a) identifying the strengths and weaknesses of each individual and (b) suggesting ways in which his / her work can be more effective. Also, evaluate the team as a whole. Feel free to attach additional pages.

***Student Performance Results for 3D-1, 3D-3, 3D-4, 3D-5, 3D-6***

| | % of students who averaged 4 (most of the time) or higher on Item 2 | |
|---|---|---|
| AY 07-08 | 10 (91%) | 10 (91%) |
| AY 10-11 | 12 (100%) | 12 (100%) |

***Analysis***

In AY 07-08 one student averaged lower than 4 on all Items of the rubric in both semesters. His teammates commented that he did not attend all the team meetings and when he did, he was not always prepared. His course grade was reduced as a result of his peer evaluations, however, his overall performance in the course allowed him to pass.

In AY 10-11 all students received peer review scores of 4 or higher on all items of the rubric, both semesters.

***Student Performance Results for 3D-2***

| | % of students who averaged 4 (most of the time) or higher on Item 3 | |
|---|---|---|
| AY 07-08 | 5 (45%) | 7 (64%) |
| AY 10-11 | 12 (100%) | 12 (100%) |

***Analysis***

I believe that leadership is critical for the success of any team, hence I am presenting a separate summary for the results and analysis of this performance criterion. As the table above indicates, approximately half of the students received scores below 4 on leadership in AY 07-08. On the other hand, all students received scores 4 or higher in AY 10-11. The latter is more an indication that the teams worked well rather than proof that all students demonstrated leadership.

***Recommendation***

To help each and every student develop leadership skills, I will randomly appoint the team leaders for each team at the beginning of the semester and rotate leadership in all teams periodically, so all students will have an opportunity to practice and develop leadership skills. I will give team leaders specific tasks, will meet with them weekly, support them as best as I can, and hold them accountable to perform these tasks.

***Implement:*** AY 2011-2012

***Outcome 3E* – Ability to communicate effectively through technical reports, memos, and oral presentations as well as in small group settings**

***Courses Statistics***

| *Course* | *Semester* | *Faculty Member* | *Enrollment* | *# of students who passed* | *% of students who passed* |
|---|---|---|---|---|---|
| AE 171 A | Fall 2007 | Dr. Nikos J. Mourtos | 10 | 10 | 100% |
| AE 162 | Spring 2008 | Dr. Nikos J. Mourtos | 28 | 22 | 79% |
| AE 171 B | Spring 2008 | Dr. Nikos J. Mourtos | 09 | 09 | 100% |
| Engr100W | Fall 2008 | Dr. Thalia Anagnos | 248 | 208 | 84% |
| AE 160 | Fall 2010 | Dr. Nikos J. Mourtos | 24 | 15 | 63% |
| AE 171 A | Fall 2010 | Dr. Nikos J. Mourtos | 12 | 12 | 100% |
| AE 171 B | Spring 2011 | Dr. Nikos J. Mourtos | 11 | 11 | 100% |

***Assessment Summary:*** The performance target is met for Outcome 3E.

**Performance Criterion 3E-1.1:** *Produce well-organized reports, following guidelines.*
**Performance Criterion 3E-1.2:** *Use appropriate graphs and tables following published engineering standards to present results.*

***Courses Assessed:*** AE160, AE162, AE171A&B

***Assessment Summary***
The performance target is met for Performance Criteria 3E-1.1 and 3E-1.2.

***Course Activities*** (AE 160, AE 162)
Students produce four (4) extensive lab reports in each of the two courses, following specific guidelines[10]. In each report they present the design of their experiment, their results, and their discussion (interpretation) of the results.

***Course Activities*** (AE 171A&B)

- Students produce a total of 12 design reports in AE171A&B[11], one for each step of the preliminary design process. They follow general[12] and specific guidelines for the content and organization of each report (e.g. guidelines for Design Report 1[13]).
- Students participate in student design competitions and/or student conferences, where they present their projects. For these projects, design reports and/or conference papers are evaluated by engineers from industry and/or faculty from other universities, providing thus an additional measure of the quality of their writing.

---

[10] <http://www.engr.sjsu.edu/nikos/courses/Common/Labs/Lab.Report.htm>
[11] < http://www.engr.sjsu.edu/nikos/courses/ae171/project.htm>
[12] <http://www.engr.sjsu.edu/nikos/courses/ae171/guidelines.htm>
[13] <http://www.engr.sjsu.edu/nikos/courses/ae171/pro-ms.htm>

***Assessment Tool*** (AE160, AE162)
Lab Report Grading Rubric[14]

| | | |
|---|---|---|
| Total Score | **112** | |
| 1. Abstract | | ***10*** |
| 2. Experimental Design | | ***42*** |
| • Practical importance of this experiment | | 4 |
| • (1) Define goals and objectives | | 4 |
| • (2a) Research / summarize relevant theory | | 10 |
| • (2b) Research / summarize previous data | | 4 |
| • (2c) Computer simulations (if available) | | 4 |
| • (3) Select dependent and independent variables | | 4 |
| • (4) Select appropriate methods to measure these variables | | 4 |
| • (5) Select proper range for independent variables | | 4 |
| • (6) Determine appropriate number of data points for each type of measurement. | | 4 |
| 3. Experimental results | | ***20*** |
| 4. Discussion<br>• Interpretation of results<br>• Explanation of any discrepancies with theory and / or published data and / or computer simulations | | ***20*** |
| 5. References | | ***10*** |
| 6. Appendices<br>• Raw data<br>• Data Analysis - Calculations<br>• Published data<br>• Other | | ***10*** |

***Student Performance Results***

| | Students who scored 70% or higher |
|---|---|
| AE160 – Fall 2010 | 15 (100%) |
| AE162 – Spring 2008 | 22 (100%) |
| AE171A&B – AY 08-09 | 10 & 9 (100%) |
| AE171A&B – AY 10-11 | 12 & 11 (100%) |

***Analysis***

AE160/AE162: Lab reports that do not follow the posted guidelines are returned to students ungraded. Hence, all students follow the guidelines.

AE171A&B: Design reports that do not follow the posted guidelines are returned to students ungraded. Hence, all students follow the guidelines and perform well in these criteria. A sample of student participation in student and professional conferences is included below:

- 2011 ***Page 7***, AIAA Design Build Fly Competition. Design report received a score of 90/100, placing them in 13th place out of 82 participating universities from the US and around the world.
- 2010 ***Design of a Very Large Luxury Airship***[15], 3rd Place-Team, AIAA Region VI Student Conference.
- 2009 ***Design of a Micro-Scale Deployable Unmanned Aerial Vehicle***, 3rd Place-Team, AIAA Region VI Student Conference, also in Proc., Aerospace Engineering Systems Workshop, WSEAS[16].
- 2009 ***Design of a Skydiving Glider,*** Proc., Aerospace Engineering Systems Workshop, WSEAS[17].

[14] < http://www.engr.sjsu.edu/nikos/courses/Common/Labs/Lab.rubric.htm>
[15] < http://www.engr.sjsu.edu/nikos/pdf/VLLAirship%20AIAA.10.pdf>
[16] < http://www.engr.sjsu.edu/nikos/pdf/micro%20UAV.pdf>
[17] < http://www.engr.sjsu.edu/nikos/pdf/skydive.pdf>

- 2008 ***Spartan Phoenix Fire Surveillance Unmanned Aerial Vehicle,*** 3rd Place-Team, AIAA Region VI Student Conference.
- 2008 ***Preliminary Design and CFD Analysis of a Fire Surveillance Unmanned Aerial Vehicle,*** Proc., Thermal-Fluids Analysis Workshop, TFAWS-08-1034[18].
- 2008 ***Double Wedge Shockwave Interaction Flow Characterization,*** Proc., Thermal-Fluids Analysis Workshop, TFAWS-08-1033[19].
- 2007 ***Design of a Heavy-Lift Remotely Controlled Aircraft,*** SAE AutoDesk Inventor Award & 3rd Place-Team, AIAA Region VI Student Conference.
- 2007 ***Design of a 3-Surface Aircraft for the Open-Class SAE Aero Design West Competition,*** Award of Excellence, SAE Aero Design West Competition.

***Recommendation:*** None.

**Performance Criterion 3E-1.3:** *Use clear, correct language and terminology while describing experiments, projects or solutions to engineering problems.*
**Performance Criterion 3E-1.4:** *Describe accurately in a few paragraphs a project / experiment performed, the procedure used, and the most important results (abstracts, summaries).*

***Course Assessed:*** *Engr100W*

***Assessment Summary***
The performance target is met for Performance Criteria 3E-1.3 and 3E-1.4.

***Statistics for Engr100W***
248 students enrolled, 30 of whom had a WST waiver, meaning they had taken the WST multiple times and never passed it. Students were granted a waiver by the AVP of Undergraduate Studies through a petition process. Students who enroll with a WST waiver are required to take Engr90W concurrently.

Student major distribution in Engr100W, Fall 2008

| Major | # Students |
|---|---|
| Aerospace Engineering | 7 |
| Aviation | 15 |
| Chemical Engineering | 8 |
| Civil Engineering | 50 |
| Computer Engineering | 27 |
| Electrical Engineering | 70 |
| General Engineering | 5 |
| Industrial Engineering | 2 |
| Materials Engineering | 8 |
| Mechanical Engineering | 31 |
| Software Engineering | 6 |
| Technology | 12 |
| Open University | 7 |
| Total Students | **248** |

***Assessment Tools***
*How to Interpret Exit Exam Scores:* The following description of Writing Skills Test (WST) scoring is taken from www.sjsu.edu/larc/resources/wst/scoring/. The same scoring process

[18] < http://www.engr.sjsu.edu/nikos/pdf/TFAWS%2008-2.pdf>
[19] < http://www.engr.sjsu.edu/nikos/pdf/TFAWS%2008-1.pdf>

and rubric is used for the Engr100W exit exam. The scoring rubric is on a scale of "0" to "6". A "0" indicates that the student did not address the topic. The final score for the essay results from summing the scores of two reviewers.

A "6" essay demonstrates superior competence in writing on both rhetorical and syntactic levels. A "6" paper:

- is effectively organized and developed
- intelligently addresses the topic, showing maturity of thought and expression
- uses clearly appropriate details to support a thesis or illustrate ideas
- shows unity and consistent facility in use of language
- demonstrates a high level of syntactic variety and appropriate word choice
- is nearly free of error

A "5" essay demonstrates clear competence in writing on both the rhetorical and syntactic levels, though it may have occasional minor errors. A "5" paper:

- is generally well-organized and well-developed, though it may offer fewer details than a "6" paper
- may address some parts of the topic better than others
- shows unity, coherence, and progression
- demonstrates some syntactic variety and range of vocabulary
- displays facility in language

A "4" essay demonstrates competence in writing on both the rhetorical and syntactic levels. A "4" paper:

- is adequately organized
- addresses the topic adequately, though perhaps not complete
- uses some details to support a thesis or illustrate ideas
- demonstrates adequate but not distinguished facility with language and syntax
- may contain some errors that obscure meaning

A "3" essay, while it may demonstrate some developing competence in writing, remains flawed on either the rhetorical or syntactic level or both. A "3" paper may reveal one or more of the following weaknesses:

- inadequate development or organization
- failure to support or illustrate generalizations with appropriate or sufficient detail
- multiple errors in sentence structure and/or usage
- inappropriate choice of words or word forms

A "2" paper suggests limited competence in writing. A "2" paper may be seriously flawed by one or more of the following weaknesses:

- failure to organize or develop
- little detail or irrelevant specifics
- serious and frequent errors in usage and sentence structure
- problems with fluency and focus

A "1" paper demonstrates incompetence in writing. A "1" paper may reveal the writer's inability to comprehend the question, may be incoherent or impressively illogical. A paper that is severely underdeveloped falls into this category.

*How the WST Essay is Scored*

- Each essay is read twice, by two separate readers.
- After a score (anywhere from 6 to 1) is assigned, the essay is passed to another reader, who then reads it and assigns another score.
- If the readers are more than one number apart, i.e., a 4 and a 6, then the essay will be read a third time to determine the correct score.
- The scores must be only one number apart, i.e., a 6 and a 5. Those scores would give the essay a final score of 11.

***Student Performance Results***

Final course grades; of the 30 waiver students, only 16 passed the class

| | Fall 2008 | |
|---|---|---|
| Grade | # Students | Percent |
| A | 95 | 38% |
| B | 91 | 37% |
| C | 22 | 9% |
| NC | 36 | 15% |
| W | 4 | 2% |

Exit exam scores (N = 231); 17 students did not take the exam

| | Fall 2008 | |
|---|---|---|
| Exit Exam Score | # Students | Percent |
| 12 | 0 | 0% |
| 11 | 4 | 2% |
| 10 | 24 | 10% |
| 9 | 30 | 13% |
| 8 | 90 | 39% |
| 7 | 66 | 29% |
| 6 (not pass) | 17 | 7% |

***Analysis***

93% of students who took the exam, passed it. Of those who passed the class the average change in score between the WST and the exit exam was $\Delta$WST = +0.78.

The following assumption was made in completing the analysis. For students who were granted waivers, the average of all WST essay scores was used as the initial score. For example, if a student took the WST 10 times, all 10 WST essay scores were averaged together to determine an initial score. In previous analyses a 4 was assigned to all students granted a waiver, but now we have access to better information through PeopleSoft. Previously, the change in score between the WST and the exit exam was reported as $\Delta$WST = ~1.0. The change in method for determining the initial score for waiver students accounts for the drop in average $\Delta$WST from ~1.0 to 0.78.

Figure 1 plots Engr100W grades and exit exam scores. A linear trendline has been added to examine correlation but the fit is not very good ($R^2$=0.22).

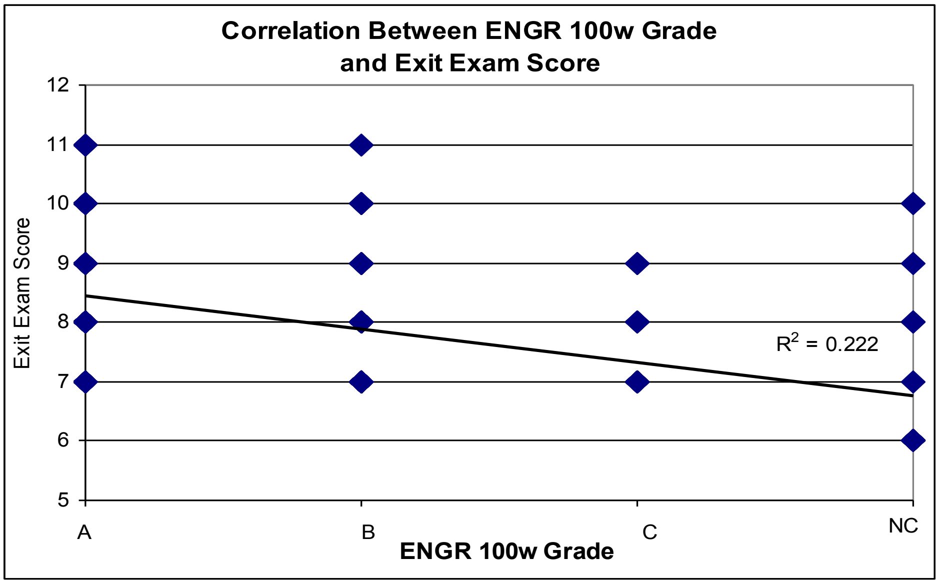



Figure 1 – Fall 2008 exit exam scores and Engr100W grades (n=231)

Figure 2 shows how the exit exam scores are distributed for each course grade. In general the A students score higher on the exit exam than C students. Sixty-two percent of C students earned 7s compared to 17% of A students. No C students earned 10 or 11. Of the students who earned an NC, only 19% passed the exit exam with a 7 or above. The remaining 81% earned a 6 or did not show up for the exam.

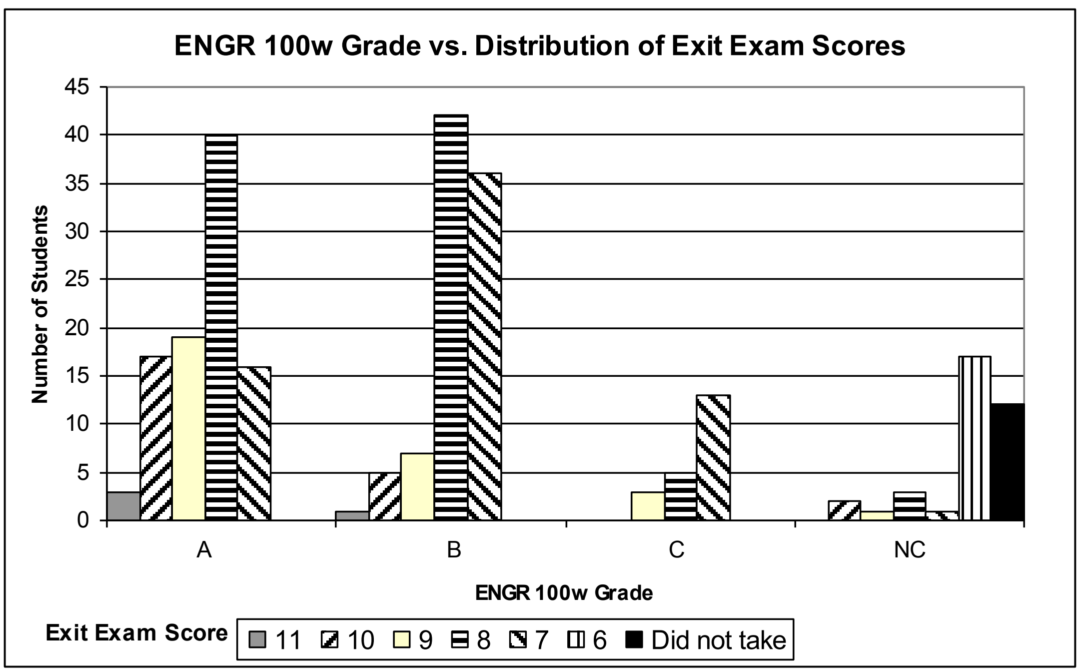



Figure 2 – Distribution of Fall 2008 exit exam scores compared with Engr100W grades

***Recommendation:*** None.

**Performance Criterion 3E-2.1:** *Give well-organized presentations, following guidelines.*

**Performance Criterion 3E-2.2:** *Make effective use of visuals.*
**Performance Criterion 3E-2.3:** *Present the most important information about a project / experiment, while staying within allotted time.*

***Courses Assessed**:* *AE 171 A&B*

***Assessment Summary***
The performance target is met for Performance Criteria 3E-2.1, 3E-2.2, and 3E2-3.

***Course Activities*** (AE 171A & B)

- Students give 3 design briefings and a final presentation in the course of the year. All juniors, friends and relatives, and engineers from industry attend the final presentations at the end of the 2nd semester.
- Students may present their design project at the AIAA Student Conference, at the SAE Aero Design Competition, or at professional conferences (see above).

***Assessment Tool***
Rubric *for* Oral Presentation Evaluation

Project Title:
Student Names:

1. Technical Content: 10 (scale) x 6 = _______ / 60 points

| Score | Performance Criterion |
|---|---|
| 10 | Included **all** pertinent technical info *AND* **all** equations, graphs, tables presented were correct. |
| 7 – 9 | Included **most** of the pertinent technical info (left out 1 or 2 pieces) + **all** of it was **correct** *OR* included **all** pertinent technical info + **most** of it was correct (a few errors). |
| 5 – 6 | Included **some** of the pertinent technical info (left out several important pieces) + **all** of it was correct ***OR*** included **all** pertinent technical info but only **some** of it was correct (several errors). |
| 1 – 4 | **Most** of the pertinent technical info was **missing** *OR* **most** of what was presented was **incorrect**. |
| 0 | **All** pertinent technical info was **missing** *OR* **everything** presented was **incorrect**. |

Comments:

2. Organization: ________ / 10 points

| Score | Performance Criterion |
|---|---|
| 10 | Presentation easy to follow (logical flow), appropriate emphasis on introduction, methodology, results and conclusions; good team member sequencing. |
| 7 – 9 | ***One*** of the following was true: (a) Presentation was not easy to follow OR (b) there was no introduction OR (c) methodology was unclear OR (d) results were unclear OR (e) conclusions were not clearly stated OR (f) rough team member sequencing. |
| 5 – 6 | ***Two or three*** of the following were true: (a) Presentation was not easy to follow, (b) there was no introduction, (c) methodology was unclear, (d) results were unclear, (e) conclusions were not clearly stated, (f) rough team member sequencing. |
| 1 – 4 | ***Four or five*** of the following were true: (a) Presentation was not easy to follow, (b) there was no introduction, (c) methodology was unclear, (d) results were unclear, (e) conclusions were not clearly stated, (f) rough team member sequencing. |
| 0 | ***All*** of the following were true: (a) Presentation was not easy to follow AND (b) there was no introduction AND (c) methodology was unclear AND (d) results were unclear AND (e) conclusions were not clearly stated AND (f) rough team member sequencing. |

Comments:

3. Presentation Skills: ________ / 10 points

| Score | Performance Criterion |
|---|---|
| 10 | Excellent briefing skills (ability to summarize key points in a few words), stayed within schedule, used visual aids appropriately, good eye contact with audience while speaking. |
| 7 – 9 | ***One*** of the following was true: (a) Briefing skills OK but not great OR (b) went overtime OR (c) used visual aids inappropriately OR (d) did not maintain eye contact with audience while speaking. |
| 5 – 6 | ***Two*** of the following were true: (a) Briefing skills OK but not great, (b) went overtime, (c) used visual aids inappropriately, (d) did not maintain eye contact with audience while speaking. |
| 1 – 4 | ***Three*** of the following were true: (a) Poor briefing skills, (b) went overtime, (c) used visual aids inappropriately, (d) did not maintain eye contact with audience while speaking. |
| 0 | ***All*** of the following were true: (a) Poor briefing skills AND (b) went overtime AND (c) used visual aids inappropriately AND (d) no eye contact with audience while speaking. |

Comments:

4. Verbal Communication: ______ / 10 points

| Score | Performance Criterion |
|---|---|
| 10 | Spoke clearly enough + slowly enough, used correct grammar + appropriate vocabulary. |
| 7 – 9 | ***One*** of the following was true: (a) Mumbled OR (b) spoke too fast OR (c) used incorrect grammar OR (d) used inappropriate vocabulary (ex. informations, aircrafts, vorticy, etc.) |
| 5 – 6 | ***Two*** of the following were true: (a) Mumbled, (b) spoke too fast, (c) used incorrect grammar, (d) used inappropriate vocabulary. |
| 1 – 4 | ***Three*** of the following were true: (a) Mumbled, (b) spoke too fast, (c) used incorrect grammar, (d) used inappropriate vocabulary. |
| 0 | ***All*** of the following were true: (a) Mumbled AND (b) spoke too fast AND (c) used incorrect grammar AND (d) used inappropriate vocabulary. |

Comments:

5. Overall Impression: ______ / 10 points

| Score | Performance Criterion |
|---|---|
| 10 | **Excellent** project quality, **excellent** presentation |
| 7 – 9 | **Excellent** project quality but **lacked** in presentation OR **very good** project quality, **excellent** presentation. |
| 5 – 6 | **Adequate** project quality, **good** presentation OR **good** project quality, **adequate** presentation. |
| 1 – 4 | Substandard project quality AND presentation. |
| 0 | Unacceptable project quality AND presentation. |

Comments:

Total Score: ______ / 100 points

### *Student Performance Results*

| | Students who scored 70% or higher |
|---|---|
| AE171A&B – AY 07-08 | 10 & 9 (100%) |
| AE171A&B – AY 10-11 | 12 & 11 (100%) |

### *Analysis*

In general student presentations are very well organized. Students use visuals effectively and stay within the allotted time. The only area where students typically need improvement is in the presentation of the technical content (e.g. not all pertinent information is presented and/or some information presented is incorrect). However, any such errors are corrected by the time students participate at a conference or competition (AE171B), at which point they are usually very proficient in their presentation skills.

***Recommendation:*** None.

***Outcome 3F* – Understanding of professional and ethical responsibility**

***Course Statistics***

| *Course* | *Semester* | *Faculty Member* | *Enrollment* | *# of students who passed* | *% of students who passed* |
|---|---|---|---|---|---|
| AE170A&B.Section 1 | Fall 2005 / Spring 2006 | Dr. Nikos J. Mourtos | 17 | 11 | 100% |
| AE170A&B.Section 2 | Fall 2005 / Spring 2006 | Dr. Periklis P. Papadopoulos | | | |
| AE171A&B | Fall 2008 / Spring 2009 | Dr. Nikos J. Mourtos | 13 | 12 | 92% |
| AE172A&B | Fall 2008 / Spring 2009 | Dr. Periklis P. Papadopoulos | | | |

***Assessment Summary:*** The performance target is met for Outcome 3F.

**Performance Criterion:** *Given a job-related scenario that requires a decision with ethical implications, students can identify any ethical issues raised by reference to professional codes of ethics (e.g. NSPE, ASME), identify possible courses of action, discuss the pros and cons of each course of action, decide what is the best course of action, and justify their decision*[20].

***Course Activities*** (AE 171A&B, AE172A&B)

- The content that pertains to this performance criterion is based on four (4) case studies in ethics, safety, and liability issues[21]:
  - The V-Tail Bonanza
  - The Crash of American Airlines Flight 191
  - Doomed from the Beginning: The Solid Rocket Boosters for the Space Shuttle
  - Apollo 13 – A Mission that Failed
- Both aircraft and spacecraft design students participate jointly in the presentation and discussion of these case studies.
- Students study the background information on each of these cases and make a 15-minute presentation in class. Aircraft design teams present the aircraft related cases and spacecraft design teams present the spacecraft related cases. For the American Airlines Flight 191 case study a video is also shown in class, which presents a detailed analysis of the accident and its aftermath.
- Following the presentation of the background information on each case, students may (a) break into small groups for 20 min, discuss ethical issues raised, and summarize their position and arguments for each issue or (b) participate in a formal debate[22].
- Each group presents a summary of their position orally as well as in writing and the floor is opened for additional comments by the rest of the class.
- Students follow up with a written paper in which they answer individually key ethical questions on each case.

[20] Students also examine ethical constraints applicable to their particular vehicle design, as discussed in Outcome 3C

[21] < http://www.engr.sjsu.edu/nikos/courses/ae171/ethics.htm>

[22] < http://www.engr.sjsu.edu/nikos/courses/ae171/ethicsbowl.htm>

***Assessment Tools***

- Presentation of the background of a case study.
- In class participation in group discussion and sharing.
- Individual written arguments in response to specific prompts in each of the four case studies.

***Student Performance Results***

| | Students who scored 70% or higher | | | |
|---|---|---|---|---|
| | Case Study 1 | Case Study 2 | Case Study 3 | Case Study 4 |
| AE170A&B.1 – F05/S06 | 13 (76%) | 17 (100%) | 17 (100%) | 17 (100%) |
| AE170A&B.2 – F05/S06 | | | | |
| AE171A&B – F08/S09 | 13 (100%) | 13 (100%) | 12 (100%) | 12 (100%) |
| AE172A&B – F08/S09 | | | | |

***Analysis***

Students are usually very engaged and perform well in their ethics assignments. Their arguments in class as well as in their individual papers indicate that they begin to appreciate the complexities of the ethical issues encountered in engineering design and in particular, in aerospace vehicle design. In AY 2005-2006 one aircraft design team and one spacecraft design team performed inadequately in their individual assignments on the first case study. However, their performance improved dramatically in the following three case studies.

***Recommendation***

Install "gateway" assignments related to this outcome, so that students must average at least 70% on their presentations, in-class participation, and papers, in each course, to earn a passing grade in the course, regardless of their performance on other aspects of the course.

***Implemented*** in AY 2010-2011[23].

---

[23] < http://www.engr.sjsu.edu/nikos/courses/ae171/grading.htm>

## *Outcome 3G* – Broad education to understand current events, how they relate to AE, as well as the impact of AE solutions in a global and societal context

***Course Statistics***

| *Course* | *Semester* | *Faculty Member* | *Enrollment* | *# of students who passed* | *% of students who passed* |
|---|---|---|---|---|---|
| AE 171 B | Spring 2011 | Dr. Nikos J. Mourtos | 11 | 11 | 100% |

***Assessment Summary:*** The performance target is not met for Outcome 3G.

**Performance Criterion 3G-1:** *Identify regional, national, or global contemporary problems that involve AE.*
**Performance Criterion 3G-2:** *Discuss possible ways AE could contribute to the solution of these problems.*
**Performance Criterion 3G-3:** *Discuss the impact of AE in a global and societal context.*

***Course Activities*** (AE 171 B)

- Assignment 1[24]: Each student identifies a ***regional, national, or global contemporary problem*** and discusses how aerospace engineering plays a role in it. For example, some of the topics selected in AE171B in AY 10-11 were:
    - Global war on terror with new aircraft design
    - No-fly zone over the Libyan airspace
    - Global hawk UAV and the earthquake in Japan
    - Aircraft and obesity
    - Jathropa biodiesel as an aviation fuel
    - Cloud seeding
- Students find at least 5 references that discuss their particular topic. At least two of these references must be technical journal articles or conference papers or technical reports. For the rest they may use newspapers, magazines, Aviation Week & Space Technology, and the worldwide web.
- Students study these references and prepare a two-page (minimum) paper summarizing the key points of their research and a 10 min PowerPoint presentation for our class. In their presentation they must include two key questions related to the issue (discussed in the article) to facilitate class discussion on the topic.
- Assignment 2[25]: Students find at least 5 references that discuss the ***impact of aerospace vehicle design in a global / societal context***. At least two of these references must be technical journal articles or conference papers or technical reports. For the rest they may use newspapers, magazines, Aviation Week & Space Technology, and the worldwide web. For example, some of the topics selected in AE171B in AY 10-11 were:
    - Contribution of jet aircraft contrails to global warming
    - Environmental impact of aircraft disposal
    - Engine efficiency and its impact on the airplane DOC and the environment
    - The effect of airplanes on cultural integration

[24] < http://www.engr.sjsu.edu/nikos/courses/ae171/Current.Events.htm>
[25] < http://www.engr.sjsu.edu/nikos/courses/ae171/Global.Societal.htm>

  - Aircraft design and urban development
  - Setting the standards for flying cars
- Students study these references and prepare a two-page (minimum) paper summarizing the key points of their research and a 10 min PowerPoint presentation for our class. In their presentation they must include two key questions related to the issue (discussed in the article) to facilitate class discussion on the topic.

***Assessment Tools***
- In-class presentation of the regional, national or global contemporary problem.
- Written analysis of the problem based on identified references.
- In-class presentation of an example of the impact of aerospace vehicle design in a global / societal context.
- Written analysis of this example of the impact of aerospace vehicle design in a global / societal context based on identified references.

***Student Performance Results***

| | Students who scored 70% or higher | |
|---|---|---|
| | Current Event as it relates to Aerospace Engineering | Impact of Aerospace Vehicle Design in a Global / Societal Context |
| AE171B – S11 | 13 (100%) | 12 (100%) |

***Analysis***
Students are usually very engaged and perform well in this area, however, these assignments have so far been implemented only in AE171B (Aircraft Design II).

***Recommendation***
Install "gateway" assignments in both AE172B related to this outcome, so that students must earn at least 70% on their presentations and papers, in each of these two assignments, to earn a passing grade in the course, regardless of their performance on other aspects of the course.

***Implemented*** in AY 2011-2012[26].

[26] < http://www.engr.sjsu.edu/nikos/courses/ae171/grading.htm>

***Outcome 3H* – Recognition of the need for, and ability to engage in lifelong learning**

***Course Statistics***

| *Course* | *Semester* | *Faculty Member* | *Enrollment* | *# of students who passed* | *% of students who passed* |
|---|---|---|---|---|---|
| AE 170 A&B Section 1 | Fall 2006 / Spring 2007 | Dr. Nikos J. Mourtos | 15 | 15 | 100% |
| AE 162 | Spring 2007 | Dr. Nikos J. Mourtos | 24 | 23 | 96% |
| AE 171 A&B | Fall 2009 / Spring 2010 | Dr. Nikos J. Mourtos | 09 | 09 | 100% |
| AE 162 | Spring 2010 | Dr. Nikos J. Mourtos | 29 | 24 | 83% |

***Assessment Summary:*** The performance target is not met for Outcome 3H.

**Performance Criterion 3H-1:** *Develop a process for learning, reflect regularly on this process, identify personal strengths and weaknesses, and take the necessary steps to improve their learning process.*

***Assessment Summary:***
The performance target is not met for Performance Criterion 3H-1.

***Course Activities*** (AE162)
Students reflect on their learning process during the semester, identify personal strengths and weaknesses, and develop strategies to improve their learning process.

***Assessment Tool***: Reflection journal

***Student Performance Results***

| | Students who scored 70% or higher |
|---|---|
| AE162 – Spring 2007 | 15 (65%) |
| AE162 – Spring 2010 | 18 (75%) |

***Analysis***
This performance criterion is similar to 3A-4.6. As discussed earlier in the context of problem solving skills, students initially have difficulty reflecting effectively on their learning process. In class, they are shown examples of proper reflections and they respond fairly well in terms of identifying their strengths and weaknesses. On the other hand, they are not always able to identify effective strategies for correcting these weaknesses and/or they do always take the necessary steps to improve their learning process. This performance criterion has become more problematic over the years, as students devote less and less time studying for their courses and furthermore, they are not always capable of processing when they read in the text or other references.

***Recommendation***
Additional class time and effort must be devoted to guiding students in their reflections and most importantly, to helping them develop and apply strategies for improving their learning process.

***Implementation***: AY 2011-2012

**Performance Criterion 3H-2:** *Access information effectively and efficiently from a variety of sources.*
**Performance Criterion 3H-3:** *Research and learn new material on their own by reading articles, books, contacting experts, etc.*

***Course Activities***
- AE162: In their course projects, students take responsibility to learn material not discussed in the lectures and demonstrate their knowledge of this material in their written and oral report at the end of the semester. Interaction with the instructor, as well as with other students is highly encouraged (not assessed).
- AE171A: Perform a comparative study of airplanes with similar mission. This assignment requires searching for appropriate references, studying these references, and summarizing the performance of several airplanes.
- AE171B: Students identify a regional, national, or global contemporary problem, find at least 5 references on this topic (two of which must be technical journal articles or conference papers or technical reports), summarize the key points and discuss how aerospace engineering plays a role in it.
- AE171B: Students find at least 5 references (two of which must be technical journal articles, conference papers or technical reports) that discuss the impact of aerospace vehicle design in a global / societal context and prepare a summary of the key points of their research.

***Assessment Tools***
AE171A: Report 1, Section 3
AE171B: Special assignment on current events
AE171B: Special assignment on the impact of aerospace vehicles in a global / societal context

***Student Performance Results***

| | Students who scored 70% or higher | | |
|---|---|---|---|
| | Report 1 – Section 3 | Assignment on Current Events | Assignment on the Impact of Aircraft Design in a Global / Societal Context |
| AE170A&B.Section1 – Fall '06 / Spring '07 | 15 (100%) | 15 (100%) | 15 (100%) |
| AE171A&B – Fall '09 / Spring '10 | 09 (100%) | 09 (100%) | 09 (100%) |

***Analysis***
Students access appropriate references from a variety of sources for each of these assignments and summarize them well, indicating that they are capable of processing new content on their own. Emphasis is given on acknowledging the professional contributions of others by making appropriate references in their discussion.

***Recommendations***: None.

***Outcome 3I* – Ability to use techniques, skills, and modern engineering tools (analytical, experimental, computational, and design) necessary for engineering practice**

***Course Statistics***

| *Course* | *Semester* | *Faculty Member* | *Enrollment* | *# of students who passed* | *% of students who passed* |
|---|---|---|---|---|---|
| AE 171 A | Fall 2007 | Dr. Nikos J. Mourtos | 10 | 10 | 100% |
| AE 162 | Spring 2010 | Dr. Nikos J. Mourtos | 29 | 24 | 83% |
| AE 171 B | Spring 2010 | Dr. Nikos J. Mourtos | 09 | 09 | 100% |
| AE 160 | Fall 2010 | Dr. Nikos J. Mourtos | 24 | 15 | 63% |

***Assessment Summary:*** The performance target is met for Outcome 3I.
Analytical, experimental, and design skills have been discussed extensively in Outcomes 3A, 3B, and 3C respectively. Hence, the emphasis in this outcome is on the use of modern software and laboratory equipment.

**Performance Criterion 3I-1:** *Use modern software to conduct computer simulations, parametric studies, and 'what if' explorations.*
**Performance Criterion 3I-2:** *Use modern equipment and instrumentation in AE laboratories.* (see Performance Criterion 3B-2).

***Assessment Summary:***
The performance target is met for Performance Criteria 3I-1 & 3I-2.

***Course Activities*** (AE160, AE162, AE168)

- Use Sub2D, Wing Analysis[27], AVL,[28] XFOIL[29], XFLR5[30], QPROP[31] to perform computer simulations and parametric studies of airfoils, wings, and other aerodynamic bodies.
- Use the AeroLab subsonic wind tunnel and instrumentation to perform 8 experiments: 3 experiments in AE160, 4 experiments in AE162, and one experiment in AE168 (new in Fall 2011).
- Use the Rolling Hills Research Corporation model 0710 water tunnel and instrumentation to perform a flow visualization experiment (AE160).

***Course Activities*** (AE171A&B)

- Use the AAA (Advanced Aircraft Analysis) Program to conduct parametric studies, process optimization, and 'what if' explorations in the design of their airplanes.
- Use AutoCad, ProE, CATIA, and other CAD programs to make the drawings of their airplanes.
- Use Sub2D, Wing Analysis[32], AVL,[33] XFOIL[34], XFLR5[35], QPROP[36] to perform computer simulations and parametric studies of airfoils, wings, and other aerodynamic bodies.

---

[27] < http://www.desktop.aero/appliedaero/potential3d/wingcalc.html>
[28] <http://web.mit.edu/drela/Public/web/avl/>
[29] < http://web.mit.edu/drela/Public/web/xfoil/>
[30] <http://xflr5.sourceforge.net/xflr5.htm>
[31] <http://web.mit.edu/drela/Public/web/qprop/>
[32] < http://www.desktop.aero/appliedaero/potential3d/wingcalc.html>

***Assessment Tools***: Project reports, lab reports, design reports

***Student Performance Results***

| | Students who scored 70% or higher |
|---|---|
| AE171A – Fall 2007 | 10 (100%) |
| AE162 – Spring 2010 | 24 (100%) |
| AE171B – Spring 2010 | 09 (100%) |
| AE160 – Fall 2010 | 15 (100%) |

***Analysis***

Students are very competent in the use of modern software as well as in hands-on laboratory work.

***Recommendation***: None

[33] <http://web.mit.edu/drela/Public/web/avl/>
[34] < http://web.mit.edu/drela/Public/web/xfoil/>
[35] <http://xflr5.sourceforge.net/xflr5.htm>
[36] <http://web.mit.edu/drela/Public/web/qprop/>

## D. BSAE Curriculum Improvements

***Revised BSAE Focus Areas***

Two new focus areas were installed since the last ABET visit: (a) Aircraft Design and (b) Space Transportation and Exploration. These focus areas replaced the original three: (a) aerodynamics and propulsion, (b) structures and materials, and (c) dynamics and control. The new focus areas are aligned with the two options in our senior design capstone sequence: aircraft design (AE171A&B) and spacecraft design (AE172A&B). Within each of these focus areas students may, if they wish, focus through electives in design and manufacturing, management and economics, mathematics and numerical methods, applied physics, thermal-fluids, structures, materials, or controls and mechatronics (see Table 5.2).

***Strengthened the BSAE Core by including:***

- *AE169 – Computational Fluid Dynamics*

AE169 was an elective course introduced by Dr. Papadopoulos in Spring 2005. AE169 was required in AY 2007–2008 for the following reasons:

a. CFD has become an essential tool in AE in recent years with applications in both aeronautics and astronautics.
b. Local industry has been requesting graduates with CFD skills.
c. Graduating seniors, having become aware of the marketability of CFD in their resumes, recommended that AE169 become a required course.

- *AE168 – Aerospace Vehicle Dynamics & Control*

AE168 replaced ME147 (Vibrations) as a required course in the BSAE curriculum and installed as a co-requisite for AE171A and AE172A and a prerequisite for AE171B and AE172B with a grade of "C–" or better. AE168 includes an introduction to control theory as well as stability and control of aircraft and spacecraft. The replacement was made for the following reasons:

a. AE faculty identified the need for "controls" in the BSAE curriculum early on and installed ME187 (Automatic Control System Design), as a required elective in the (old) "dynamics & control" focus area. The disadvantage of this arrangement was that unless a student selected "dynamics & control" as their focus area, they would not get any content in control theory. Furthermore, after the merger of AE and ME, the ME Program installed ME147, as a prerequisite for ME187 and AE students could no longer take ME187. At some point, without any discussion with AE faculty ME147 was installed as a required course in the BSAE curriculum. However, the "controls" content in ME147 is very limited and the course did not serve the needs of the AE Program.
b. The "stability" content in AE165 is inadequate for design purposes in AE171B and AE172B. Hence, it became imperative that a follow-up course in stability and control of aerospace vehicles was required in the first senior semester.
c. The AE faculty researched BSAE curricula across the US and discovered that more than 2/3 of the BSAE programs did not require "vibrations". Among the schools that did not require vibrations were the following:
   1. The University of Alabama in Huntsville
   2. The University of Alabama
   3. University of Arizona

4. Auburn University
5. Boston University
6. California Polytechnic State University, San Luis Obispo
7. California State Polytechnic University, Pomona
8. California State University, Long Beach
9. University of California, Davis
10. University of California, Irvine
11. Case Western Reserve University
12. University of Central Florida
13. University of Colorado at Boulder
14. Embry-Riddle Aeronautical University - Prescott
15. Embry-Riddle Aeronautical University - Daytona Beach
16. University of Florida
17. Georgia Institute of Technology
18. University of Illinois at Urbana-Champaign
19. Illinois Institute of Technology
20. Iowa State University
21. The University of Kansas
22. Massachusetts Institute of Technology
23. University of Minnesota-Twin Cities
24. University of Missouri-Rolla
25. State University of New York at Buffalo
26. North Carolina State University at Raleigh
27. The Ohio State University
28. Oklahoma State University
29. The University of Oklahoma
30. Princeton University
31. San Diego State University
32. University of Southern California
33. University of Texas at Arlington
34. University of Texas at Austin
35. United States Air Force Academy
36. United States Naval Academy
37. Virginia Polytechnic Institute and State University
38. University of Virginia
39. West Virginia University
40. Wichita State University

Furthermore, it was observed that AE programs in the US, which did require "vibrations", were all merged with ME programs, hinting that the impetus for a required "vibrations" course was a matter of economy in a merged department.

- *AE160 – Aerodynamics I*

AE160 is a lecture/lab course, which replaced ME111 (Fluid Mechanics) for the following reasons:

a. Introduction of a 2$^{nd}$ aerodynamics course allows a proper introduction to boundary layer theory as well as aerodynamic drag calculations, which is prerequisite knowledge for AE171A&B and AE172A&B.

b. While AE students took ME111 as a required course, they scored on average 10% – 30% on the Fluid Mechanics Concept Inventory (FMCI), indicating that their working knowledge of fluid mechanics was at unacceptable levels. In particular, they averaged 0% – 10% on boundary layer concepts. When students came into AE162 with this level of background knowledge it became impossible to include drag calculations without a proper presentation of boundary layer theory. However, there was not sufficient time in AE162 to do both.
c. Introduction of a 2nd semester aerodynamics course allows for 8 aerodynamic experiments to be split between AE160 and AE162 with a full lab report for each; students used to do only four of these experiments in AE162. With the limited number of experiments available in the old AE162, AE students not only did not get boundary layer theory, they also missed an opportunity to perform a boundary layer experiment in the Aerodynamics Lab due to lack of time.

***Strengthened the Mathematics Base***

Math129A (Linear Algebra) replaced ME130 (Applied Engineering Analysis) as a required course because a large percentage of graduating seniors indicated in their exit interviews that the content of ME130 was review of what they already knew from previous math courses. ME130 does cover linear algebra, however, the amount of time dedicated to the subject (2 weeks) is insufficient for students to acquire working knowledge of the material. Linear algebra has now been installed as a prerequisite for AE169.

**References**

Anagnos, T., Komives, C., Mourtos, N.J., McMullin, K.M., Evaluating Student Mastery of Design of Experiment *Proc., 37th IEEE / ASEE Frontiers in Education Conference*, October 2007. Received the SJSU 2008 Provost's Outstanding Scholarship of Teaching and Learning Award - Honorable Mention.)

Bloom, B.S., *Taxonomy of Educational Objectives, Handbook 1, Cognitive Domain.* New York: Addison Wesley, 1984.

Bloom, B.S., Karthwohl, D.R., Massia, B.B., *Taxonomy of Educational Objectives, Handbook 2, Affective Domain.* New York: Addison Wesley, 1984.

Du, W.Y., Furman, B.J., Mourtos, N.J. On the Ability to Design Engineering Experiments Lead Paper, *Proc., 8th Annual UICEE Conference on Engineering Education*, February 2005.

Maxwell, J.C., *The 17 Indisputable Laws of Teamwork*, Thomas Nelson Publishers, Nashville, 2001.

Mourtos, N.J., The Nuts & Bolts of Cooperative Learning in Engineering *ASEE Journal of Engineering Education,* January 1997, pp. 35-37. SJSU Institute for Teaching & Learning Award for Research on College Teaching & Learning, 1998.

Mourtos, N.J., Papadopoulos, P., Agrawal, P., A Flexible, Problem-Based, Integrated Aerospace Engineering Curriculum, *Proc., 36th IEEE / ASEE Frontiers in Education Conference*, 2006.

Mourtos, N.J., Challenges Students Face when Solving Open – Ended Problems, *International Journal of Engineering Education*, Vol. 26, No. 4, Part 1, 2010.

Roskam, J., *Airplane Design, Parts I-II,* Roskam Aviation and Engineering Corp. Route 4, Box 274, Ottawa, Kansas, 66067, 1985.

Woods, D.R., *Problem-Based Learning: How to Gain the Most from PBL*, Donald R. Woods, Waterdown, ON, L0R 2H0, 1994.

# CRITERION 5. CURRICULUM

## A. Program Curriculum

Table 5.1 shows the recommended 4-year plan towards the BSAE degree. SJSU is on a semester system. As shown in Figure 5.1, students build on a foundation of mathematics and physical sciences following up with courses in four basic engineering disciplines: thermal-fluids, materials and structures, dynamics and controls, and electronics. The BSAE core includes aerospace structures, aerodynamics and compressible flow, rigid body dynamics, flight mechanics, propulsion, aerospace vehicle dynamics and control, and computational fluid dynamics.

The BSAE curriculum aligns with the PEO with a strong emphasis on both technical and non-technical skills. Technical skills include analytical, laboratory, computational, and design. Non-technical skills include lifelong learning, communication, team and leadership, professionalism and ethics, as well as understanding of current events and how aerospace engineering is influenced by these events.

***General Education***

The BSAE curriculum includes 38 semester units of GE courses (including two units of physical education), organized in various areas, as shown in Table 5.1. Courses in written and oral communication, arts and letters, human understanding, comparative systems, social issues, as well as culture, civilization and global understanding prepare students for responsible, 21$^{st}$ century citizenship. In addition, GE courses contribute to Program Outcomes such as 3C (as it relates to design constraints), 3D (ability to collaborate with people from different cultures, abilities, and backgrounds), 3E (effective communication), 3F (professionalism and ethics), 3G (broad education to understand current events), and 3H (lifelong learning skills).

***Mathematics and Basic Sciences***

Requirement = 1 year / 32 units. The BSAE curriculum includes 40 units of mathematics and basic sciences: five math courses (Calculus I, II, III, Differential Equations, Linear Algebra), three physics courses (Mechanics, Electricity & Magnetism, Atomic)[37] and a course in General Chemistry (5 units).

Technical Curriculum (requirement = 1.5 years or 48 units of engineering topics that include engineering sciences and engineering design): The AE curriculum includes 66 units of engineering topics, 15 of which are lower division and 51 are upper division. All upper division courses emphasize engineering problem solving through mathematical and physical modeling, while several of them include open-ended problems and integrated projects (AE114, AE160, AE162, AE165, AE164, AE167), computer modeling/ simulations (AE162, AE164, AE168, AE169, AE171A&B, AE172A&B among others), experimentation/product testing

[37] Refers to the Physics 70 series; most AE students take the 50 series, which is 4 courses = 14 units.

(AE114, AE160, AE162, ME120, AE171A&B, AE172A&B among others), and design (AE114, AE160, AE162, AE164, AE165, AE167, AE171A&B, AE172A&B among others).

***Experimentation***

The BSAE curriculum includes 9 required laboratory courses (Phys.70, Phys.71, Phys.72, Chem.1A, MatE25, ME120, AE114, AE160 and AE162). In all upper division laboratory courses students are taught not only how to perform experiments but also how to design experiments that meet specific objectives. Moreover, they are taught to analyze, interpret, and present their data in formal laboratory reports and oral briefings.

***Senior Design Capstone Experience***

In their senior year students integrate their knowledge and skills from all AE sub-disciplines in a year-long aerospace vehicle design experience, which introduces them to systems-level engineering. This experience involves a team-based design project of an aircraft (AE171A&B) or a spacecraft (AE172A&B) subject to realistic constraints, such as economic, environmental, social, political, ethical, safety, liability, and manufacturability. Additional exposure to such constraints comes through case studies, guest speakers and field trips. At the same time students have the option of focusing through electives in one or more of several areas, such as design and manufacturing, management, economics, modeling / numerical methods, materials, structures, thermal-fluids, controls / mechatronics, and sustainability. A small number of students opt to perform both an aircraft and a spacecraft design project. The MAE Department provides technical support for students in the senior design projects and for those entering regional and national design competitions (e.g. AIAA Design-Build-Fly and SAE Aero-Design).

Non-curriculum mechanisms that support the BSAE PEO and Student Outcomes include:

- The student chapters of the aerospace engineering professional societies: AIAA[38] and Sigma Gamma Tau[39] as well as the Society of Automotive Engineers (SAE).
- Other student societies: AISES (American-Indian Science and Engineering Society), BASE (Black Alliance of Scientists and Engineers), MESA Engineering Program, (MEP), SME (Society of Manufacturing Engineers), SOLES (Society of Latino Engineers and Scientists), SWE (Society of Women Engineers), VESA (Vietnamese Engineering Students Association), and Tau Beta Pi (Engineering Honor Society).

Course syllabi for all courses included in the BSAE Major Form are included in this report (Appendix A). Course textbooks as well as a course binder, including the syllabus, description of assignments and samples of student work organized by outcome will be available for review during the visit.

[38] American Institute for Aeronautics and Astronautics
[39] Aerospace Engineering Honor Society

**Capstone Senior Design Experience**

| **Aircraft Design – AE 171 A&B** | | **Spacecraft Design – AE172 A&B** |
|---|---|---|

Electives (6 units – Figure 5.2)

**ME 120 – Experimental Methods**

| **Thermal-Fluids** | **Materials & Structures** | **Dynamics & Controls** | **Electronics** |
|---|---|---|---|
| AE167 – Propulsion<br>AE164 – Compressible Flow<br>AE162 – Aerodynamics II<br>AE160 – Aerodynamics I<br>ME113 - Thermodynamics | AE114 – Aerosp. Structures<br>CE112 – Mech. of Materials<br>CE99 – Statics<br>MatE25 – Prop. of Materials | AE168 – Dyn. & Control<br>AE140 – Rigid Bod. Dyn.<br>AE165 – Flight Mech.<br>ME101 - Dynamics | EE98 - Circuits |

**Engineering Fundamentals:** Engr10 (Intro. to Engr.), ME20 (Design & Graphics), ME30 (Computer Applications), Engr100W (Engr. Reports)

**Science:** Phys70 (Mechanics), Phys71 (Electricity & Magnetism), Phys72 (Atomic) Chem1A (General Chemistry)

**Mathematics:** Math30 (Calculus I), Math31 (Calculus II), Math32 (Calculus III), Math129A (Linear Algebra), Math 133A (ODE)

Figure 5.1 – BSAE curriculum structure

| | |
|---|---|
| AE180 – Individual Studies | |
| | AE 110 - Space systems engineering |
| *Design / Manufacturing*<br><br>ME 165 – CAD in ME<br>ME 110 – Manufacturing processes<br>ME 136 – Design for manufacturability<br>ME 154 – ME design<br>ME189 – Design & manufacture of microsystems | <br><br><br>Tech 140 – Green & sustainable product design<br>Tech 141 – Product design III<br>ISE 114 – Safety engineering |
| *Management / Economics* | ISE 102 – Engineering economic systems<br>ISE 105 – System engineering & activity costing<br>ISE 151 – Managing engineering |
| *Mathematics, Numerical Methods & Modeling*<br><br>Math 112 – Vector calculus<br>Math 129 B – Linear algebra II<br>Math 133 B – PDE<br>Math 143 M – Numerical analysis for scientific computing<br>ISE 130 – Engineering probability & statistics<br>ISE 170 – Operations research | |
| *Materials* | AE 135 – Composite materials<br>MatE 160 – Fracture mechanics |
| *Applied Physics*<br><br>Phys 105A&B – Advanced Mechanics<br>Phys 120A - Laboratory Electronics for Scientists I<br>Phys 120C – Advanced Physics Lab: Optics<br>Phys 120D – Advanced Physics Lab: Lasers<br>Phys 120I – Laboratory Electronics for Scientists II: Instrumentation<br>Phys 158 – Modern Optics<br>Phys 160 – Thermodynamics & Statistical Physics<br>Phys 168 – Lasers | |
| *Structures* | ME 160 – Finite Element Method<br>CE 160 – Structural Mechanics I<br>CE 161 – Intermediate Structural Mechanics |
| *Thermal/Fluids* | ME 114 – Heat transfer<br>ME 149 – Acoustics<br>ME 182 – Thermal systems design |
| *Controls / Mechatronics*<br><br>ME 106 – Mechatronics<br>ME 190 – Mechatronic system design<br>ME 187 – Automatic control system design | <br><br><br>EE 112 – Linear systems<br>EE 132 – Theory of automatic |
| *Sustainability* | E103 – Life cycle engr.<br>CE 173 – Engr. for sustainable environment |

Figure 5.2 – BSAE electives

| Course (Department, Number, Title) List all courses in the program by term starting with first term of first year and ending with the last term of the final year. | Indicate Whether Course is Required, Elective or a Selected Elective by an R, an E or an SE.[2] | Math & Basic Sciences | Engr. Topics Check if Contains Significant Design (√) | General Education | Other |
|---|---|---|---|---|---|
| First Year Semester One | | | | | |
| English 1A - (Area A2: Written Comm) | R | | | 3 | |
| General Ed (Area A1: Oral Communication) | R | | | 3 | |
| Kinesiology/Human Perf/PE* | R | | | 1 | |
| Math 30 - Calculus 1 | R | 5 | | | |
| Chem 1A - Chemistry | R | 5 | | | |
| Engr 10 - Intro to Eng | R | | 3 | | |
| First Year Semester Two | | | | | |
| English 1B - (Area C3: Written Comm) | R | | | 3 | |
| General Ed (Area C1: Arts) | R | | | 3 | |
| Math 31 - Calculus 2 | R | 4 | | | |
| Physics 50 - Mechanics | R | 4 | | | |
| ME 20 - Design & Graphics | R | | 2 | | |
| Kinesiology/Human Perf/PE* | R | | | 1 | |
| Second Year Semester one | | | | | |
| General Ed (Area C2: Letters) | R | | | 3 | |
| General Ed (Area D1: Human Behavior) | R | | | 3 | |
| Math 32 - Calculus 3 | R | 3 | | | |
| Physics 51 - Elec & Mag | R | 4 | | | |
| MatE 25 - Intro to Materials | R | | 3 | | |
| ME 30 - Computer Applications | R | | 2 | | |
| Second Year Semester Two | | | | | |
| General Ed (Area D2: Comparative Systems, incl F1/F2/F3) | R | | | 3 | |
| General Ed (Area D3: Social Issues, , incl F1/F2/F3) | R | | | 3 | |
| Math 133A - Diff Eqns | R | 3 | | | |
| Phys 52 - Heat & Light | R | 4 | | | |
| EE 98 - Circuits | R | | 3 | | |
| CE 99 - Statics | R | | 2 | | |
| Third Year Semester One | | | | | |
| Phys 53 - Atomic Physics | R | 2 | | | |
| Engr 100W - Engr. Reports | R | | | 3 | |
| CE 112- Mechanics of Materials | R | | 3 | | |
| ME 101 - Dynamics | R | | 3 | | |
| ME 113 - Thermodynamics | R | | 4 | | |
| AE 160 - Aerodynamics I | R | | 3 | | |
| Third Year Semester Two | | | | | |
| Math 129A - Linear Algebra | R | 3 | | | |
| AE 114 - Aerospace Structures | R | | 3 | | |
| AE 140 - Rigid Body Dynamics | R | | 3 | | |
| AE 162 - Aerodynamics II | R | | 3 | | |
| AE 165 - Flight Mechanics | R | | 3 | | |
| General Ed (Area E: Human Understanding) | R | | | 3 | |
| Fourth Year Semester One | | | | | |
| ME 120 - Exper. Methods | R | | 2 | | |
| AE 164 - Compressible Flow | R | | 3 | | |
| AE 167 - Propulsion | R | | 3 | | |
| AE 168 - AE Vehicle Dyn&Control | R | | 3 | | |
| AE 171A - Aircraft Des. I or AE 172A - Spacecraft Des. I | SE | | 3 | | |
| Technical Elective | E | | 3 | | |
| Fourth Year Semester Two | | | | | |
| AE 169 - Computational Fluid Dynamics | R | | 3 | | |
| AE 171B - Aircraft Des. II or AE 172B - Spacecraft Des. II | SE | | 3 | | |
| General Ed (Area S: Self, Society & Equality) | R | | | 3 | |
| General Ed (Area V: Culture, Civiliz. & Global Underst.) | R | | | 3 | |
| Technical Elective | E | | 3 | | |
| | | | | | |
| TOTALS-ABET BASIC-LEVEL REQUIREMENTS | | 37 | 66 | 38 | 0 |
| OVERALL TOTAL CREDIT HOURS FOR THE DEGREE | 134 | | | | |
| PERCENT OF TOTAL | | 28% | 49% | 28% | 0% |
| | Min Sem. Credit Hrs | 32 Hours | 48 Hours | | |
| Total must satisfy either credit hours or percentage | Min % | 25% | 37.50% | | |

1. For courses that include multiple elements (lecture, laboratory, recitation, etc.), indicate the average enrollment in each element.
2. Required courses are required of all students in the program, elective courses are optional for students, and selected electives are courses where students must take one or more courses from a specified group.

# CRITERION 6. FACULTY

## A. Faculty Qualifications

Tables 6.1 shows the qualifications, activity levels and workload of full-time and part-time faculty directly supporting the BSAE Program. In reference to Figure 5.1, the full-time faculty of the Program cover the core areas of thermal-fluids and flight mechanics as well as aerospace vehicle design. Aerospace structures and dynamics and control are covered by part-time faculty. This means that typically full-time faculty teach six of the nine required BSAE courses (AE160, AE162, AE164, AE165, AE167, AE169), plus the senior design capstone experience (AE171A&B, AE172A&B), while part-time faculty teach AE114, AE140, and AE168. Our lecturers constitute an important component of the BSAE Program, as they bring contemporary industrial expertise into the classroom. Many of them have had a sustained affiliation with the University and the Department, and have been active in updating the curriculum and the laboratories. Resumes of all full-time and part-time faculty within the Department are included in Appendix B. The Department has eleven full-time tenure-track faculty members, all with Ph.D. degrees in their respective subject areas.

Table 6.1 – Faculty Qualifications; Aerospace Engineering Program

| Faculty Name | Highest Degree Earned- Field and Year | Rank [1] | Type of Academic Appointment [2] | FT or PT [4] | Years of Experience | | | Professional Registration/ Certification | Level of Activity H, M, or L | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Govt./Ind. Practice | Teaching | This Institution | | Professional Organizations | Professional Development | Consulting/summer work in industry |
| Mourtos, N.J. | PhD/AA '87 | P | T | FT | 0 | 26 | 26 | Greece | H | M | H |
| Papadopoulos, P. | PhD/AA | P | T | FT | 12 | 6 | 6 | | H | M | H |
| Datta-Barua, S.* | PhD/AA | AST | TT | FT | 0 | 1 | 1 | | H | M | L |
| Djordjevic, N. | MS/AE '78 | I | NTT | PT | 33 | 21 | 13 | | | | N/A |
| Hunter, J. | MA/AA '81 | I | NTT | PT | 20 | 9 | 9 | | M | M | N/A |
| Mendoza, C. | MS/AE '08 | I | NTT | PT | 13 | 3 | 3 | | L | H | N/A |
| Murbach, M. | MS/ME '87 | I | NTT | PT | 14 | 2 | 2 | | L | M | N/A |
| Swei, S. | PhD/AA '93 | I | NTT | PT | 14 | 7 | 5 | | L | H | N/A |

Instructions: Complete table for each member of the faculty in the program. Add additional rows or use additional sheets if necessary. Updated information is to be provided at the time of the visit.

1. Code: P = Professor ASC = Associate Professor AST = Assistant Professor I = Instructor A = Adjunct O = Other
2. Code: TT = Tenure Track T = Tenured NTT = Non Tenure Track
3. The level of activity, high, medium or low, should reflect an average over the year prior to the visit plus the two previous years.
4. At the institution.

*Full-time, tenure-track faculty member in the Aviation Program, Department of Aviation & Technology; teaches one MSAE course per year.

***Faculty as Innovative Teachers***

AE faculty members have been awarded College, University and National awards for the quality of their teaching as well as for their scholarship in the area of teaching and learning. AE faculty has been using alternative teaching methods that have been shown to produce results, such as:

- Cooperative learning in the classroom: Students are given problems or open-ended questions to work on in small groups, while faculty walk around and observe student work and interactions, answer questions, and coach students as necessary. Depending on the problem / question a student or a team is often asked to present the solution on the board. Student work is collected, graded, and returned to the students (Mourtos, 1998).
- Integrated problem-based learning: This practice is facilitated by the fact that the majority of our BSAE students take certain AE core courses concurrently (e.g. AE114, AE162 and AE165 in the spring of their junior year, AE164 and AE167 in the fall of their senior year). Students in these courses work in teams to define a problem of interest to them, carry out a multi-disciplinary AE analysis that addresses issues from each of these courses, and present their results in a technical report and oral presentation at the end of the semester (Mourtos, Papadopoulos & Agrawal, 2006).
- Student presentations in professional conferences: students are encouraged to present their work in student as well as in professional conferences, in the latter as co-authors with AE faculty (see list of student papers presented in Outcome 3E, Criterion 4).

## B. Faculty Workload

Table 6.2 shows the AE faculty workload in AY 2010-2011. The CSU requirement for full-time faculty is 80% teaching (12 WTU[40]) and 20% service (3 WTU). Release time may be given by the Department for administrative responsibilities (e.g. AE Associate Chair, preparation of the ABET self-study report) and supervision of MSAE projects/ theses (3 WTU after completion of 6 projects or theses). Faculty may also get release time through sponsored research. While the number of teaching WTU per faculty member is the same across the entire CSU system, actual teaching load may vary greatly from program-to-program, in fact even within the same department, according to the number of different courses (preps) a faculty member is responsible to teach every semester. This is the main reason for the high teaching workload load of the full-time AE faculty, namely the smaller class size of AE classes (typically 20–30 for AE core courses and 10–12 for senior design). At this size, each class is counted as 3 WTU hence an AE faculty member must teach four different courses (4 preps) in a semester to earn a full teaching load of 12 WTU. In contrast, ME core courses are scheduled with 60–70 students, which allows a faculty member 6 WTU per class. A class of this size automatically reduces the number of preps by one, significantly reducing faculty workload.

[40] Weighted Teaching Units

Table 6.2 – Faculty Workload Summary; Aerospace Engineering

| Faculty Member (name) | PT or FT[1] | Classes Taught (Course No./Credit Hrs.) Term and Year[2] | Program Activity Distribution[3] | | | % of Time Devoted to the Program[5] |
|---|---|---|---|---|---|---|
| | | | Teaching | Research or Scholarship | Other[4] | |
| FALL 2010 | | | | | | |
| Mourtos, N. | FT | F10: AE160 3 hrs lec<br>AE164 3 hrs lec<br>AE171A 3 hrs lec | 60% | | 20% AE Associate Chair<br>20% Service | 100% |
| Papadopoulos, P. | FT | F10: AE110 3 hrs lec<br>AE167 3 hrs lec<br>AE172A 3 hrs lab<br>AE269 3 hrs lec | 80% | | 20% Service | 100% |
| Desautel, R. (Emeritus) | PT | N/A | 0% | | 50% Interim Department Chair | N/A |
| Swei, S. | PT | F10: AE168 3 hrs lec | 20% | | | |
| Djordjevic, N. | PT | F10: AE270 3 hrs lec | 20% | | | |
| Mendoza, G. | PT | F10: AE271 3 hrs lec | 20% | | | |
| SPRING 2011 | | | | | | |
| Mourtos, N. | FT | S11: AE162 3 hrs lec<br>AE171B 3 hrs lec | 40% | | 20% AE Associate Chair<br>20% Service<br>20% ABET Report | 100% |
| Papadopoulos, P. | FT | S11: AE165 3 hrs lec<br>AE169 3 hrs lec<br>AE172B 3 hrs lab<br>AE267 3 hrs lec | 80% | | 20% Service | 100% |
| Desautel, R. (Emeritus) | PT | N/A | 0% | | 50% Interim Department Chair | N/A |
| Datta-Barua, S. (TT in Aviation) | FT | S11: AE245 3hrs lec | 20% | | | 20% |
| Djordjevic, N. | PT | S11: AE270 3 hrs lec | 20% | | | 20% |
| Hunter, J. | PT | S11: AE114 3hrs lec<br>AE140 3 hrs lec | 40% | | | 40% |

1. FT = Full Time Faculty or PT = Part Time Faculty, at the institution
2. For the academic year for which the self-study is being prepared.
3. Program activity distribution should be in percent of effort in the program and should total 100%.
4. Indicate sabbatical leave, etc., under "Other."
5. Out of the total time employed at the institution.

## C. Faculty Size

The current size of the AE full-time faculty is inadequate for the needs of the BSAE Program. When one considers also the MSAE Program, the inadequacy is even more pronounced. In addition to the increased teaching workload as described above, the small number of full-time faculty results in increased workloads in program assessment, implementation of continuous improvements, and laboratory maintenance and development.

Nevertheless, AE faculty works closely with students through advising, counseling, classroom and laboratory teaching, and extra-curricular activities. Some of these faculty-student relationships continue after graduation. For example, some of our BSAE alumni have served and continue to serve on the AE Advisory Board and/or teach AE courses. The AE faculty spends additional time with students while mentoring the student chapters of our professional societies (AIAA and Sigma Gamma Tau) and student teams who participate in design competitions. AE faculty also engages students in their research, often co-authoring papers with students, which students then present at professional conferences. Finally, AE faculty provides students career guidance, helps them obtain internships, summer jobs, and full-time jobs upon graduation.

## D. Professional Development

Professor Papadopoulos has significant industry contact and exchange with Lockheed Martin and NASA through his research. Moreover, he is very active with AIAA. Professor Mourtos has industry contact with Cessna and NASA Ames and is very active in engineering education venues such as ASEE and WIETE[41].

## E. Authority and Responsibility of Faculty

The AE program is conveniently located close to NASA Ames Research Center, Lockheed-Martin, Space Systems Loral, and several smaller AE companies. The AE faculty has been active in creating a vision for the AE program in collaboration with engineers from the AE industry and implementing this vision through curriculum and laboratory development. Following the 2005 ABET visit input from all program constituents was used to redesign the BSAE curriculum, so that it better meets the PEO. Unfortunately, the implementation of these programmatic improvements took an enormous amount of time and effort due to lack of leadership in the Department, lack of representation of the AE faculty in the departmental leadership, and a continuous violation of due process in programmatic assessment and in approving course and curriculum proposals. Several AE course and curriculum proposals, although approved more than once by the MAE Department Curriculum Committee and the MAE Department Faculty at large, were simply ignored by the Department Chair and were not forwarded to the College. It is worth noting that a formal explanation for the rejection of these proposals was never given to the AE faculty. These issues were finally resolved in Fall 2010 with the intervention of the College and the University and we are currently in transition towards achieving an organizational structure and due processes in the MAE Department that will allow the AE Program to thrive. A critical element of this structure is the position of the Associate Chair for the AE Program, with sufficient authority to carry out the responsibilities described in the Background section of this report as well as the block-vote (AE and ME) in the Department curriculum committees (graduate and undergraduate), which was installed by the College in Fall 2009. However, as of the writing of this report, such structure has not yet been formalized due to opposition by ME faculty members and the lack of support from the College.

Program faculty is normally responsible for developing, assessing and reviewing their Student Outcomes and Program Educational Objectives. Each department provides representation to the CoE Assessment Committee which meets several times each month to discuss assessment issues related both to ABET and WASC accreditation processes as well as our internal

---

[41] World Institute for Engineering and Technology Education

Program Planning process. However, until recently, an AE Program representative was not allowed in this Committee under the pretext that only one representative should serve from each department. Unfortunately, the ME faculty member who represented the MAE Department in this Committee did not serve the interests of the AE Program.

Curricular changes are initiated by program faculty. Depending on whether the changes are minor or significant, the approval cycle may differ, as documented below, from the SJSU Curriculum Guide. New Degree Programs must be approved at the CSU Chancellor's Office.

*New Permanent Course Proposals*

Proposals for New Permanent Courses must be submitted on the appropriate undergraduate or graduate form of that name, with course syllabi attached, for action by the department chair or school director (signature required), the college curriculum committee, and the college dean (signature required). Following the dean's approval, the proposal is reviewed by the AVP for Undergraduate Studies or Graduate Studies, as appropriate, and, if approved, is entered into the PeopleSoft Student Administration Course Catalog for scheduling. The AVP may elect to bring any curricular proposal to the Undergraduate or Graduate Studies Committee, especially if there are significant current or potential future resources involved.

*New Concentrations, Options, Emphases, and Minors*

These are, with rare exception, authorized at the discretion of the campus, and need not go through the Master Planning process. They require approval of the Undergraduate or Graduate Studies Committee and the Curriculum & Research Committee. Special forms outlining resource needs must be secured from UGS, and attached to proposals for new concentrations, or for large new emphases or options. Prior to implementation, the Chancellor's Office must receive written notification of the exact title of the proposed program, together with a list of courses.

*Minor Changes to Existing Degree Majors, Concentrations, or Minors*

Changes to existing degree programs, concentrations, or minors require submission of a Minor Curriculum Change: Academic Major/Minor Program form. Changes may include one or more of the following: course additions or deletions, unit changes, number changes, addition or deletion or changes to preparation for and/or support for the major, etc. Changes in requirements require review and approval as follows: Chair, Dean, and appropriate AVP. If the AVP believes the change is major, especially if new resources are involved, s/he may refer to the Undergraduate or Graduate Studies Committee for review.

# CRITERION 7. FACILITIES

## A. Offices, Classrooms and Laboratories

### A1. Offices

The MAE Department office suite is located in room E310 of the CoE building. Within the Department office, there are eleven faculty offices (rooms 310A to 310K) and two cubicle offices for the administrative assistant and the student assistant. In addition, the Department also has several offices throughout the CoE building for both full-time and part-time faculty. The full-time AE faculty offices are located in rooms E181 (Papadopoulos) and E183 (Mourtos). The Department office is equipped with copy machine, fax machine, paper shredder, wireless Internet access, and typical office stationary for use. Each faculty office is equipped with desktop PC with wired internet access and telephone equipment. Student assistants have their offices in the AE labs (E107, E272). The clubroom for the student chapters of AIAA and Sigma Gamma Tau is located in E164C. It includes also a library. The clubs maintain their own web pages linked to the MAE Department web page.

### A2. Classrooms & Meeting Rooms

The CoE manages a 210-seat auditorium (E189), the Alumni Room (E285-287), several meeting rooms (E247, E335, E285, E287), and an open study area on the third floor. The auditorium is regularly used for professional presentations, symposiums, and occasionally, for large class lectures and exams. The Alumni Room used for banquets, CoE faculty meetings, workshops, and other events. The meeting rooms are used for faculty and staff meetings and events. Table 7.1 lists the 15 CoE classrooms and their capacities. These classrooms are shared by all engineering programs. Overflow lecture sections are scheduled in other facilities on campus through the Academic Scheduling Office.

Table 7.1 – CoE classroom capacities

| Room # | 232 | 301 | 303 | 327 | 329 | 331 | 337 | 338 | 339 | 340 | 341 | 343 | 395 | 401 | 403 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Capacity | 40 | 40 | 40 | 30 | 70 | 100 | 70 | 30 | 70 | 50 | 100 | 100 | 35 | 40 | 40 |

### A3. Laboratory Facilities

Table 7.2 provides a summary of the laboratory facilities used for instruction in the AE Program. It includes AE laboratories dedicated exclusively to AE courses as well as ME laboratories that serve AE students. The equipment and instrumentation in aerodynamics (E107) and aerospace structures (E114) is excellent and in aircraft design (E164) is good.

Table 7.2 – Instructional Laboratory Facilities

| Location / Name | Courses Served | Current Status | Adequacy of Instruction | # of students served annually | Area ($ft^2$) | Director |
|---|---|---|---|---|---|---|
| E107 – Aerodynamics | AE160, AE162 AE171A,B AE262 | Excellent | Excellent | 100 | 1,357 | Mourtos |
| E133 – Engineering Measurements | ME 120 | Good | Good | 120 | 2,000 | Furman |
| E137 – Space Systems | AE110 AE172A,B | Poor | Poor | 15 | 400 | Papadopoulos |
| E164 – Aircraft Design | AE160, AE162 AE171A,B | Good | Good | 30 | 2,622 | Mourtos |
| E236 – Spacecraft Design | AE110 AE172AB | Good | Good | 15 | 1,318 | Papadopoulos |
| E240 – Aerospace Structures | AE114 | Excellent | Excellent | 30 | 400 | Hunter |
| E272 – Computational Fluid Dynamics | AE110, AE167 AE169, AE172AB, AE269 | Poor | Inadequate | 30 | 1,975 | Papadopoulos |

All labs are furnished with electronic locks to allow students to enter on an as-needed basis. The laboratory support of the BSAE curriculum is shown in Figure 7.1.

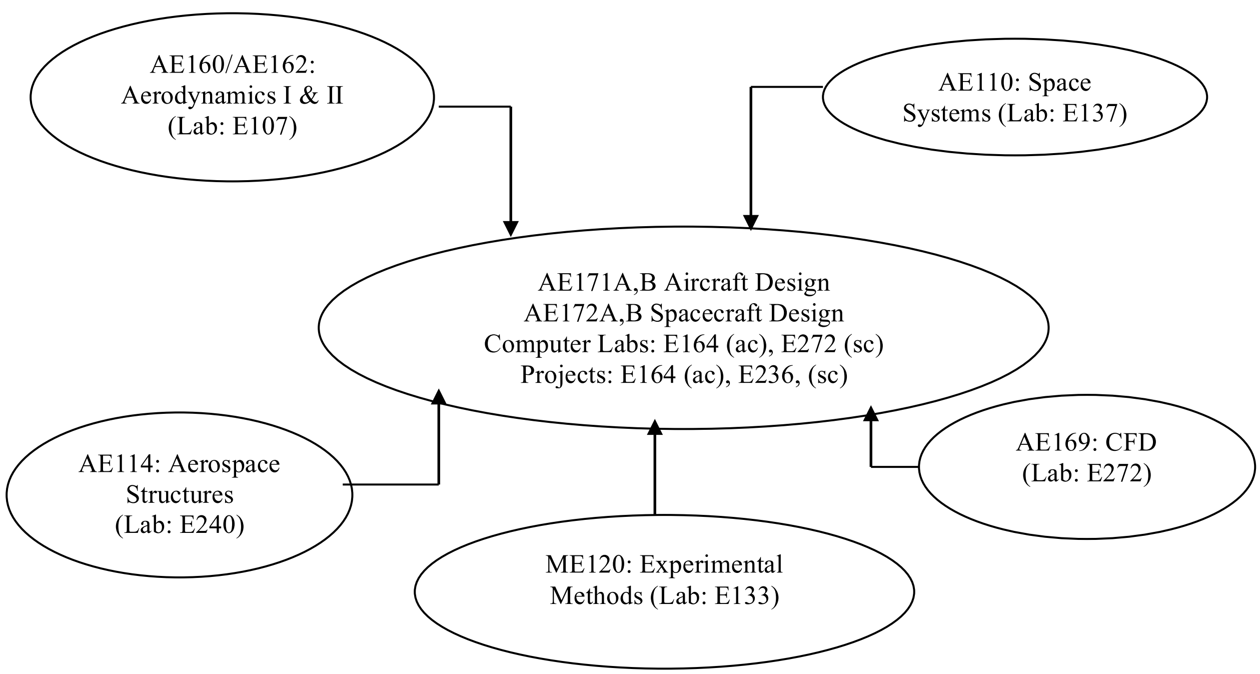



Figure 7.1 – BSAE curriculum laboratory support.

## B. Computing Resources

The CoE Computing Systems group manages eight computer laboratories as listed in Table 7.3. These laboratories are exclusively for CoE students, faculty, and staff use. These computers are loaded with programs including Matlab, AutoCAD, Unigraphics, ProModel, Visual Studio, Minitab, Pspice, ProEngineer, C compiler, word processing, spreadsheet and web browser. These labs primarily support engineering common courses such as programming and writing classes. The open laboratories (E390 and E305) are available five days a week on a walk-in basis. Wireless Internet access is available in the CoE Building.

Table 7.3 – CoE computer laboratories

| Room # | No. of PCs | Usage |
|---|---|---|
| E333 | 30 | Engineering classes using multimedia presentation or cooperative learning |
| E390 | 25 | Open Lab |
| E391 | 25 | Engineering core writing and programming classes such as: E10, E100W, CmpE46, ME20, and ME30. |
| E392 | 25 | Engineering core writing and programming classes such as: E10, E100W, CmpE46, ME20, and ME30. |
| E393 | 25 | Engineering core writing and programming classes such as: E10, E100W, CmpE46, ME20, and ME30. |
| E394 | 25 | Engineering core writing and programming classes such as: E10, E100W, CmpE46, ME20, and ME30. |
| E405 | 27 | Open Lab |
| E407 | 25 | Engineering core writing and programming classes such as: E10, E100W, CmpE46, ME20, and ME30. |

### B1. College of Engineering Network

All the computers and laboratories in the CoE are connected to 10/100 Ethernet ports. In particular, each laboratory with more than 25 computers contains a secondary distribution closet (SDC). Within each SDC is housed a Cisco 3750 switch containing 24 or 48 ports. The SDC switches are connected to the COE Ethernet backbone via Gigabit fiber connections. Our infrastructure allows high-speed data connections, which enables research, instruction, and convenient maintenance. By having an SDC, we gain flexibility and the ability to easily upgrade our switches to Gigabit speed. This spring over 70 switches in the COE were upgraded to Cisco 3750s with 10/100 ports. Our next round of upgrades should bring Gigabit speeds to the desktop.

Engineering students can also take advantage of the computer lab located in the Student Union (adjacent to the CoE Building) and computing services in the King Library. The Student Union computer lab has one hundred computer stations managed by the Associated Students Computer Services Center. The lab supports major operating systems (Windows, Linux, and Macintosh) and provides DVD and CD burners, high-speed Internet access, and document scanning capability. The King Library provides the following computer resources to all SJSU students:

- Laptop checkout for students (80 laptop computers and 20 tablet computers)
- Four (4) computer classrooms (total of 123 computers)
- Reserve-a-computer with office software & internet access (208 computers)
- Research information computers with Internet access (51 computers)

- Library catalog computers for quick look-up (27 computers)
- Personal laptop computer connections (180 ports)

## C. Guidance

For machine shop equipment, each student in the Department has to go through the shop safety and operation procedure workshop by the CoE lead machinist before they are allowed to operate the equipment. During shop open hours, there is a shop supervisor/student lab monitors on site to provide assistance and oversee the operation.

## D. Maintenance and Upgrading of Facilities

Each AE laboratory is developed and operated by the corresponding regular faculty member serving as the Laboratory Director (Table 7.1). The Laboratory Director is responsible for ongoing planning in terms of how the laboratory is serving the BSAE curriculum. On the other hand, the Department and the College traditionally have provided technical support for the maintenance of the laboratories. Unfortunately, the MAE Department technician resigned several years ago and he has not been replaced. As a result the Department does not have adequate technician support; it shares with the rest of the College a technician in the area of computer / software maintenance and upgrading, and a technician in the area of machine shop design fabrication. Day-to-day maintenance tasks have fallen on student assistants. Clearly both funding and personnel are inadequate at present.

Institutional resources available for development, maintenance, and upgrading of laboratories are very marginal, and prospects for improvement in support are not likely for some time. The state-provided funding for the Department comes in the form of the General Operating Fund and the Trust Fund (reallocation of net proceeds for off-campus programs). Neither fund has provided more than very meager funding for equipment replacement or upgrading. The CoE Laboratory Refresh program supported by non-state funds is a possible and competitive source of funding that can be captured only intermittently for laboratory equipment needs, primarily for modernization. It was this program that allowed the recent replacement (Summer 2010) of the subsonic wind tunnel in the Aerodynamics Laboratory.

For more information on laboratory status, equipment, maintenance and upgrades, please refer to Appendix C.

## E. Library Services

SJSU Library and San Jose Public Libraries have jointly developed and managed a library, Dr. Martin Luther King, Jr. Library since August 2003. This Library is the first joint library between a university and a city in the country. Its success can be measured by the dramatic increase in its circulation statistics of SJSU faculty and students. Its success is also measured by the many awards it has received, including the prestigious national Thomson/Gale Library of the Year award.

The King Library is jointly managed by the Dean of the University Library, the Director of the San Jose City Public Library System, with four integrated key operational units: Access Services, Information Technology, Reference, and Technical Services. The Dean, Director, and key unit heads make up the King Management Team for issues of common concern. However, all academic and related collection development decisions are the sole responsibility of the University Library. Special attention is paid to areas in which collaboration may yield benefits.

Organizationally, the SJSU Library is in the Academic Affairs division. It is headed by the Dean of the University Library, who reports to the Provost.

*Acquisitions and Expenditures*

The following tables summarize library acquisitions and expenditures over the last five years.

| Summary of Acquisitions | Current Total Holdings | Books Added: 2005 – 2010 |
|---|---|---|
| Engineering | 77,058 | 23,934 |
| Related Subjects | 106,775 | 27,952 |

| Summary of Expenditures* | 2005/06 | 2006/07 | 2007/08 | 2008/09 | 2009/10 |
|---|---|---|---|---|---|
| Budget for Collection Management | 2,284,804 | 2,863,545 | 2,865,065 | 2,677,818 | 2,504,020 |
| Total Engineering Funds | 156,394 | 232,722 | 175,744 | 129,246 | 114,179 |
| Books | 42,549 | 51,138 | 75,629 | 74,704 | 55,921 |
| Periodicals | 34,199 | 41,540 | 33,859 | 19,264 | 18,781 |
| Electronic Resources | 8,350 | 9,589 | 41,770 | 35,281 | 37,140 |
| Additional fund for electronic resources | 157,051 | 163,504 | 169,293 | 171,172 | 173,946 |

* Refers to State general funds. They do not include gifts, donations, and grants.

*Printed Engineering Collection*

The Engineering collection consists of books classified in the Library of Congress call numbers of HD, HE, T, TA, TC, TD, TE, TF, TG, TH, TJ, TK, TL, TN, TP, and about 50% of the TS area. About 25% to 30% of the QA books are purchased for engineering. These include QA76 for the subjects of Control Systems/Theory, Optimization, Operations Research, and QA901-931 for the subjects of Hydrodynamics, Fluid Mechanics and Elasticity. Related subject areas include Biology, Chemistry, Computer Science, Environmental Studies, Geology, Math, Medicine, and Physics. The ranges of call numbers are GE, GF, QA, QB, QC, QD, QE, QH, QM, QP, QR, S, SB, SD, SF.

Engineering related materials are acquired through the joint efforts of the engineering collection development librarians and the engineering faculty. Recommendations are encouraged from students and are honored if the subject matter is appropriate and funds are available. Books are purchased through the Yankee Book Peddler approval plan, from other vendors, and directly from professional societies. The engineering librarians attend the College of Engineering Curriculum Committee, and work closely with engineering faculty to coordinate purchases of library materials to meet the needs of the changing engineering curricula.

*Electronic Resources*

Access to the SJSU library collection is through an online catalog searchable in the King Library and from remote sites both on and off campus. Users may search by title, author, subject, keyword, call number, and other standard numbers. During the last five years, many ebooks are added to the collection. Students and faculty can easily read ebooks online anywhere at any time via personal computer or other digital devices.

There are many Internet access stations in the King Library. Starting with the Library Home Page http://library.sjsu.edu , there are links to a large variety of the World Wide Web based electronic resources. A total of more than 300 full-text and bibliographic databases are available for students and faculty to use. Among them, fifteen are the essential engineering related databases, namely, *Academic Search Premier, Aerospace and High Technology Database, ACS Publications, ACM Digital Library, ASCE Database, ASME Digital Library*, *Engineering Village, GeoRef, INSPEC, IEEE Xplore, ScienceDirect, SciFinder Scholar, SPIE Digital Library, Web of Science,* and *Wiley Online Library.* Most of these databases have full-text coverage, so that students and faculty can print or download the complete articles they want to read.

In addition, the Library subscribes to *ProQuest Dissertations & Theses*, a primary database for doctoral dissertations and master's theses which is an essential resource for student and faculty research. More recently, the Library has launched SJSU ScholarWorks, a digital service representing scholarship of SJSU faculty and students. Its primary goal is to provide access to and preserve the unique work of the SJSU community.

*Reference Services*

The King library is open 8:00 am – midnight Monday through Thursday, 8:00 am – 6:00 pm on Fridays, 9:00 am – 6:00 pm on Saturdays, and 1pm-midnight on Sundays. The Library's person-to-person reference services are available to students and faculty 68 hours per week in the Library. In addition, the reference questions are also answered by telephone, by email, and through the live online reference service. Users are encouraged to select the most appropriate type of help through the Reference Help-Ask a Librarian Web Page (http://library.sjsu.edu/ask-librarian-0).

*Interlibrary Services*

Interlibrary Services (ILS) provides access to materials not owned by the San Jose State University Library. Link+ and ILLiad are the two interlibrary loan services. Users can place a request electronically by filling out a form through the Library's web page. Users can request books, periodical articles and materials of other types. San Jose State University is a member of Link+, a book request service and union catalog that allow SJSU faculty and students to borrow books unavailable at SJSU from other academic or public libraries in California. ILLiad is able to borrow from virtually any library in the world willing to lend from their collections. These services are free for students and faculty.

*Professional Engineering Librarians*

There are two library faculty members who are subject specialists in engineering. These engineering librarians, with professional information degrees, have extensive knowledge of the nature and organization of engineering information and a good understanding of the information-seeking behavior of engineering students and faculty. With their knowledge and understanding, they are able to provide in-depth research assistance to students and faculty when requested, as well as to collect engineering materials for the library according to the engineering curriculum requirements, faculty research interests, and student needs. The engineering librarians are also responsible for instruction in library research.

## F. Overall Comments

The AE Program has generous laboratory space, more than 8,000 $ft^2$, assigned to it from its early days by the CoE. It has several high quality instructional laboratories encompassing most of the basic AE disciplines and applications and there is space for growth in some of the laboratories. AE faculty and/or qualified student assistants provide adequate oversight to ensure proper and safe use of the equipment. The faculty is fully capable of proper vision, planning and implementation of the laboratory facilities however, the challenge is to develop sources of support for maintaining and upgrading the laboratories.

# CRITERION 8. INSTITUTIONAL SUPPORT

## A. Leadership

The CoE leadership team consists of the Dean (Dr. Belle Wei), the Associate Dean (Dr. Emily Allen), the Associate Dean for Graduate and Extended Studies (Dr. Ahmed Hambaba, and the Council of Chairs. In addition, the College Budget Analyst (Karel Floyd) works with the Dean and Chairs on fiscal issues, and the College HR Confidential (Molly Crowe) works with the departments on faculty, staff and student assistant hiring and employee relations. The Council of Chairs meets twice per month, and the Dean meets with each Chair on a weekly basis. As part of its shared governance process, the College faculty serve on the following College committees to contribute to policy and practice decisions:

- The CoE Undergraduate Curriculum Committee
- The CoE Graduate Studies Committee
- The CoE Research Committee
- The Master Faculty Advising Team
- The CoE Retention, Tenure and Promotion Committee (elected)

In addition to the administrative and formal governance team, the College, as part of its strategic planning process, has established the following ad hoc groups consisting of faculty, staff and student participants, who were nominated by department chairs and invited to serve by the Dean:

- The Resource Advisory Board - to review opportunities and provide advice to the Dean regarding priorities for the College
- The Vision 2015 Task Force – to collectively arrive at what are the highest priorities for the College for the next five years

## B. Program Budget and Financial Support

### B.1 Budget Sources and Process

The primary financial resource for the College is the state-supplied general fund allocated by the University. The general fund supports the program's basic operating needs: faculty and staff salaries, supplies and services, and equipment requisitions. The College also receives a significant amount of financial support from three major external sources: funds from Continuing Education, research grants, and donations and gifts. Funding from these sources supports college-wide initiatives for faculty and student development.

*General Fund*

Budgets are allocated by department and not by program. The annual budget allocation for each department is made by the Dean of the College with assistance from the Associate Deans, Department Chairs and the College Budget Analyst. For the most part, allocations are formula driven, especially in the areas of supplies and services. The formulas are based on each department's fraction of the College's FTES. FTES are calculated by the number of students enrolled in courses with the departmental prefix, multiplied by the number of units, and divided by 15 (the number of units taken by a full-time undergraduate). The FTES are translated into the number of Full-Time Equivalent Faculty (FTEF) for tenured and tenure-track as well as non-tenure-track lecturers. The average lecturer salary is budgeted at $45,708 per academic year. The total faculty salary allocation is the sum of the actual salaries of tenure-track faculty and the budgeted amount for full-time equivalent lecturers. The total staff allocations are based on actual staff salaries and operating allocations are based on FTES ratios for each department. Total General Fund allocations have ranged from $11.5M - $13.4M over the last several years.

*Funds from Continuing Education*

Funds from Continuing Education are derived from two sources: Open University and Off-Campus programs. Through the Open University program, non-matriculated students may be permitted, on a space-available basis, to take a regular course being offered. The Off-Campus programs include degree programs offered on company sites and at the Techmart location. The net revenue from the Continuing Education programs has been approximately $300K-$800K per year for the last several years. A portion of the net revenue is distributed to the academic departments that contribute to the teaching of the programs. The remaining funds are used for supporting activities that would otherwise not be funded. Examples are travel expenses for faculty, expenses for hiring and recruiting new faculty members, start-up packages for new faculty, lab refresh equipment grants, faculty development grants, and faculty fellowships.

*Research Grants*

Faculty research grants have ranged from $2.9M – $4.8M over the past several years. These funds are used by faculty to advance their knowledge in their research areas. The College also derives support from the return on indirect charges collected by the San Jose State University Foundation in connection with faculty research grants. The funding distributed to the College, which is used to support research-related activities, is divided into three equal portions: one-third goes to the Dean, one-third to the principal investigator's department, and one-third to a research account controlled by the principal investigator. Over the past few years, the funds available from indirect charges have ranged from $53.1K-$310.9K. In addition, grants that support instructional materials and laboratory development typically include budgets for lab equipment or computers.

*Donations and Gifts*

The College receives significant donations and gifts from our industry partners and individual donors. These contributions take the form of equipment donations and cash grants from friends, alumni, and Silicon Valley companies such as AMD, Applied Materials, Atmel, Cadence, Cisco, IBM, Intel, Lam Research, Lockheed Martin, Maxim Integrated Products, National Semiconductor, Rockwell Collins, Solectron, Synopsys, and Xilinx. Major

contributors of laboratory and instructional equipment are Agilent Technologies, Applied Materials, Atmel, Cadence, Cisco, HP, Intel, Novellus, and Xilinx.
Another significant financial source for the College is the interest income generated from the College's endowment funds. Currently, the College has endowment funds of about $19.2 million dollars that support faculty development and hiring, student scholarships, and student co-curricular programs. The College had an average of over $2.4 million available in funds from gifts, grants and endowment interest over the last 4 years.

Table 8.1 – Department of Mechanical and Aerospace Engineering
Funding Sources and Levels

| Source / AY | 06/07 | 07/08 | 08/09 | 09/10 | 10/11 |
|---|---|---|---|---|---|
| General Fund | 1,469,785 | 1,483,114 | 1,676,479 | 1,445,765 | 1,389,446 |
| CE Trust | 119,964 | 79,225 | 86,842 | 94,757 | |
| Tower Foundation | 2,226 | 13,000 | 27,101 | 66,066 | |
| Research Foundation | 1,326 | 21,280 | 8,897 | 171,936 | |
| Totals | 1,593,301 | 1,596,619 | 1,799,319 | 1,778,524 | |

### B.2 Teaching Support

The MAE Department in recent years has developed sufficient funding to support instructors in all qualifying courses with student assistant graders. Regular faculty are given sufficient funding to employ graders in most of their courses each semester, and Lecturers are also provided grader support in their courses whenever the class size is significant enough to warrant a grader.

In addition, student assistants paid from lab fee accounts serve to enrich and support student use of the multi-media and computer labs, and the Department-hosted fabrication facility (machine-shop) by maintaining and supporting the facilities. Lecture/lab courses with multiple lab sections have Teaching Assistant support for the lab sections, or in some cases, student lab assistants assisting the instructor.

Generally, the Department has equipped all its classrooms with computer projectors. In addition the Department provides projectors and laptops on a checkout basis or instructors as well as student groups doing presentations, rehearsal, etc.

### B.3 Acquisition, Maintenance and Upgrading

Support for replacement and upgrading of instructional laboratory equipment has been scarce in recent years. In addition to very modest General Fund OE&E funding, the Department has had funding from the continuing education programs it supports (Trust Fund) as well as competitive laboratory refresh grants it has won. Equipment expenditures from OE&E (supplies and equipments) may have averaged about $10,000 per year. Trust funds expended for equipment may have averaged another $20,000 annually. Two competitive College-funded laboratory refresh grants totaling $200,000 were received in the last three years. Criterion 7.D provides additional discussion on this.

### B.4 Adequacy of Resources to Support Outcomes

With the diversity of sources noted, the funding has been adequate to maintain the operational status of the instructional laboratories, although a slow deterioration has been occurring primarily because of lack of electronics/instrumentation technical support. Having been given recruiting approval, we anticipate success in hiring a Department-dedicated technician for these areas. We also anticipate continued development of funding opportunities through our industrial community particularly as we expand our partnerships in addressing industry's needs in the graduates we produce.

## C. Staffing

### C.1 Technician Support

In recent years, the MAE Department has not had a dedicated technician to maintain its laboratories. Excellent college-shared technician support has been and is being provided in: i) machine design and fabrication (senior projects, competitions, laboratory stations and repairs); and ii) computer equipments and usage in offices and laboratories. The unmet need has been in laboratory electronics and instrumentation. That is about to change. As this report is being written, the Department has been given approval to recruit a Departmental technician during Summer 2011 for these areas.

### C.2 College-Wide Staff

The CoE has significant staff supporting the entire College. This includes the staff of the Engineering Student Success Center (ESSC), the Engineering Computing Services (ESC), the Central Shops and the Dean's Office.

The ESSC staff includes the Executive Director (vacant as of writing, search underway) Engineering Outreach Coordinator (Rendee Dore), the Student Program Coordinator (vacant as of March 2011), an Academic Adviser (recently vacated, new search in process), and a Coordinator of Student Support Services (Linda Ortega), as well as an administrative assistant in the ESSC (Ester Burton), along with five to ten Peer Advisors. The ESSC provides General Education Advising, probation advising, career advising (in collaboration with the Career Planning and Placement Center personnel, who hold office hours at the Center). The ESSC Academic Advisor also coordinates the Master Faculty Advising Team (MFAT) meetings and sets the agenda for advising discussions. The Coordinator of Student Support Service also directs the MESA Engineering Program (MEP), which serves mainly first generation college students, many of whom are underrepresented minorities. MEP runs a significant number of career workshops, student leadership activities, and tutoring. In addition Linda runs the Women in Engineering program and the cohort freshman residential program CELL.

The Engineering Computing Services (ECS) group includes its Director (Kindness Israel), the Desktop Support technician (Ben Rashid), the Lab Support technician (Scott Pham), and a Webmaster (currently vacant). These individuals and their student assistants provide the backbone of service to maintain the network, the shared laboratories, and desktop support. Engineering Central Shops includes a master machinist (Craig Stauffer), and until recently an additional Tech II (who recently retired and has not yet been replaced).
Technician training is done on an ad-hoc basis.

# D. Faculty Hiring and Retention

### D.1 Hiring

In hiring new faculty, a department must create a five-year strategic plan and make the case that new faculty are needed. This has been difficult for the last several years as there have been hiring freezes in place for at least two years, except for critical positions. In any case, the department must consider the demand, the coverage of curricular areas, and potential for growth in a disciplinary area. In the last five years there have been no *new* funds provided for departments, so new hires must come from existing budgets. The College is beginning to utilize endowments for new faculty chairs.

### D.2 Retention

The College has established the policy to assist new faculty members to develop their teaching repertoires and initiate research programs by reducing their teaching loads by one-half during their first year and by one-quarter during their second year. This policy pertains to all faculty members newly hired as assistant professors. More experienced faculty members also receive some initial release-time support depending on their needs and qualifications.

The College also has a 1:2 matching policy to provide assistance to faculty members who secure external grants to reduce their teaching loads. If a faculty member secures external funding sufficient to reduce his/her teaching load by two courses, the College provides a third course reduction.

# E. Support of Faculty Professional Development

Acquiring teaching resources and supporting faculty development are a high priority in the CoE. The College has two endowed chairs: the Pinson Chair, and the Charles W. Davidson Chair in Construction Management which is earmarked for the Department of Civil and Environmental Engineering. The goal of the Pinson Chair is to help programs to develop new curricular areas. In the area of faculty development, the College provides sabbatical leave opportunity and faculty development grants.

### E.1 Sabbatical leave

The purpose of sabbatical leave is to benefit the University, its students, and its programs through the professional development of the faculty. Sabbatical projects include scholarly and professional activities, activities, which enhance a faculty member's pedagogical and professional competencies, and projects, which contribute significantly to the development of a discipline or curricular area. Faculty can either take a one-semester sabbatical with full pay or a two-semester sabbatical with half pay. The number of awards given to the engineering faculty is typically between three to five annually and is dependent on the University budget. Faculty are eligible to apply every 6 years but are not guaranteed.

### E.2 Faculty Development Grants

Faculty development grants provide a way to advance faculty career aspirations and the College objective of becoming a premier undergraduate engineering educational institution by recognizing, promoting, and supporting faculty's research achievements and excellence in teaching. The research and teaching goals are mutually supportive with research providing vitality and vision in technical issues and teaching providing focus for research and a channel for dissemination of knowledge gained in research efforts. Since 2002, the College has offered the Engineering Research Development Grant and the Teaching Development Grant to the faculty of the College of Engineering. These two grant programs are entirely supported by external funding.

The Engineering Research Development Grant provides support to enable, to initiate, or to coordinate research efforts of the faculty members and their departments. Faculty members are encouraged to collaborate on project proposals and pursue team-oriented projects. The Engineering Teaching Development Grant is intended to support faculty efforts in curricular development, assessment, and improvement for subjects aligned with departmental priorities as well as enhancing students' learning effectiveness.

### E.3 University Grant Programs

In addition to the CoE faculty development grants, the University offers two faculty grant programs: the CSU Research Grant and Professional Development Grant. The CSU Research Grant offers funding for "seed" money or summer fellowships. "Seed" money ($5k) is for testing promising ideas and obtaining preliminary results prior to seeking external support. "Seed" money can be used for research, clerical assistance, equipment, software, or travel, which is essential to the project. The grants fund the time needed by the faculty to initiate, continue, or complete research projects.

The Professional Development Grant supports professional development for faculty, staff, and students. Categories for which funds may be used include participating in training/education programs, conferences, hiring student assistants, travel, software, equipment and supplies. Staff and student organizations are also eligible to apply.

## E.4 Silicon Valley Leaders Symposium

For the past several years, each Thursday the College invites an industry or technology leader to campus to speak on topics of importance to engineering faculty and students: emerging technologies, business practices, and industry trends. This is the College's Silicon Valley Leaders Symposium, the Symposium provides an opportunity for our faculty and students to interface with industry leaders and learn from their insights and experience. The following table lists the speakers and their topics presented in the AY 2010/2011.

Table 8.2 – Fall 2010 Silicon Valley Leaders Symposium

| Name | Title | Affiliation | Presentation Title |
|---|---|---|---|
| Dr. Martin L. Perl | Physics Nobel Laureate and Professor | Stanford University | Creativity and Risk in Technology |
| Dan Reicher | Director of Climate Change and Energy Inititives | Google Inc. | Clean Energy Future |
| Dr. Stephen Herrod | Chief Technology Officer and SVP of R&D | VM ware | Cloud Changes Everything |
| John McCool | SVP/GM | Cisco Systems Inc. | The Consumerization of It: Cloud, Virtualization and the Data Center |
| Mark Milani | Senior Vice President | Oracle Corp. | What Problem Are We Solving? A Look at Cloud Computing |
| Peter Nelson | President and CEO | California Water Company | The Water Profession and You |
| Cheryl Ainoa | SVP Global Service Engineering | Yahoo! Inc. | Innovation at Scale |
| Dr. Jane Shaw | Chairman of the Board of Directors | Intel Corp. | Corporate Social Responsibility |
| Peter Darbee | Chairman, CEO, and President | PG&E Corp. | Climate Change for Policy Makers and Business Leaders |
| Dr. Christopher Field | Director of Department of Global Ecology and Professor | Stanford University | Climate Change for Policy Makers and Business Leaders |

# CRITERION 9. PROGRAM CIRTERIA

## A. Curriculum

The following courses in our BSAE curriculum address the *aeronautical engineering* requirement (see also Figure 5.1):

- Aerodynamics – required courses: AE160, AE162, AE164, AE169.
- Materials – required courses: MatE25, AE114; electives: AE135, MatE160
- Structures – required courses: CE99, CE112, AE114; electives: ME160, CE160, CE161.
- Propulsion – required courses: AE167.
- Flight mechanics – required courses: AE165.
- Stability and control – required courses: AE165, AE168.
- Aircraft Design – AE171A & B

The following courses in our BSAE curriculum address the *astronautical engineering* requirement (see also Figure 5.1):

- Orbital mechanics – required course: AE165; elective AE110
- Space environment – required courses: AE172A & B; elective: AE110
- Attitude determination and control – required course: AE168
- Telecommunications – required courses: AE172A & B; elective: AE110
- Space structures – required course: AE114
- Rocket propulsion – required course: AE167
- Spacecraft Design – AE172A & B

Clearly, the BSAE Program addresses all the subject areas required under aeronautical and astronautical engineering. Furthermore, program graduates demonstrate design competence in at least one of the two fields:

- Aeronautical Engineering: students perform a year-long aircraft design project (AE171A&B), which requires integration of aerodynamics, flight mechanics, propulsion, aircraft structures and materials, and stability and control.
- Astronautical Engineering: students perform a year-long spacecraft design project (AE172A&B), which requires integration of orbital mechanics, space environment, attitude determination and control, telecommunications, space structures, and rocket propulsion.

# B. Faculty

The AE faculty has formed an AE Advisory Board (Appendix F) that meets once a year. In the most recent meeting[42], the Board examined the PEO for currency and the BSAE curriculum to ensure it adequately addresses these objectives. The AE faculty is also charged with the responsibility and authority to develop courses and laboratories in support of the PEO. Since the last ABET visit, AE faculty have been very active in curriculum and laboratory development.

Following the 2005 ABET visit input from all program constituents was used to redesign the BSAE curriculum, so that it better meets the PEO. Unfortunately, the implementation of these programmatic improvements took an enormous amount of time and effort due to lack of leadership in the Department, lack of representation of the AE faculty in the departmental leadership, and a continuous violation of due process in programmatic assessment and in approving course and curriculum proposals. Several AE course and curriculum proposals, although approved more than once by the MAE Department Curriculum Committee and the MAE Department Faculty at large, were simply ignored by the Department Chair and were not forwarded to the College. It is worth noting that a formal explanation for the rejection of these proposals was never given to the AE faculty. These issues were finally resolved in Fall 2010 with the intervention of the College and the University and we are currently in transition towards achieving an organizational structure and due processes in the MAE Department that will allow the AE Program to thrive. A critical element of this structure is the position of the Associate Chair for the AE Program, with sufficient authority to carry out the responsibilities described in the Background section of this report as well as the block-vote (AE and ME) in the Department curriculum committees (graduate and undergraduate), which was installed by the College in Fall 2009. However, as of the writing of this report, such structure has not yet been formalized due to opposition by ME faculty members and the lack of support from the College.

The faculty information in Table 6.1 clearly shows that both the full-time and part-time faculty who teach upper division courses are current in their area of specialization. The full-time faculty stay current in various ways, such as research in their disciplines, interaction with industry on undergraduate and graduate student projects, participation in professional societies (AIAA, SAE, ASEE), conferences, and publishing.

[42] April 6, 2011.

# Appendix A
# Course Syllabi

***Math 30 – Calculus***

**Required Course:** Yes
**Course Coordinator:** Misako van der Poel

**Description:** Introduction to Calculus including limits, continuity, differentiation, applications and introduction to integration. Graphical, algebraic and numerical methods of solving problems.

**Prerequisites:** Satisfactory score on the Mathematics Placement Exam; satisfaction of the ELM requirement.

**Required Text:**
Calculus: Early Transcendentals, by J. Stewart, Thomson/Brooks/Cole, 6th Ed.

**Student Learning Objectives for the course:**
By the end of the course, students should be able to:

- To learn the concepts and techniques of differential calculus and use them in solving applied problems.
- To study limits, continuity, differentiation and applications of the derivative

**Class/laboratory schedule**:

**Contribution of course to meeting the requirements of Criterion 5:**

1. College level mathematics and science 3 units
2. Engineering discipline 0 unit
3. General Education 0 unit
4. Others 0 unit

**Prepared by:** Misako van der Poel **Date:** June 17, 2011

***Math 31 – Calculus II***

**Required Course:** Yes
**Course Coordinator:** Tatiana Shubin

**Description:** Definite and indefinite integration with applications. Sequences and series. Graphical and algebraic and numerical methods of solving problems

**Required Text:**
*Calculus: Early Transcendentals*, by J. Stewart, Thomson/Brooks/Cole, 6th Ed.

**Student Learning Objectives for the course:**
By the end of the course, students should be able to:
To learn the concepts and techniques of integral calculus and to use them in solving applied problems.
To learn the concepts of infinite sequences and series.
To investigate convergence properties of numerical and power series and their application to representation of functions as a power series.

**Class/laboratory schedule**: Lab meets for 1 hour and 15 minutes four times a week.

**Contribution of course to meeting the requirements of Criterion 5:**

1. College level mathematics and science 4 units
2. Engineering discipline 0 unit
3. General Education 0 unit
4. Others 0 unit

**Prepared by:** Tatiana Shubin **Date:** June 17, 2011

***Math 32 – Calculus III***

**Required Course:** Yes

**Description:** Introduction to graphical communication tools used by engineers. Design and graphical solutions to three-dimensional design problems involving points, lines and surfaces. Development of visualization and technical sketching skills in conjunction with orthographic and pictorial projections. Tolerance analysis for fabrication. Individual design project. Focus on computer-aided design and graphical analytical methods.

**Prerequisites:** Math 31 (Calculus II) with a grade of C- or better

**Required Text:** Calculus with Early Transcendentals by J. Stewart, 2008, 6th ed. :Brooks/Cole, Pacific Grove, CA

**Student Learning Objectives for the course:**
By the end of the course, students should be able to:
1. Use polar coordinates effectively in applications.
2. Use parametrizations of lines and curves.
3. Compute velocities and curvature.
4. Graph three dimensional surfaces.
5. Differentiate functions of several variables
6. Find tangent lines and tangent planes.
7. Use the chain rule to transform partial differential equations.
8. Find the extreme values for functions of two variables.
9. Evaluate areas, volumes, center of mass using double integrals.
10. Use triple integrals and spherical coordinates to compute volumes and center of mass of a solid.

**Course Topics:**
Parametric Equations and polar coordinates
Vectors and applications
Vector Functions and Space Curves
Functions of Several Variable
Multiple Integrals
Exams and Quizzes

**Class/laboratory schedule**: 2 lecture periods, 75 minutes each per week

**Contribution of course to meeting the requirements of Criterion 5:**

| | | |
|---|---|---|
| 1. | College level mathematics and science | 3 units |
| 2. | Engineering discipline | 0 unit |
| 3. | General Education | 0 unit |
| 4. | Others | 0 unit |

**Prepared by:** Samih Obaid **Date:** June 17, 2011

***Math 133A – Ordinary Differential Equations***

**Required Course:** Yes

**Description:** This course is intended to provide an introduction to ordinary differential equations. It covers first order equations, such as separable and linear ones, first order systems, and second order homogeneous and non-homogenous equations, and the Laplace transform

**Prerequisites:** Math 32 (with a grade of ”C–” or better) or instructor consent

**Required Text:** P. Blanchard, R. L. Devaney, and G. R. Hall, Differential Equations, 3rd edition, Thomson–Brooks/Cole, 2006, ISBN 0-495-01265-3

**Student Learning Objectives for the course:**
Upon completion of the course, students will be able to do the following:

1. Demonstrate understanding of the basic ideas of ODEs: the notion of the solution, phase portrait and qualitative behavior.
2. Analyze and solve a variety of applications including problems involving the harmonic oscillator, predator-prey systems, and RC circuits.
3. Solve a system of two linear first order ODEs.
4. Solve second order constant coefficient homogeneous ODEs.
5. Solve second order constant coefficient forced ODEs using the Laplace transform or the method of the "lucky guess".
6. Give practical interpretations of the solutions of ODEs coming from applications.
7. To use the computer to solve ODEs numerically.

**Course Topics:**
First order equations
Geometry of systems
Linear systems
Forced harmonic oscillators
Analysis of nonlinear systems
The Laplace transform

**Class/laboratory schedule**: 2 lecture periods, 75 minutes each, per week

**Contribution of course to meeting the requirements of Criterion 5:**

| | | |
|---|---|---|
| 1. | College level mathematics and science | 3 units |
| 2. | Engineering discipline | 0 unit |
| 3. | General Education | 0 unit |
| 4. | Others | 0 unit |

**Prepared by:** Slobodan Simić **Date:** June 17, 2011

***Math 129A – Linear Algebra***

**Required Course:** Yes
**Course Coordinator:** Dr. Marilyn Blockus

**Description:** Matrices, systems of linear equations, vector geometry, matrix transformations, determinants, eigenvectors and eigenvalues, orthogonality, diagonalization, applications, computer exercises. Theory in R^n emphasized; general real vector spaces and linear transformations introduced.

**Prerequisites:** Math 31 (with a grade of C- or better) or instructor consent

**Required Text:** Elementary Linear Algebra. Spence, Insel, and Friedberg, 2nd ed.

**Student Learning Objectives:**
Upon completion of the course, students will be able to do the following:

- Perform operations involving real vectors and matrices
- Solve systems of linear equations using the method of Gaussian elimination
- Find the inverse of a matrix, or show that it does not exist
- Compute the determinant of a square matrix
- Find the rank and null space of a matrix
- Solve problems involving the span and linear dependence/independence of sets of vectors
- Find the inverse of a linear transformation, if it exists
- Prove that a set is or is not a subspace of R^n
- Find a basis for a subspace and determine the dimension of a subspace
- Find the eigenvalues and eigenvectors for a matrix or linear transformation
- Determine whether a matrix is diagonalizable

**Course Topics:**

- Systems of linear equations
- Vector geometry and vector spaces
- Matrix algebra and determinants
- Linear dependence and independence, basis, and dimension
- Linear transformations
- Subspaces
- Eigenvectors and eigenvalues
- Diagonalization of matrices

**Class/laboratory schedule**: Two 75-minute lectures

**Contribution of course to meeting the requirements of Criterion 5:**

| | | |
|---|---|---|
| 1. | College level mathematics and science | 3 units |
| 2. | Engineering discipline | 0 unit |
| 3. | General Education | 0 unit |
| 4. | Others | 0 unit |

**Prepared by**: Dr. Marilyn Blockus **Date:** June 17, 2011

***Physics 50 – General Physics: Mechanics***

**Required Course:** Yes
**Course Coordinator:** Dr. Monika Kress

**Description:** First semester of university-level calculus-based Physics. This course is required of all Science and Engineering majors except Biological Sciences. Topics include the motion of particles (kinematics and dynamics), gravity, work and energy, linear momentum, rotational motion, equilibrium and gravitation. Lab program complements lecture.

**Prerequisites:** A grade of C- or better in Math 30 or 30-P (Calculus I).

**Required Text:** Physics, 12th ed., Young and Freedman, 2008.

**Student Learning Objectives for the course:**
The student will be able to
1. Be able to assign the proper units and significant digits to the solutions of physics problems
2. Understand the relationship between forces and the objects that respond to those forces
3. Apply Newton's Laws and Conservation Laws (energy, momentum and angular momentum) to the world around you
4. Use Newton's Laws and Conservation Laws to predict the behavior of simple mechanical systems
5. Solve relatively complex physical problems in a systematic manner (i.e. not just plug-and-chug)

**Course Topics:**
1. Vectors and vector mathematics (vector addition and subtraction, vector product, scalar product)
2. Equations of motion: Displacement and velocity, with constant and time-varying acceleration.
3. Motion in a circle, projectile motion
4. Newton's laws
5. Work, force, kinetic energy, potential energy
6. Conservation of momentum
7. Conservation of energy
8. Equations of rotational motion: angular displacement, angular velocity, with constant or time-varying angular acceleration
9. Conservation of angular momentum
10. Torque and equilibrium
11. Newton's Laws of Gravitation
12. Sound, waves, and simple harmonic motion: Few instructors cover these topics because there is insufficient time, particularly given how unprepared most of our students are for this course.

**Class/laboratory schedule**: 2 hours per week, 1 unit, credit/no credit

**Contribution of course to meeting the requirement of Criterion 5:**

1. College level mathematics and science 4 units
2. Engineering discipline 0 unit
3. General Education 0 unit
4. Others 0 unit

**Prepared by:** Monika Kress **Date:** June 17, 2011

***Physics 51 – General Physics: Electricity and Magnetism***

**Required Course:** Yes
**Course Coordinator:** Dr. Joseph F. Becker

**Description:** This course covers the fundamental principles of basic dc and ac circuits, electric and magnetic fields, and electromagnetic waves

**Prerequisites:** Physics 50 or 70 and Math 31

**Required Text:** *University Physics*, 12th Edition, Young and Freedman, 2008.

**Student Learning Objectives for the course:**
The student will be able to

1. Explain the relationship between electric fields and electric charges
2. Determine the electric field caused by a continuous distribution of electric charge
3. Demonstrate the use of Gauss's Law to calculate electric fields
4. Calculate the electric potential energy of a collection of charges
5. Analyze and solve for the energy and power in circuits
6. Find the resistance of a conductor from its dimensions and its resistivity
7. Describe how an electromotive force that makes it possible for current to flow
8. Apply the use of Kirchoff's Rules in analyzing complicated
9. Analyze the motion of a charged particle in a magnetic field
10. Apply Ampere's Law to calculate the magnetic field cause by a current
11. Explain how a changing magnetic flux generates an electric field
12. Evaluate the amount of power flowing into or out of an AC circuit
13. Give interpretation of propagating and standing electromagnetic waves

**Course Topics:**

1. Electric Charged and Electric Field: Basic Concepts and Colomb's Law
2. Gauss's Law: Used to calculate the value of the electric field
3. Electric Potential: Related to potential energy for a charge
4. Capacitance and Dielectrics: Energy stored in the electric field of a capacitor
5. Current, Resistance, and Electromotive Force: The flow of electric charge
6. Direct Current Circuits: Direct of constant, current flowand RC circuits
7. Magnetic Field and Magnetic Forces: Magnetic force on moving electric charge
8. Sources of Magnetic Field: Ampere's Law and Law of Biot-Savart's Law
9. Electromagnetic Induction: Faraday's Law
10. Inductance: Energy stored in the magnetic field of an inductor or coil
11. Alternating Current: Analysis of RLC circuit using phasors
12. Electromagnetic Waves: Maxwell's equations of electromagnetic theory

**Class/laboratory schedule**: 2 lecture periods 75 minutes each, 1 lab period 3 hours each week

**Contribution of course to meeting the requirement of Criterion 5:**

1. College level mathematics and science 4 units
2. Engineering discipline 0 unit
3. General Education 0 unit
4. Others 0 unit

**Prepared by:** Dr. Joseph F. Becker **Date:** June 17, 2011

***Physics 52 – General Physics: Heat & Light***

**Required Course:** Yes
**Course Coordinator:** Todd Sauke

**Description:** Temperature, heat, thermodynamics, kinetic theory, geometric and physical optics.
Students will study and learn about the following topics:
The wave nature of light, reflection refraction and polarization of light, optical instruments and geometric optics, interference and diffraction of light waves. Temperature and heat, thermal properties of matter, the First and Second Laws of thermodynamics.

**Prerequisites:** Phys 50 or Phys 70, and Math 30 or 30P with grades of "C-" or better

**Required Text:** University Physics, 12th ed., Volumes 1 and 2. By Young and Freedman (Addison-Wesley). Chapters to be covered: Chapters 33-36 (Vol. 2) and Chapters 17-20 (Vol. 1). Also required: "Mastering Physics" Student Access Kit for online course materials.

**Student Learning Objectives for the course:**
The student will be able to

(a) An ability to apply knowledge of mathematics and science.

(b) An ability to conduct experiments, as well as to analyze and interpret data.

**Course Topics:**

| | | | |
|---|---|---|---|
| 1-27 | Intro / Review of Ch. 32 from PHYS 51 | | |
| 2-1 | Ch. 33 / HW Intro due | 2-3 | Ch. 33 |
| 2-8 | Ch. 34 / HW 33 due | 2-10 | Ch. 34 |
| 2-15 | Ch. 34 | 2-17 | Ch. 34 |
| 2-22 | Ch. 35 / HW 34 due | 2-24 | Ch. 35 |
| 3-1 | Catch up / Practice Midterm / HW 35 due | 3-3 | Midterm Exam #1 |
| 3-8 | Review Midterm / Start Ch. 36 | 3-10 | Ch. 36 |
| 3-15 | Ch. 36 | 3-17 | Ch. 36 |
| 3-22 | Ch. 17 / HW 36 due | 3-24 | Ch. 17 |
| 3-29 | Spring Break | 3-31 | Spring Break / Cesar Chavez Day / Campus clo |
| 4-5 | Ch. 17 / HW 17 due April 6 | 4-7 | Midterm Exam #2 |
| 4-12 | Review Midterm / Start Ch. 18 | 4-14 | Ch. 18 |
| 4-19 | Ch. 18 | 4-21 | Ch. 18 |
| 4-26 | Ch. 19 / HW 18 due | 4-28 | Ch. 19 |
| 5-3 | Ch. 19 | 5-5 | Ch. 20 / HW 19 due |
| 5-10 | Ch. 20 | 5-12 | Ch. 20 |
| 5-17 | Ch. 20 Wrap up / HW 20 due | 5-19 | Finals |

**Class/laboratory schedule**: 2 lecture periods, 75 minutes each, plus Lab, 2 hours and 50 minutes per week

**Contribution of course to meeting the requirement of Criterion 5:**

| | | |
|---|---|---|
| 1. | College level mathematics and science | 4 units |
| 2. | Engineering discipline | 0 unit |
| 3. | General Education | 0 unit |
| 4. | Others | 0 unit |

**Prepared by:** Todd Sauke **Date:** June 17, 2011

***Physics 53 – General Physics: Atomics***

**Required Course:** Yes
**Course Coordinator:** Carel Boekema

**Description:** Introduction to quantum physics emphasizing electronic structure or atoms and solids, radiation and relativity

**Prerequisites:** Phys 50 or Phys 70, and Math 30 or 30P with grades of "C-" or better

**Required Text:** University Physics, Sears and Zemansky (Young & Freedman, 11$^{th}$ ed.)

**Student Learning Objectives for the course:**
Physics 53 is a calculus-based two-unit course, whose purpose is for students to (learn to) understand and apply basic principles of Atomic Physics. Chapters 37 - 42 of University Physics (Y&F11th edtn) are covered.

**Course Topics:**
Photons, Electrons & Atoms (Ch 38)
Quantum Physics: an Intro… (Ch's 39 & 40)
Atomic and Molecular Structures (Ch's 41 & 42)
& Special Relativity (Ch 37).

**Class/laboratory schedule**: 2 lecture periods, 75 minutes each, plus Lab, 2 hours and 50 minutes per

**Contribution of course to meeting the requirement of Criterion 5:**

| | |
|---|---|
| 1. College level mathematics and science | 2 units |
| 2. Engineering discipline | 0 unit |
| 3. General Education | 0 unit |
| 4. Others | 0 unit |

**Prepared by:** Carel Boekema **Date:** June 17, 2011

***Chem 1A – General Chemistry***

**Required Course:** Yes
**Course Coordinator:** Dr. Resa Kelly

**Description:** First semester of college level General Chemistry. Course is required of all Science and Engineering majors except Computer Science. Topics including stoichiometry, reactions, atomic structure, periodicity, bonding, states of matter, energy changes, solutions using organic and inorganic examples. Lab program complements lecture.

**Prerequisites:** Proficiency in high school chemistry or Chem 10 (with a grade of "C" or better; "C-" not accepted) or instructor consent; proficiency in high school algebra and eligibility for Math 19; eligibility for Engl 1A.

**Required Text:** Chemistry: The Central Science, Eleventh Edition, Brown, LeMay and Bursten. Lab Manual – by Dr. Karen Singmaster

**Student Learning Objectives for the course:**
The student will be able to

1. Perform calculations and report the correct number of significant figures and units.
2. Select the appropriate conversion factors and make use of them in dimensional analysis problems.
3. Convert between moles, mass and number of particles, making use of stoichiometric factors.
4. Calculate a % composition given a molecular formula and vice versa (empirical formula and molecular formula problems).
5. Name salts, acids, bases and covalent compounds. Be able to provide the formula of these compounds given their chemical name.
6. Provide the net ionic representation of any salt, base or acid by using the solubility and dissociation rules.
7. Demonstrate he difference between solubility and dissociation.
8. Identify weak and strong acids and bases by formula and name.
9. Construct molecular, total and net ionic equations for double displacement reactions, and identify the physical state of species.
10. Recognize an oxidation, a reduction, an oxidation agent, a reducing agent and a redox reaction.
11. Calculate an oxidation number of the elements in a formula.
12. Balance a reduction oxidation reaction under acidic and basic conditions.
13. Perform stoichiometric calculations for chemical and non-chemical systems whether they have a known or unknown limiting reactant.
14. Calculate the molarity of a solution given the necessary data whether you are starting with a mass of solute or with a concentrated solution.
15. Name elements, provide their symbols and be able to determine number of electrons, protons and neutrons for any chemical species.
16. Use de Broglie's equation and have a simple understanding of what it means.
17. Calculate and convert between wavelength, frequency and energy.
18. Have some general understanding of what color is and why things exhibit color.
19. Calculate the energy associated with a given electronic transition in a hydrogen atom.
20. Demonstrate what each quantum number represents and how to obtain the quantum numbers for any electron in an atom.
21. Write the full and abbreviated electronic configuration of an element, the quantum numbers for any electron in an atom and a representative diagram of orbitals with correct electron filling.
22. Predict whether an atom is paramagnetic or diamagnetic. Provide the number of unpaired electrons and predict the expected oxidation states. Identify an element given the four quantum numbers of the last electron or the $nl^x$ notation of the element.
23. Explain what is meant by electronegativity, electron affinity and ionization potential.

24. Organize a set of elements in order of increasing atomic radius, ionic radius, first ionization energy and electronegativity.
25. Use the element's position in the periodic table to determine its: metal/nonmetal properties; acid/base properties; insulator/conductor/semiconductor properties. Understand the role electronic configuration plays in band gap theory and how manipulating elemental composition alters the energy gap
26. Determine whether a bond is metallic, ionic, covalent or polar covalent.
27. Represent ionic bonding using Lewis dots.
28. Provide Lewis dot diagrams, the molecular geometry, hybridization and polarity of a covalent molecule.
29. Determine the bonding types in a molecule as well as the types of orbital used to make the particular bond.
30. Explain and understand the concept of pressure. How to convert from height readings in one liquid to mercury heights and vice versa. Convert temperatures in C to K.
31. Successfully solve for a variable using the ideal gas law equation, PV = nRT, and derive relationships between variables in that equation such as $P_1V_1 = P_2V_2$ as well as relationships with density and molecular weight.
32. Understand and perform calculations using Dalton's Law of Partial Pressures.
33. Understand the fundamentals of the Kinetic Molecular Theory of Gases including root mean square velocity and Graham's Law of Effusion and Diffusion.
34. Explain the gas laws at the molecular level including the role of temperature, collision rate, force of collisions, number of particles plays on determining the pressure of a gas.
35. Identify and explain the nature of each of the intermolecular forces and apply how the intermolecular forces affect physical properties.
36. Organize a set of molecules/atoms in order of increasing intermolecular force.
37. Define basic properties of viscosity, surface tension, capillary action, boiling and vapor pressure and understand how intermolecular forces affect these physical properties.
38. Recognize examples of materials that manipulate intermolecular forces in the real world. (adhesives, coatings, nanotechnology, DNA, etc.).
39. Explain specific heat and perform calculations using the heat equation for temperature changes.
40. Perform calculations of heat transfer with and without phase changes and with both combined.
41. Use Hess' Law to obtain the heat of reaction and use heats of formation to obtain heats of reaction.
42. Identify what are exothermic and endothermic reactions and how chemicals can store energy.
43. Recall nomenclature for alkanes, alkenes and alkynes, and recognize a few of the organic functional groups and their importance.

**Course Topics:**
Moles/empirical/molecular, naming/solubility/net ionic equation, stoichiometry, reduction oxidation reactions, molarity, atomic structure, electronic configuration periodic properties, bonding, forces, gases, heat transfer, heats of reaction organic, examples of applications of chemistry to biology, medicine and engineering fields.

**Class/laboratory schedule**: Lecture: (3) sessions each week. Each lecture session is 50 minutes. Lab: (1) session each week. Each lab session is 3 hours. Seminar: (1) session each week. Each seminar is 50 minutes

**Contribution of course to meeting the requirement of Criterion 5:**

| | |
|---|---|
| 1. College level mathematics and science | 5 units |
| 2. Engineering discipline | 0 unit |
| 3. General Education | 0 unit |
| 4. Others | 0 unit |

**Prepared by:** Resa Kelly **Date:** June 17, 2011

***Engr 10 – Introduction to Engineering***

**Required Course:** Yes

**Description:** E10 is designed to allow students to explore engineering through hands-on design projects, case studies, and problem-solving using computers. Students will learn about the various aspects of the engineering profession and acquire both technical skills and non-technical skills, in areas such as communication, team work, and engineering ethics. In addition, the course supports students in their efforts to succeed in engineering through personal and professional development.

**Prerequisites:** High School Geometry, Trigonometry, and Algebra.

## Required Text:

No textbooks are required for this course. All lecture notes, assignments, and special instructions are contained in the E10 course web site: www.engr.sjsu.edu/E10 and in the course management system Desire2Learn.

## Student Learning Objectives for the course:

At the end of this course students will be able to:

1. Summarize the steps of the engineering design process
2. Apply teamwork skills and resolve team conflict
3. Write a simple engineering report and present the report orally
4. Use tools such as spreadsheets, C++ programming, and CAD software design and analysis
5. Use ethical reasoning to address to evaluate ethical dilemmas
6. Explain principles of sustainability and how they affect engineering
7. Recognize the value of participation in professional activities

## Course Topics:

- In addition to topics pertinent to the labs, lectures will cover various aspects of the engineering profession, engineering tools and non-technical skills, such as communication skills, team skills, global and environmental issues, and engineering ethics.
- Each student must bring his/her assigned clicker to each and every "Lecture" meeting.
- Lecture homework will be assigned by the individual instructor, and it will be collected at the lecture hall. Late homework will not be accepted without the instructor's approval.
- There will be a course Final Examination at the end of the semester at the date and time specified by the University's Schedule. There will be no "Make Up Finals" unless there is a "verifiable emergency" or the student has more than two exams in a 24 hour period.

**Class/laboratory schedule**:

## Contribution of course to meeting the requirement of Criterion 5:

1. College level mathematics and science 0 unit
2. Engineering discipline 3 units
3. General Education 0 unit
4. Others 0 unit

**Prepared by:** **Date:** June 6, 2011

***Engr 100W – Engineering Reports on the Earth and Environment***

**Required Course:** Yes
**Course Coordinator:** Dr. Jeanne Lindsdell

**Description:** Engr 100W is required of all engineering students, in all engineering majors. This is an SJSU Studies course that satisfies Area Z, Written Communication II, and Area R, the Earth and Environment. SJSU Studies (formerly Advanced GE) This course helps students become integrated thinkers who can see connections between and among a variety of concepts and ideas. An educated person will be able to apply concepts and foundations learned in one area to other areas as part of a lifelong learning process. These courses will help students to live and work intelligently, responsibly, and cooperatively in a multicultural society and to develop abilities to address complex issues and problem using disciplined and analytical skills and creative techniques.

**Prerequisites:** Undergraduates must have successfully completed English 1A, 1B (earned at least a C grade), and the WST Exam or 96S before enrolling in 100W.

**Required Text:** Markel, Michael (2008, 2010). *Technical Communication* ($8^{th}$ or $9^{th}$ ed.). Beford/St.Martin's. ($9^{th}$ ed. available on iBooks for $45)

Wright, R. T. & Nebel, B. J. (2008). *Environmental Science: Toward A Sustainable Future*, (10th ed.). Prentice Hall.

**Student Learning Objectives for the course:**
By the end of the course, students should be able to:

COURSE OBJECTIVES: Written Communication II: Area Z
ENGR100W has been designed to meet the University Written Communication II (Area Z) requirements. Each assignment meets some aspect of these learning objectives. These requirements are as follows:
Learning Objective 1 (Area Z, LO 1): Students shall be able to refine the competencies established in Written Communication IA and IB as summarized below:
*IA Student Learning:*

- *Students should be able to perform effectively the essential steps in the writing process (prewriting, organizing, composing, revising, and editing).*
- *Students should be able to express (explain, analyze, develop, and criticize) ideas effectively.*
- *Students should be able to use correct grammar (syntax, mechanics, and citation of sources) at a college level of sophistication.*
- *Students should be able to write for different audiences (both specialized and general)*

*IB Student Learning:*

- *Students should be able to use (locate, analyze, and evaluate) supporting materials, including independent library research.*

- *Students should be able to synthesize ideas encountered in multiple readings.*
- *Students should be able to construct effective arguments.*

Learning Objective 2 (Area Z, LO 2): Students shall be able to express (explain, analyze, develop, and criticize) ideas effectively, including ideas encountered in multiple readings and expressed in different forms of discourse.
Learning Objective 3 (Area Z, LO 3): Students shall be able to organize and develop essays and documents for both professional and general audiences, including appropriate editorial standards for citing primary and secondary sources.
COURSE OBJECTIVES: Earth and Environment: Area R
ENGR100W has also been designed to meet the Earth and Environment (Area R) requirements. These requirements are as follows:
Learning Objective 1 (Area R, LO 1): Students should be able to demonstrate an understanding of the methods and limits of scientific investigation.
Learning Objective 2 (Area R, LO 2): Students should be able to distinguish science from pseudo-science.
Learning Objective 3 (Area R, LO 3): Students should be able to apply a scientific approach to answer questions about the earth and environment.

**Course Topics:**
Sample Course Topics:

| | |
|---|---|
| AREA Z (LO1, LO2, LO3) | AREA R (LO1, LO2, LO3) |
| Writing Topics Include: | Environmental Topics Include: |
| Technical Resumes & Letters of App. | Energy and Renewable Energies |
| Communication in the Global Arena | Sustainability |
| Business Emails | Green Buildings (LEED Certification) |
| Technical Description | Environmental Impact Reports |
| Compare and Contrast | Water Issues |
| Memos | Food Production and Distribution |
| Good/Bad News Letters | Soil Conservation and Agricultural Issues |
| Lab Report | Marine Protection |
| Technical Proposal | Hazardous Chemicals |
| Executive Summary | Landfill Dumping Sites |
| Progress Report | Pollution |
| Incident Report Storm | Water Control |
| Feasibility Report | Environmental Law |
| Trip/Conference Report | Underground Storage Tanks |
| Activity Report | Ecology |
| Task Report | Pesticides |
| Process Explanation | Fuel Cells |
| Request for ... | Waste Minimization |
| Technical Instructions | Manufacturing Processes |
| Interviewing Techniques | Occupational Health & Safety |
| Oral Presentations | Public Policy |
| Communicating in Teams | E-waste |
| Developing Visual Aids | Recycling |
| Promotional Pieces | Natural Disasters (earthquakes, tsunamis) |

PowerPoint Skills
Social Responsibility/Ethics

Research Methodology Topics:
Methods and limits of scientific research
Science and critical thinking
Science vs. pseudoscience
Library resources
Internet resources
Professional journals
Gantt Charts
Documentation

**Class/laboratory schedule**: Two 50-min lecture and one 3 hour lab per week

**Contribution of course to meeting the requirement of Criterion 5:**

| | | |
|---|---|---|
| 1. | College level mathematics and science | 0 unit |
| 2. | Engineering discipline | 3 units |
| 3. | General Education | 0 unit |
| 4. | Others | 0 unit |

**Prepared by:** Jeanine Linsdell **Date:** June 6, 2011

***EE-98 – Introduction to Circuit Analysis***

**Required Course:** Yes
**Course Coordinator:** M. Javad Zoroofchi

**Description:** Circuit laws and nomenclature, resistive circuits with DC sources, ideal operational amplifier, controlled sources, natural and complete response of simple RLC circuits, steady-state sinusoidal analysis and power calculations.

**Prerequisites:** Phys 51 or 71, Math 133A or Math 123 can be taken concurrently.

**Required Text:**
"Fundamentals of Electric Circuits", $4^{th}$ ed., by Alexander and Sadiku, McGraw Hill.

**Student Learning Objectives for the course:**
At the end of this course students will be able to:

1. Determine voltages and currents of a DC circuit consisting of resistors, current sources, voltage sources, and dependent sources.
2. Determine Thevenin and Norton equivalent circuit of a DC circuit and find the maximum power output of a DC circuit.
3. Determine the DC gain and operating point of an OP amp circuit.
4. Determine the transient response of a first and second order circuit consisting of RLC.
5. Determine the sinusoidal steady state response of a circuit consisting of RLC.
6. Determine the power delivered and absorbed by an element in a RLC circuit

**Course Topics:**
• Ohm's law and Kirchhoff's laws
• Series and parallel circuits
• Superpostion
• Thevenin and Norton Equivalent
• Maximum power transfer
• Nodal and mesh analysis
• Active and op amp circuits
• Capacitors and inductors
• Transient analysis
• Steady state analysis
• AC power

**Class/laboratory schedule**: MW 10:30-11:45 (Sec. 2) TR 9:00-10:15 (Sec. 1)

**Contribution of course to meeting the requirement of Criterion 5:**

| | | |
|---|---|---|
| 1. | College level mathematics and science | 0 unit |
| 2. | Engineering discipline | 3 units |
| 3. | General Education | 0 unit |
| 4. | Others | 0 unit |

The following table shows the level of this course's contribution to the achievement of EE program outcomes and meeting the ABET program requirements. Bloom's Taxonomy is used in the definition of learning level: 0-Not Applicable, 1-knowledge, 2-Comprehension, 3-Application, 4-Analysis, 5-Synthesis,
6-Evaluation.

| EE Program Outcomes (a~l) and ABET Program Requirements (1~3) | Outcome | Level |
|---|---|---|
| (a) An ability to apply knowledge of mathematics, science, and engineering | 1~6 | 3 |
| (b) An ability to design and conduct experiments, as well as to analyze and interpret data | | 0 |
| (c) An ability to design a system, component, or process to meet desired needs | | 0 |
| (d) An ability to function on multi-disciplinary teams | | 0 |
| (e) An ability to identify, formulate, and solve engineering problems | 1~6 | 3 |
| (f) An understanding of professional and ethical responsibility | | 0 |
| (g) An ability to communicate effectively | | 0 |
| (h) The broad education necessary to understand the impact of engineering solutions in a global and societal context | | 0 |
| (i) A recognition of the need for, and an ability to engage in life-long learning | | 0 |
| (j) A knowledge of contemporary issues | | 0 |
| (k) An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice | 1~6 | 3 |
| (l) Specialization in one or more technical specialties that meet the needs of companies | 1~6 | 2 |
| 1. Knowledge of probability and statistics, including applications to electrical engineering | | 0 |
| 2. Knowledge of advanced mathematics, including differential and integral equations, linear algebra, complex variables, and discrete mathematics | 1~6 | 3 |
| 3. Basic sciences, computer science, and engineering sciences necessary to analyze and design complex electrical and electronic devices, software, and systems containing hardware and software components | 1~6 | 3 |

**Prepared by:** M. Javad Zoroofchi **Date:** June 6, 2011

***CE 99 – Statics***

**Required Course:** Yes
**Course Coordinator:** Wendell Kawahara

**Description:** The primary goal of CE99 is for students to master the application of equilibrium equations to statically determinate systems. The engineering student is expected to build upon previously acquired skills in statics, mathematics, and physics to solve practical problems of mechanics

**Prerequisites:**
1. A transcript (unofficial) showing that the student has the prerequisites and co - requisites for the course with the required grade.
2. A copy of the assist.org document showing the equivalency for any prerequisite or co - requisite if the course was taken at another university or a community college.
3. A signed equivalency forms if the prerequisite or co - requisite was taken at a college for which an assist.org document is not available.
4. A copy of the student's official schedule for the current semester indicating enrollment in a co - requisite course if the student is concurrently enrolled in a co - requisite.
5. For courses that require junior and/or senior standing, the instructor will check the class roster to verify the required standing.
Students who do not meet the prerequisites or co-requisites will be dropped from the course. Students who are enrolled in the class at the beginning of the semester and fail to produce the appropriate documents by the beginning of the third class meeting will be dropped from the course.
Students who were not enrolled in the class at the beginning of the semester will produce the required document(s) by the beginning of the third class meeting after enrolling in the course. Such students, who fail to produce the appropriate document(s) by the beginning of the third class meeting after enrolling in the course, will be dropped from the course.

**Required Text:**
R.C.Hibbeler, Engineering Mechanics: STATICS, 11$^{th}$ed.
Used copies are available on-line.
Do the text reading assign's—lectures can't cover all the required material.
Do NOT use the version of the text that is exclusively in SI-units.
If these are helpful to you, use them: http://web.mst.edu/~oci/
http://uawc1.wayne.uakron.edu/online/online.html
http://paws.kettering.edu/~jhargrov/statics/statics.htm

**Student Learning Objectives:**
(note: these meet the "Program ABET Outcomes A and E2")
Through completion of this course, students will be able to:
1. Perform Vector operations used in analysis of solids in equilibrium & motion.
2. Calculate Equivalent Force Systems
3. Construct Free-Body Diagrams and appropriate forces, incl. static friction
4. Insightfully apply equations of equilibrium to determine unknown quantities
5. Analyze Internal Forces in simple structures (trusses, frames, beams)

6. *Calculate Centroid, Center of Gravity; Moments of Inertia*

**Course Topics:**

- The course is a combination of lecture and self-learning; the course text is a great resource, lectures alone cannot be as thorough. Questions in class are encouraged. Important: Check your email at least weekly for updates, notices, corrections, etc. Statics is KEY to understanding behavior of structural members in frames, buildings, machinery, bridges, etc. All engineering design of structural members is based on the principles of mechanics of materials.

**Class/laboratory schedule**:

**Contribution of course to meeting the requirements of Criterion 5:**

| | | |
|---|---|---|
| 1. | College level mathematics and science | 0 unit |
| 2. | Engineering discipline | 2 units |
| 3. | General Education | 0 unit |
| 4. | Others | 0 unit |

**Prepared by:** **Date:** June 6, 2011

***CE 112 – Mechanics of Materials***

**Required Course:** Yes
**Course Coordinator:** Wendell Kawahara

**Description:** The primary goal of CE112 is to familiarize students with the behavior (stress, strain, deformation, buckling) of structural members and materials when subjected to a variety of loadings (bending, axial, torsion and shear). The engineering student is expected to build upon previously acquired skills in statics, mathematics, and physics to solve practical problems of mechanics.

**Prerequisites:** A transcript (unofficial) showing that the student has the prerequisites and co - requisites for the course with the required grade .
2. A copy of the assist.org document showing the equivalency for any prerequisite or co - requisite if the course was taken at another university or a community college.
3. A signed equivalency forms if the prerequisite or co - requisite was taken at a college for which an assist.org document is not available.
4. A copy of the student's official schedule for the current semester indicating enrollment in a co - requisite course if the student is concurrently enrolled in a co - requisite.
5. For courses that require junior and/or senior standing, the instructor will check the class roster to verify the required standing.

Students who do not meet the prerequisites or co-requisites will be dropped from the course. Students who are enrolled in the class at the beginning of the semester and fail to produce the appropriate documents by the beginning of the third class meeting will be dropped from the course.
Students who were not enrolled in the class at the beginning of the semester will produce the required document(s) by the beginning of the third class meeting after enrolling in the course. Such students, who fail to produce the appropriate document(s) by the beginning of the third class meeting after enrolling in the course, will be dropped from the course.

**Required Text**: *Mechanics of Materials*, R.C. Hibbeler, 8$^{th}$ ed, Prentice-Hall 2011 (not any exclusively SI-version)

Supplementary references (not required):

- Good visual supplement: http://web.mst.edu/~mecmovie/index.html
- On-line text by M.Vable: http://www.me.mtu.edu/~mavable/MoM2nd.htm
- http://uawc1.wayne.uakron.edu/online/online.html
- Demos: http://www.handsonmechanics.com/hom/demos/list.do?areaID=3
- Other "Mechanics of Materials" texts from which I use material: Beer-Johnson-DeWolf; Riley, Ugural; Philpot; Spiegel; Bedford; Logan.

**Student Learning Objectives for the course:**
(note: these meet the "Program ABET Outcomes A and E2")

Through completion of this course, students will be able to:

1. Calculate internal forces (axial, shear, bending and torsion) and develop force diagrams
2. Evaluate stress and strain using individual and combined loads
3. Demonstrate the ability to transform stresses to arbitrary axes

4. Explain the concept of beam and shaft design
5. Calculate beam deflections
6. Explain the concept of buckling, critical load and stress calculation

**Course Topics:**

Mechanics of Materials is KEY to

- Understanding behavior of structural members in frames,
- Buildings,
- Machinery,
- Bridges, etc.
- All engineering design of structural members is based on the principles of mechanics of materials. It is a prerequisite to many CE and ME courses.

**Class/laboratory schedule**:

**Contribution of course to meeting the requirement of Criterion 5:**

| | | |
|---|---|---|
| 1. | College level mathematics and science | 0 unit |
| 2. | Engineering discipline | 3 units |
| 3. | General Education | 0 unit |
| 4. | Others | 0 unit |

**Prepared by:** Wendell Kawahara **Date:** June 8, 2011

***MatE 25 – Introduction to Materials***

**Required Course:** Yes
**Course Coordinator:** Masao Drexel

**Description:** This course is designed to give you a broad foundation in materials engineering while highlighting the importance of materials in modern technologies.

**Prerequisites:** Chem. 11A (Chemistry 1), Phys. 50 or 70 (Mechanics), and Math 31 (Calculus 2) or equivalent

**Required Text:**
Materials Science and Engineering, An Introduction, 7th ed., W.D. Callister Jr., John Wiley and Sons, Inc., 2007

Materials Engineering 25 Laboratory Handbook: Available for $10 CASH ONLY in lab.

**Student Learning Objectives for the course:**
At the end of this course students will be able to:

1. Recognize the role material have played in shaping the history of the world including present day technologies
2. Identify how materials properties impact performance and reliability in specific engineering technologies
3. Identify how materials properties impact performance and reliability in specific engineering technologies

**Course Topics:**
- Memory Mental Stents: Biomaterials is fast growing field in materials science. In this module, we discuss how the crystal structure and mechanical properties of metals lead to the key properties needed to make coronary stents out of memory metal. In a group project, you will research the materials structure and processing of a biomaterial device of your choice.
- Nanomaterials in Solid Oxide Fuel Cells: Fuel cells will play a critical role as our society transitions away from a dependence on oil. We will be a key component for the success of these devices
- Sports Materials: The high tech world has even touched upon our recreation with materials engineering leading to many innovations in sporting equipment. In this module, we will be learning about the polymers and composites used in making skis. In a group project, you will research the materials and processing used in a sporting good of your choice.
- Non-volatile Memory for Portable Electronics: Portable electronics are spreading to every aspect of our lives. Advancements in non-volatile memory are needed to guarantee lightweight and cheap electronic device. In this class we will discuss the fundamentals of FLASH memory, the standard non-volatile memory media in portable electronics.

**Class/laboratory schedule**: MTWR according to lab instructor

**Contribution of course to meeting the requirement of Criterion 5:**

| | | |
|---|---|---|
| 1. | College level mathematics and science | 0 unit |
| 2. | Engineering discipline | 3 units |
| 3. | General Education | 0 unit |
| 4. | Others | 0 unit |

**Prepared by:** Masao Drexel **Date:** June 8, 2011

***ME 20 – Design and Graphics***

**Required Course:** Yes
**Course Coordinator:** Prof. Ken Youssefi

**Description:** Introduction to graphical communication tools used by engineers. Design and graphical solutions to three-dimensional design problems involving points, lines and surfaces. Development of visualization and technical sketching skills in conjunction with orthographic and pictorial projections. Tolerance analysis for fabrication. Individual design project. Focus on computer-aided design and graphical analytical methods.

**Prerequisites:** Engr 10

**Required Text:** Bertoline and Wiebe "Fundamentals of Graphics Communication", 6th ed., 2011, McGraw-Hill AutoCAD tutorial (2008), Pro/E Wildfire 5.0 tutorial

**Student Learning Objectives for the course:**
By the end of the course, students should be able to:

- Freehand sketch a 3D view of an object (isometric, oblique and perspective).
- Draw the standard two dimensional views (top, front and profile) of an object.
- Draw section and auxiliary views
- Properly dimension standard views for fabrication.
- Apply the proper tolerances to parts.
- Draw complicated two dimensional views of an object using AutoCAD.
- Draw three dimensional objects using Pro/Engineering (solid modeling).
- Understand the engineering design process and the implementation of different design phases.

**Course Topics:**

* To help students visualize three dimensional objects.
* To introduce students to technical freehand sketching (pictorials).
* To introduced students to the principal of orthographic projections.
* To introduce students to technical drawings; shop, assembly, and exploded.
* To introduce students to proper dimensioning and tolerancing.
* To introduce students to computer-aided design tools, 2D and 3D (parametric modeling).
* To introduce the students to engineering design process through a design project and lab. work.

**Class/laboratory schedule**: 1 hour lecture and 3-hour lab per week

**Contribution of course to meeting the requirements of Criterion 5:**

1. College level mathematics and science — 0 unit
2. Engineering discipline — 2 units
3. General Education — 0 unit
4. Others — 0 unit

**Relationship of course to Student Outcomes:**

| 3A | 3B | 3C | 3D | 3E | 3F | 3G | 3H | 3I |
|---|---|---|---|---|---|---|---|---|
| √ | | √ | | | | | | |

√ : Skills relevant

**Prepared by:** Ken Youssefi **Date:** March 25, 2011

***ME 30 – Computer Applications***

**Required Course:** Yes
**Course Coordinator:** Dr. B. Furman

**Description:** Using a computer to solve engineering problems through programming and the use of engineering application procedures. Use of procedural and informational problem solving methods and practices applied to software design, application, programming and testing. Lecture 1 hour/lab 3 hours. 2 units.

**Prerequisites:** None

**Required Text:** Tan, H. H. & D'Orazio, T. B. (1999) *C Programming for Engineering and Computer Science*, McGraw-Hill, New York. ISBN 0-07-913678-8

**Student Learning Objectives for the course:**

By the end of the course each student should be able to:

**1. General**

1.1 Locate course materials using course management and web resources
1.2 Explain what the course is about what will be covered
1.3 Describe where and how computers are used by mechanical and aerospace engineers (MAEs)
1.4 List some of the software commonly used by MAEs
1.5 Describe what the major elements of a computer are and what they do conceptually
1.6 Explain the focus of the course

**2. Problem Solving**

2.1 Describe and apply a general method for solving an engineering problem that leads to a computational solution
2.2 Analyze a problem and devise an effective algorithm that can be implemented by a computer by applying specific techniques such as problem decomposition, defining diagrams, data dictionaries, pseudocode, desk checking, etc.

**3. Programming Methodology**

3.1 Apply the basic concepts of sequence, selection, and repetition in the development of a computational solution to a specific problem
3.2 Write programs that are sufficiently documented so that colleagues can understand their operation

**4. Application of Software Tools**

4.1 Select and explain your choice of appropriate engineering software among potential candidates to use to solve a specific engineering problem
4.2 Apply correct syntax, grammar, and design patterns to create a functional software program that solves a given problem
4.3 Construct visual graphics using various software tools to effectively analyze and present data

4.4 Write program code to interact with the physical world outside the computer

**Course Topics:**

The overall goals for the course are to:

- Understand how mechanical and aerospace engineers can and do use computers to solve engineering problems
- Learn how to solve engineering problems using computational methods
- Get experience in developing algorithms for effectively solving problems using computers
- Gain familiarity with several software tools that are widely used by mechanical engineers to solve analytical and numerical problems
- Prepare for subsequent courses which involve computation to solve engineering problems

**Class/laboratory schedule**: 1 hour lecture and 3 hours lab per week

**Contribution of course to meeting the requirement of Criterion 5:**

1. College level mathematics and science 0 unit
2. Engineering discipline 2 units
3. General Education 0 unit
4. Others 0 unit

**Relationship of course to Student Outcomes:**

| 3A | 3B | 3C | 3D | 3E | 3F | 3G | 3H | 3I |
|---|---|---|---|---|---|---|---|---|
| √ | | | | | | | | √ |

√ : Skills relevant

**Prepared by:** Dr. B. Furman **Date:** February 4, 2011

***ME 101 – Dynamics***

**Required Course:** Yes
**Course Coordinator:** Dr. John Lee

**Description:** Vector mechanics. Two and three dimensional motion of particles and rigid bodies. Force, energy and momentum principles.

**Prerequisites:** CE 99, Math 32.

**Required Text:** R. C. Hibbeler, Engineering Mechanics Dynamics, 12$^{th}$ ed., New Jersey: Pearson-Prentice Hall, 2007, ISBN 9780136077916.

**Student Learning Objectives for the course:**
Upon successful completion of this course, the student should be able to:
1. Apply vector calculus to perform engineering analysis of physical scenarios involving the motion of particles and rigid bodies.
2. Model a physical system involving the motion of particles and rigid bodies, and reasonably justify engineering assumptions.
3. Solve problems involving the dynamics of particles and rigid-bodies using Newton's Second Law.
4. Solve problems involving the dynamics of particles and rigid-bodies using principles of energy and momentum.

**Course Topics:**
1. Particle Kinematics
2. Particle Force and Acceleration
3. Particle Work and Energy
4. Particle Impulse and Momentum
5. Rigid Body Kinematics
6. Rigid Body Force and Acceleration
7. Rigid Body Work and Energy
8. Rigid Body Impulse and Momentum

**Class schedule**: Two 75-minute lectures per week

**Contribution of course to meeting the requirement of Criteria 5:**

5. College level mathematics and science 0 unit
6. Engineering discipline 3 units
7. General Education 0 unit
8. Other 0 unit

**Relationship of course to Student Outcomes:**

| 3A | 3B | 3C | 3D | 3E | 3F | 3G | 3H | 3I |
|---|---|---|---|---|---|---|---|---|
| √ | | | | | | | | |

√: Skills relevant

**Prepared by:** John Lee **Date:** June 13, 2011

*ME 113 – Thermodynamics*

**Required Course:** Yes
**Course Coordinator:** Dr. Nicole Okamoto

**Description:** This class covers properties of simple compressible substances, ideal gas and other equations of state, and the first and second laws of thermodynamics. Power cycles, refrigeration cycles, gas mixtures, and gas-vapor mixtures are also included.

**Prerequisites:** Phys 52 or 70 and Math 32

**Required Text:** Thermodynamics: An Engineering Approach, by Cengel and Boles, 7th ed., McGraw-Hill, 2011. 6th, 5th and 4th editions are also OK.

**Student Learning Objectives for the course:**
Upon completion of this course, student should be able to

1) Discuss the causes of ozone depletion and global warming and the uncertainty involved in making long-term environmental predictions.
2) Discuss basic thermodynamic terms, such as enthalpy, entropy, specific and relative humidity, dew point, and adiabatic saturation and wet-bulb temperatures, in simple enough terms that someone outside the field of thermodynamics could understand what they are.
3) Understand how energy transfer processes (heat and work) affect the thermodynamic state of pure substances. This involves the ability to
    a) Use tabulated data, equations of state, and the computer program EES to determine the phase and properties (temperature, pressure, specific volume, internal energy, enthalpy and entropy) of a pure substance.
    b) Analyze the thermodynamic performance (i.e., calculate work or heat input or output, mass flow rates, and first and second law efficiencies) of common steady-flow engineering devices such as pumps, compressors, turbines, nozzles and diffusers, expansion valves, heat exchangers, and mixing chambers using the first and second laws of thermodynamics and the conservation of mass.
    c) Apply the first law of thermodynamics to simple unsteady-flow problems.
    d) Explain physical aspects of the first and second law of thermodynamics, and apply them in solving real engineering problems
4) Understand the operation of basic energy conversion devices and be able to analyze their performance, including calculation of work, heat input or output, mass flow rates, and first law efficiencies. This involves the ability to
    a) Analyze the performance of a simple Otto cycle and Diesel cycles
    b) Analyze the performance of a simple Brayton cycle and one with regeneration.
    c) Analyze the performance of a simple Rankine cycle and one with reheating and regeneration.
    d) Analyze the performance of a simple vapor compression cycle.
    e) Use EES to model and optimize thermodynamic cycles.
5) Understand engineering systems involving non-reacting mixtures and be able to analyze their thermodynamic performance. This involves the ability to

a) Calculate properties of ideal and real gas mixtures.
b) Explain why condensation forms using technical terms.
c) Analyze different air-conditioning and cooling processes involving air-water vapor mixtures.

**Course Topics:**

1. Thermodynamics properties, property diagrams, property tables, specific heat.
2. Forms of energy, steady-state first law of thermodynamics for closed and open systems
3. Equations of state.
4. Boundary work, conservation of mass, flow work
5. Application of steady-state first law of thermodynamics to devices such as piston-cylinders, turbines, heat exchangers, nozzles, throttling valves, etc.
6. Application of first law to uniform-state, uniform-flow (unsteady) processes.
7. Use of simulation software to model and optimize a system.
8. Second law of thermodynamics, entropy, T-dS relations, reversible work, entropy balance.
9. Isentropic processes, isentropic efficiency.
10. Gas power cycles
11. Vapor power and refrigeration cycles
12. Ozone depletion, Greenhouse effect.
13. Properties of gas mixtures, mixture behavior.
14. Properties of air-water mixtures, air conditioning processes.

**Class/laboratory schedule**: Two 1 hour and 40 minute lectures per week

**Contribution of course to meeting the requirement of Criterion 5:**

1. College level mathematics and science — 0 unit
2. Engineering discipline — 4 units
3. General Education — 0 unit
4. Others — 0 unit

**Relationship of course to Student Outcomes:**

| 3A | 3B | 3C | 3D | 3E | 3F | 3G | 3H | 3I |
|---|---|---|---|---|---|---|---|---|
| √ | | | | √ | | √ | √ | √ |

√: Skills relevant

**Prepared by:** Nicole Okamoto **Date:** September 14, 2010

*ME 120 – Experimental Methods*

**Required Course:** Yes
**Course Coordinator:** Dr. Buff Furman

**Description:** Theory and practice of experimental methods and sensors for mechanical measurements; statistical and uncertainty analysis; computer-hosted data acquisition, processing and analysis; formal report writing and presentations.

**Prerequisites:** CE 112, Engr 100W, AE160 or ME 111, AE162 or ME 130

**Required Text:** Experimental Methods for Engineers, custom edition by Pearson Custom Publishing, Boston, MA, 2004 (ISBN 0-536-90018-3). Available at Robert's Bookstore http://www.robertsbookstore.com/, 330 S. 10th Street, San Jose, CA 95112.

**Student Learning Objectives:**
By the end of the course, students should be able to:

1. Draw a concept map for a generalized measurement system that identifies the most important concepts.
2. Apply basic statistical methods to design experiments, to analyze, and to present the results of experiments. Such methods may include identification of probability distributions of experimental data, estimation of population statistics from large and small samples, classification and propagation of error sources for experiment design and analysis of results, and graphical presentation of statistical descriptions.
3. Identify and describe the elements making up computer-based data acquisition systems, including alternative configurations and technologies.
4. Design a data acquisition system for a given application by analyzing and specifying requirements, selecting appropriate commercial hardware, and writing a computer program to acquire, analyze, and present the desired data.
5. Identify and describe the various types of mechanical measurements including temperature, pressure, sound, motion and position, force and torque, stress and strain, flow visualization and measurement (e.g., volume flow rate, velocity, etc.) and explain the transduction principles that underlie them.
6. Operate modern instrumentation systems that include mechanical and electro-optical technologies and computer-based data acquisition systems.
7. Communicate effectively in written form and in oral presentations information relating to the design and/or results of an engineering experiment
8. Work productively and effectively in an engineering team

**Course Topics:**
Experimentation and Validity of Measurement Data Acquisition and Sampling
Measuring Displacement and Motion
Measuring Force, Stress, and Strain
Measuring Temperature and Light
Measuring Pressure and Sound
Measuring Fluid Flow
Signal Conditioning

Dynamic Signal Analysis
Statistical Analysis I: Probability Distributions
Statistical Analysis II: Parameter Estimation
Statistical Analysis III: Correlation and Regression
Uncertainty Analysis

**Class/laboratory schedule**: One 50-minute lecture and one 3-hr lab session per week

**Contribution of course to meeting the requirement of Criterion 5:**

1. College level mathematics and science 0 unit
2. Engineering discipline 2 units
3. General Education 0 unit
4. Others 0 unit

**Relationship of the course to Student Outcomes:**

| 3A | 3B | 3C | 3D | 3E | 3F | 3G | 3H | 3I |
|---|---|---|---|---|---|---|---|---|
| √ | √ | | √ | √ | | √ | √ | √ |

√: Skills relevant

**Prepared by:** Dr. Buff Furman **Date:** March 28, 2011

***AE 110 – Space Systems Engineering***

**Required Course:** No
**Course Coordinator:** Dr. Periklis Papadopoulos

**Description:** Introduction to design, analysis and operation of spacecraft power, communications, attitude determination/control, structures, propulsion, thermal management systems. Typical payload systems design and operation, including remote Earth sensors. System integration issues. Lab experiments and field trips.

**Prerequisites:** Grade of C- or better in AE 165

**Required Text:**
*Understanding Space: An introduction to* Astronautics
By: Jerry Joe Sellers, William J. Astore, Robert B. Griffen, Wiley J. Larson

**Other Readings**
*Fundamentals of Space Systems* by Vincent Pisacane and Robert Moore, Oxford Press

**Student Learning Objectives:**
By the end of the course, students should be able to:
1. **I**dentify each element of space system.
2. Identify each subsystem of a spacecraft.
3. Perform a systems-level analysis of spacecraft subsystems including:
    a. Communication, power, thermal, attitude, control, structures, guidance and navigation
4. Formulate a high-level spacecraft design give basic design given basic parameters, involving trade-offs between competing subsystems demands.
5. Study a single spacecraft subsystem in detail within a team of 2-3 students then present findings to the class in a series of class lectures
6. Subdivide a complex system into smaller disciplinary models, manage their interfaces and reintegrate them into an overall system model.
7. Be able to use traditional numerical optimization algorithms.

**Course Topics:**
- Introduction, Course Overview, Mission Analysis and Design
- Space System characterization
    1. Identification of objectives, design variables, constraints, subsystems
    2. System-level coupling and interactions
- Subsystem model development:
    1. Model partitioning , interface control
    2. Subsystem model selection: fidelity versus expense
- Space system design optimization and exploration techniques:
    1. Review of linear and nonlinear programming
    2. Design Space Exploration: Design of Experiments (DOE)
- Design sensitivity analysis, trade-off studies and approximations
- Multi-objective system level optimization, spacecraft design and sizing
- Launch vehicles and space environment

Subsystems presentations:

- Communications, Command and Data Handling
- Power
- Thermal
- Propulsion
- Attitude Dynamics and Control
- Mission Operations, Spacecraft Integration
- Miscellaneous Topics, Summary Review

**Class/laboratory schedule**: Monday and Wednesday 9:00-10:15am

**Contribution of the course to the requirements of Criterion 5:**

1. College level mathematics and science 0 unit
2. Engineering discipline 3 units
3. General Education 0 unit
4. Others 0 unit

**Relationship of the course to Student Outcomes:**

| 3A | 3B | 3C | 3D | 3E | 3F | 3G | 3H | 3I |
|---|---|---|---|---|---|---|---|---|
| | | √ | √ | √ | | | √ | √ |

√: Skills relevant

**Prepared by:** Perklis Papadopoulos **Date:** March 25, 2011

***AE 114 – Aerospace Structures***

**Required Course:** Yes
**Course Coordinator:** J. M. Hunter

**Description:** Aircraft and spacecraft structural analysis and design. Conventional and introductory finite element methods. Bending and shear stress analysis as well as shear flow analysis. Aircraft wing and fuselage design considerations for simplified models and actual structures. Matrix structural analysis of joint displacement and axial bar stress as well as design of spacecraft truss structures.

**Prerequisites:** Grade "C-" or better in CE 112

**Required Text:** Bruhn: Analysis and Design of Aircraft Structures

**Course Goals:**
1. To demonstrate the iterative design/analysis process of aerospace structures.
2. To provide a review of strength of materials.
3. To delineate the trade-offs present in the structural design of aerospace vehicles.
4. To examine actual aircraft design successes and failures via case studies.
5. To show the application of air loads, mass properties and materials in the consideration of aircraft structural design.

**Student Learning Objectives:**
1. Compute area properties of two-dimensional wing and fuselage cross sections: centroid and moments/products of inertia.
2. Find the orientation of the centroidal principal axes and calculate the centroidal principal moments of inertia.
3. Construct the axial force, shear force and bending moment diagrams for aircraft beam structures.
4. Perform a buckling analysis for beam-column-type wing and fuselage structures.
5. Calculate shearing stress and angle of twist along a shaft-type structure in torsion.
6. Determine the shear flow distribution for a (closed) multiple-cell wing section under torsion.
7. For a wing section subjected to multiple bending moments, find the bending stress in the wing stringers.
8. Plot the shear flow distribution and find the location of the shear center for an (open) thin-walled wing cross section under a shear load.
9. Determine the shear flow distribution and shear center location for a (closed) thin-walled section with stringers.
10. Iterate to a successful aircraft stringer-skin-type wing design using actual material properties – beginning with a baseline configuration.
11. Using Finite Element Method, assemble the stiffness matrix for a spacecraft truss structure.
12. Analyze a spacecraft truss structure to determine axial force and joint displacement.
13. Design and carry out experiments to define material or geometric properties of the cantilever beam, torsional beam and Beechcraft tail section.

**Course Topics:**

| | |
|---|---|
| 1 | Class Introduction, Strength of Materials Review |
| 2 | History of Strength of Materials |
| 3 | Two-Dimensional Inertia Properties of Wing Sections |

| | |
|---|---|
| 4 | History of Aircraft Structures; Structural Design Considerations for Contemporary Aircraft |
| 5 | Bending Moments on Beam Columns |
| 6 | Pure Torsion and Pure Bending |
| 7&8 | Aircraft Static Testing: Strain Gauges and Data Acquisition |
| 9 & 10 | Torsion of Circular Cross Sections, Thin-Walled Cross Sections |
| 11 & 12 | Non-Symmetrical Bending Stresses; Shear Center |
| 13 | Structural Design Considerations for Contemporary Aircraft |
| 14 & 15 | Shear Flow and Shear Center in an Open Section |
| 16 | Shear Flow in a Section with Stringers |
| 17 | Analysis of Wing Structures |
| 18 | Components of Fuselage Design |
| 19 & 20 | Fuselage Stress Analysis |
| 21 & 22 | Loads and Stresses on Ribs and Frames |
| 23 | Analysis of a Whole Wing |
| 24 | History of Spacecraft Structures |
| 25 | Introduction to Finite Element Analysis |
| 26 | Booms and Truss Structures |
| 27 | Axial Force and Joint Displacement |
| 28 | Final Exam Review |

**Contribution of course to the requirements of Criterion 5:**

1. College level mathematics and science — 0 unit
2. Engineering discipline — 3 units
3. General Education — 0 unit
4. Others — 0 unit

**Relationship of the course to Student Outcomes:**

| 3A | 3B | 3C | 3D | 3E | 3F | 3G | 3H | 3I |
|---|---|---|---|---|---|---|---|---|
| √ | √ | | | √ | | | √ | √ |

√: Skills relevant

**Prepared by:** M. J. Hunter **Date:** February 4, 2011

***AE 135 – Introduction to Composite Materials***

**Required Course**: Yes
**Course Coordinator:** Dr. W. Richard Chung

**Description:** Introduction to theory, application, and design with composite materials, including high performance resin-matrix fibrous composites and metal-matrix materials. Topics include materials, test techniques, environmental effects, design considerations, and application requirements. (Lecture 3 hours, 3.0 units)

**Prerequisites:** MatE 25, or instructor consent

**Required Text:** Agarwal, Bhagwan D., Broutman, Lawrence J., Chandrashekhra, K. Analysis and Performance of Fiber Composites, 3rd edition, 2006, John Wiley and Sons, Inc. TA418.9C6A34, ISBN: 0-471-26891-7

**Student Learning Objectives:**

By the end of the course, students should be able to:

1. Recognize some of the basic differences in mechanical, physical, and thermal properties of composite materials that distinguish them from other materials
2. Define composite materials and explain the fundamental construction of composite materials
3. Apply the basic principles of elastic and plastic behacior of composite materials to industrial applications
4. Calculate materials properties depending on the structure configuration and reinforcement orientation
5. Describe the concept of deformation mechanisms with respect to continuous and short-fiber reinforcements and their application to product design, manufacturing method, and service reliability
6. Identify the principal uses for each major types of reinforcement and describe their advantages and limitations
7. Discuss the roles played by the fiber and matrix in composite and recognize the interface problem in bonding
8. Identify environmental factors that affect material performance in a service condition
9. Compare the different types of reinforcement forms and evaluate their relative merits
10. Provide sources of information for supplies and materials used in the composite industry
11. Identify the major manufacturing methods for composites and discuss the areas where the improvements in composite and/or manufacturing can be enhanced
12. Discuss special design considerations for processing composite materials
13. List and Explain the most common causes of damage for composite structures
14. Describe the principal methods for damage detection and damage prevention

**Course Topics:**

1. Introduction to composite materials
2. Fibers of composites
3. Matrices of composites
4. Fabrication of composites
5. Behavior of unidirectional composites
6. Stress and Strains in short-fiber composites
7. Analysis of orthotropic lamina
8. Analysis of laminated composites
9. Advanced topics in fiber composites
10. Fatigue, impact and failure modes of composites
11. Characterization of composites (physical properties)
12. Characterization of composites (mechanical properties)
13. Emerging composite materials

**Contribution of the course to the requirements of Criterion 5:**

| | | |
|---|---|---|
| 1. | College level mathematics and science | 0 unit |
| 2. | Engineering discipline | 3 units |
| 3. | General Education | 0 unit |
| 4. | Others | 0 unit |

**Prepared by:** Richard Chung **Date:** March 25, 2011

***AE 140 – Rigid Body Dynamics***

**Required Course:** Yes
**Course Coordinator:** Prof. J. M. Hunter

**Description:** Co-ordinate frames and descriptions of absolute and relative motion. Particle motion with respect to the rotating Earth. General equations of rotational motion in Euler and Lagrangian formulations. Spinning body motions. Gyroscopic instruments. Stable platform for inertial guidance. Applications to aerospace vehicles.

**Prerequisites:** Grade "C" or better in ME 101 (if entering SJSU prior to Fall 2006)
Grade "C-" or better in ME 101 (if entering SJSU in Fall 2006 or after)

**Required Text:**
Hunter: Rigid Body Dynamics Class Notes (Maple Press)
Thomson: Introduction to Space Dynamics

**Student Learning Objectives:**

By the end of the course each student should be able to:

1. Develop a direction-cosine matrix and use it to transform vectors among reference frames.
2. Differentiate a vector in multiple reference frames.
3. Choose the appropriate reference frames for writing equations of motion.
4. Derive point-mass equations of motion using Newton's or Lagrange's method.
5. Write equations which define the motion of a particle with respect to the rotating Earth; identifying Coriolis and centripetal contributions.
6. Integrate Earth-relative particle equations to determine particle position.
7. Predict Earth-relative particle position using engineering judgment.
8. Describe the differences between northern- and southern-hemisphere motion, e.g. rotation of low-pressure systems.
9. Calculate rigid body mass properties and transform them among reference frames.
10. Compose the angular momentum vector and differentiate it inertially.
11. Write rigid body equations of motion using Newtonian and Lagrangian methods.
12. Apply concepts of nutation and precession in describing the motion of aerospace vehicles.
13. Compute and draw the orientations of the space & body cones.
14. Distinguish between direct and retrograde motion; understand and predict the differences in dynamic response from the equations of motion.
15. Understand and predict the motion of a top.
16. Apply the principles of rigid body motion to gyroscopic instruments.

**Course Topics:**

The overall goals for the course are to:

1. To provide the fundamentals of intermediate dynamics of rigid bodies using Newtonian, Lagrangian and Eulerian dynamics.
2. To provide a review of point-mass dynamics.
3. To show the different approaches available in analyzing an equation of motion.
4. To demonstrate the connection between modeling, simulation, numerical solution and analytical solutions to equations of motion.

**Class/laboratory schedule**: M 1:30 – 2:45 pm W 1:30 – 2:45 pm

| Lecture | Lecture Outline |
|---|---|
| 1 | Class Overview |
| 2 | Vector dynamics review |
| 3&4 | Rigid body translational kinematics |
| 5&6 | General motion with respect to the rotating Earth |
| 7 | Euler angles |
| 8&9 | Rigid body rotational kinematics |
| 10&11 | Angular momentum of a rigid body |
| 12&13 | Moments / products of inertia, principal axes |
| 14&15 | Euler's moment equation |
| 16&17 | Solution of general gyro equations |
| 18 | General rigid body gyroscopic motion |
| 19&20 | Gyroscopic instruments |
| 21 | Stable platform for inertial guidance |
| 22&23 | Six degree-of-freedom rigid body equations of motion |
| 24 | Satellite despinning |
| 25 | Spacecraft attitude drift |
| 26 | Lagrange's equations |
| 27 | Introduction to Kane's method |
| 28 | Final exam review |

**Contribution of the course to the requirements of Criterion 5:**

1. College level mathematics and science 0 unit
2. Engineering discipline 3 units
3. General Education 0 unit
4. Others 0 unit

**Relationship of the course to Student Outcomes:**

| 3A | 3B | 3C | 3D | 3E | 3F | 3G | 3H | 3I |
|---|---|---|---|---|---|---|---|---|
| √ | | | | | | | | |

√: Skills relevant

**Prepared by:** Prof. J. M. Hunter **Date:** February 4, 2011

***AE 160 – Aerodynamics I***

**Required Course:** Yes
**Course Coordinator:** Dr. Nikos Mourtos

**Description:** This course provides an introduction to incompressible, inviscid and viscous aerodynamics through problem solving, computer simulations, water and wind-tunnel experiments, and films. Topics include aerodynamics forces and moments, flow classification and similarity, conservation laws with applications in the calculation of lift and drag, and boundary layer theory with emphasis on calculation of skin friction and pressure drag.

**Prerequisites:** C- or better in Math 32, Physics 50 or 70; co-requisite: Engr 100W

**Required Text:**
Anderson, J.D. Jr., *Fundamentals of Aerodynamics*, McGraw Hill, 5th ed., 2011.
Course website: <www.engr.sjsu.edu/nikos/courses/ae160/>

**Student Learning Objectives:**

By the end of the course, students should be able to:

1. Explain the nature of aerodynamic forces.
2. Define the aerodynamic center and the center of pressure for an airfoil.
3. Calculate aerodynamic forces and moments on bodies by integrating surface pressure and shear stress distributions.
4. Use flow similarity to design wind tunnel tests.
5. Classify a flow as 1-D, 2-D, or 3-D, uniform / non-uniform, viscous / inviscid, compressible / incompressible, steady / unsteady, subsonic, transonic, supersonic or hypersonic.
6. Design and perform flow visualization tests to study the characteristics of the flow around 2-D and 3-D aerodynamic bodies and analyze the results from such experiments.
7. Use the momentum equation to calculate (a) lift from given pressure distributions on the top and bottom of an aerodynamic body and (b) drag from given velocity profiles ahead and downstream of an aerodynamic body.
8. Describe qualitatively and quantitatively laminar and turbulent boundary layers in terms of thickness, velocity profiles, and shear stress variation.
9. Predict transition from laminar to turbulent flow on an aerodynamic surface.
10. Calculate the skin friction drag and estimate the pressure drag of aerodynamic bodies.
11. Predict location on an airfoil surface and inside a nozzle, where boundary layer separation is likely to occur.
12. Design and perform wind tunnel experiments to measure the drag of a 2-D aerodynamic body and analyze the results from such experiments.
13. Design and perform wind tunnel experiments to study boundary layer characteristics on an aerodynamic surface and analyze the results from such experiments.

**Course Topics:**

1. Introduction to fluids. Density, Pressure, viscosity.
2. Newton's law of viscosity: calculation of viscous forces.
3. Aerodynamic forces and moments.
4. Aerodynamic coefficients. Center of pressure. Aerodynamic center.
   ***Water tunnel experiment:*** Flow visualization.
5. Flow similarity. Application in wind tunnel testing.
6. Flow description. Streamlines. Flow classification
   ***Wind tunnel experiment 1:*** Effect of shape on aerodynamic drag.
7. Continuity. Flow quality. Wind tunnel design.
8. Bernoulli. Airspeed measurement. Airfoil pressure distributions.
9. Momentum equation.
10. Drag calculation for 2-D bodies.
    ***Wind tunnel experiment 2:*** Airfoil drag from a wake traverse.
11. Boundary layers: qualitative description
12. Laminar boundary layers: thickness, velocity and shear stress distribution.
13. Turbulent boundary layers: thickness, velocity and shear stress distribution
    ***Wind tunnel experiment 3:*** Boundary layer study.
14. Skin friction and pressure drag calculation.
15. Boundary layer transition and separation – Boundary layer control

**Contribution of the course to the requirement of Criterion 5:**

| | | |
|---|---|---|
| 1. | College level mathematics and science | 0 unit |
| 2. | Engineering discipline | 3 units |
| 3. | General Education | 0 unit |
| 4. | Others | 0 unit |

**Relationship of the course to Student Outcomes:**

| 3A | 3B | 3C | 3D | 3E | 3F | 3G | 3H | 3I |
|---|---|---|---|---|---|---|---|---|
| √ | √ | √ | √ | √ | | | √ | √ |

√ : Skills relevant

**Prepared by:** Nikos Mourtos **Date:** March 28, 2011

***AE 162 – Aerodynamics II***

**Required Course:** Yes
**Course Coordinator:** Dr. Nikos Mourtos

**Description:** This course builds on Aerodynamics I to introduce modeling of inviscid flows around aerodynamic bodies through problem solving, computer simulations, and wind tunnel experiments. Topics include 2-D / 3-D, incompressible potential flow theory. Airfoil and wing theory. Lift and drag measurements in a subsonic wind tunnel.

**Prerequisites:** Grade of "C-" or better in Math 133A, AE 160 or ME 111, Engr 100W

**Required Text:**
Anderson, J.D. Jr., *Fundamentals of Aerodynamics*, McGraw Hill, $5^{th}$ ed., 2011.
Course website: <www.engr.sjsu.edu/nikos/courses/ae162/>

**Student Learning Objectives:**

By the end of the course, students should be able to:
1. Define the vorticity of a flow field and distinguish between rotational and irrotational flows.
2. Define circulation and calculate it around various paths.
3. Define the stream function and the potential function for a flow and calculate each, if they exist.
4. Analyze the elementary flows (uniform, source / sink, doublet, vortex, corner) as well as combinations of them.
5. Explain Kelvin's theorem and its implications for the vortex system of an airfoil.
6. Use and interpret airfoil nomenclature.
7. Describe the aerodynamic characteristics of an airfoil and their importance in airplane design.
8. Explain the design and the performance improvements of modern airfoils (LS, MS, and supercritical).
9. Use experimental data, thin airfoil theory results, and computer programs to predict aerodynamic characteristics of airfoils (ex. lift and drag at various angles of attack, pitching moment about various points, ac location, etc.)
10. Design and perform an experiment to study the performance of an airfoil, analyze and interpret the results from this experiment, compare with analytical / computational predictions and other published experimental data, and explain any discrepancies.
11. Use the Biot-Savart law to calculate induced velocities in the vicinity of line vortices.
12. Explain how rectangular, swept, and delta wings differ in terms of maximum lift, lift slope, stall angle of attack, induced drag, skin friction drag, L/D at low speeds, and L/D at high speeds.
13. Describe the horseshoe vortex model for a wing and its limitations.
14. Apply Prandtl's lifting-line theory to calculate the aerodynamic characteristics of airplane wings.

15. Use the method of images to discuss and calculate aerodynamic interference for (a) wings flying in the vicinity of each other (i.e., wing/tail/canard combination, biplanes, etc.), (b) wind-tunnel boundaries, and (c) ground effects.
16. Work effectively in a team to (a) define and solve open-ended problems that combine aerodynamics and flight performance, (b) design and perform wind tunnel experiments, and (c) analyze and interpret experimental data.

**Course Topics:**

| Week | Lecture Topic(s) |
|---|---|
| 01 | Introduction to potential flow theory. |
| 02 | Vorticity. Rotational and irrotational flows. |
| 03 | Velocity potential and stream function. |
| 04 | Elementary flows: uniform, source / sink, doublet, vortex. |
| 05 | Circulation and its relation to lift. Kutta – Jukowski theorem. |
| | ***Wind tunnel experiment 1:*** Circular cylinder pressure distributions. |
| 06 | Airfoils: Kutta condition, nomenclature, characteristics |
| | ***Wind tunnel experiment 2:*** Airfoil pressure distributions. |
| 07 | Airfoils: Design and performance. |
| 08 | Wings: Induced drag, Biot-Savart law |
| | ***Wind tunnel experiment 3:*** Airfoil lift & drag. |
| 09 | Wings: Twist, horseshoe vortex model |
| | ***Wind tunnel experiment 4:*** High-lift devices. |
| 10 | Prandtl's lifting-line theory. |
| 11 | Calculating wing aerodynamic characteristics |
| 12 | Aerodynamic interference; wind tunnel corrections (method of images) |
| 13 | Aerodynamic interference: ground effect (method of images) |
| 14 | Student project presentations. |
| 15 | Student project presentations. |

**Contribution of the course to the requirements of Criterion 5:**

1. College level mathematics and science — 0 units
2. Engineering discipline — 3 units
3. General Education — 0 units
4. Others — 0 units

**Relationship of the course to Student Outcomes:**

| 3A | 3B | 3C | 3D | 3E | 3F | 3G | 3H | 3I |
|---|---|---|---|---|---|---|---|---|
| √ | √ | √ | √ | √ | | | √ | √ |

√: Skills relevant

**Prepared by:** Nikos Mourtos **Date:** March 25, 2011

***AE 164 – Compressible Flow***

**Required Course:** Yes
**Course Coordinator:** Dr. Nikos Mourtos

**Description:** An introduction to compressible flow theory through problem solving, and project-based learning in combination with AE167. Topics include Mach waves, shock waves, flow with friction and heat addition, supersonic nozzles, diffusers, and wind tunnel design.

**Prerequisites:** "C-" or better in: AE160 or ME111, ME113, Engr100W

**Required Text:** Anderson, John Jr., *Modern Compressible Flow*, 3rd ed., McGraw-Hill, 2003.
Course website: <www.engr.sjsu.edu/nikos/courses/ae164/>

**Student Learning Objectives:**
By the end of the course, students should be able to:
1. Define and explain physically the following: (a) Conservation law, (b) Energy and internal energy (c) Entropy, (d) Equilibrium state, (e) Time-reversible and time-irreversible process, (f) Enthalpy, (g) Real gas, (h) Perfect gas, (i) Thermally perfect gas, (j) Calorically perfect gas, (k) Adiabatic process, (l) Isentropic process, (m) Compressibility and compressible flow.
2. Use the 1st and 2nd law of thermodynamics to calculate heat transfer, work done and entropy changes in a thermodynamic system.
3. Use the equation of state and the definition of enthalpy to calculate thermodynamic properties.
4. Calculate the isothermal and isentropic compressibility of a gas for given conditions.
5. Define and explain physically the following: (a) Speed of sound and Mach number, (b) Stagnation and sonic (critical) conditions for isentropic flow, (c) Stagnation and sonic (critical) conditions for flow with heat addition.
6. Derive the conservation equations for 1-D compressible flow (isentropic, adiabatic, with heat addition, with friction).
7. Use thermodynamics and conservation equations to calculate flow parameters at various points of a flow field.
8. Derive the alternative forms of the energy equations.
9. Calculate stagnation and critical conditions at various points of a flow field for isentropic flow, adiabatic flow, flow with heat addition and flow with friction.
10. Explain physically what happens to flow parameters when the flow (a) crosses a normal shock wave, (b) is heated or cooled and (c) is subjected to friction.
11. List the differences between a Mach wave and a shock wave.
12. Explain the conditions under which you get a bow shock in front of a body or a compression corner.
13. Explain the conditions under which you get an oblique shock at the nose of a body or at a compression corner.
14. Explain the differences between the flow over a cone and the flow over a wedge.
15. Calculate the flow properties downstream of a Mach wave.
16. Calculate the flow properties downstream of an oblique shock wave.
17. Calculate the flow properties downstream of a Prandtl-Meyer expansion wave.

18. Calculate the lift and drag coefficients on supersonic airfoils using shock-expansion theory.
19. Calculate the flow properties downstream of a reflected / refracted shock wave.
20. Define quasi 1-D flow.
21. Explain mathematically and physically the relationship between flow cross-sectional area and local Mach (or flow speed).
22. Explain what we mean by "choked flow".
23. Describe what happens to the flow inside a Laval nozzle as we change the exit pressure and / or the reservoir pressure.
24. Explain an (a) ideally expanded, (b) overexpanded and (c) underexpanded nozzle.
25. Calculate the flow properties at various locations of an (a) ideally expanded, (b) overexpanded and (c) underexpanded nozzle.
26. Calculate the location of a shock in a Laval nozzle (assuming there is one).
27. Design a supersonic / hypersonic wind tunnel (i.e. select the appropriate reservoir, throat and nozzle exit conditions to get the desirable test section conditions).
28. Explain what we mean by an "unstarted" supersonic wind tunnel.
29. Use linearized theory to calculate the aerodynamic characteristics of airfoils in subsonic and supersonic flight.
30. Describe the qualitative aspects of hypersonic flows.
31. Apply Newtonian theory to estimate pressure, lift, and drag of hypersonic vehicles.
32. Work effectively in a team to (a) define and solve open-ended problems that combine compressible flow and jet / rocket engine performance, (b) design and perform shock tunnel experiments, and (c) analyze and interpret experimental data.

**Course Topics**

| Week | Topic(s) |
|---|---|
| 1,2 | Introduction; review of thermodynamics |
| 3,4,5,6 | 1-D compressible flow, normal shocks, flow with heat addition and friction |
| 7,8,9 | Mach waves, oblique shock and expansion (Prandtl-Meyer) waves |
| 10,11 | Quasi 1-D flow; nozzles, diffusers, supersonic wind tunnels |
| 12,13,14 | Linearized subsonic and supersonic flow. Hypersonic flow |
| 15,16 | Student project presentations |

**Contribution of course to the requirements of Criterion 5:**

1. College level mathematics and science — 0 unit
2. Engineering discipline — 3 units
3. General Education — 0 unit
4. Others — 0 unit

**Relationship of the course to Student Outcomes:**

| 3A | 3B | 3C | 3D | 3E | 3F | 3G | 3H | 3I |
|---|---|---|---|---|---|---|---|---|
| √ | | √ | √ | √ | | | √ | √ |

√ : Skills relevant

**Prepared by:** Nikos Mourtos **Date:** March 25, 2011

***AE 165 – Aerospace Flight Mechanics***

**Required Course:** Yes
**Course Coordinator:** Dr. Periklis Papadopoulos

**Description:** The goal of this course is to provide students with a basic understanding of aircraft and spacecraft flight mechanics. Basics of launch vehicle mechanics will be addressed as well. Topics to be covered include: standard atmospheric properties, basic elements of subsonic and supersonic aerodynamics, airfoil and finite wing theories, aircraft performance, atmospheric flight, principles of stability and control, space flight, rocket launch and reentry dynamics.

**Prerequisites:** Grade of "C-" or better in ME 101; co-requisite: AE162

**Required Text:** John D. Anderson, Jr.: " Introduction to Flight", McGraw-Hill, 4$^{th}$ ed., 200. Lecture notes and additional material will be handed out in class.

**Student Learning Objectives:**

Upon completion of the course, the students will:

- Be able to develop an understanding of spacecraft and aircraft flight mechanics
- Be able to understand lift and drag and wing performance
- Be able to understand and apply methods for estimating aircraft performance
- Be able to understand performance characteristic of propulsion systems
- Be able to appreciate the impact of aircraft design characteristics on performance
- Be able to calculate simple satellite orbits
- Be able to compute multi-stage launch vehicle performance

**Course Topics:**

- Space flight dynamics introduction
- Tow-body problems
- Orbital elements and Earth-satellite Operations
- Introduction to aircraft flight
- Aerodynamic forces and moments for subsonic flight, wing theory
- Aerodynamic forces and moments for supersonic flight
- Aircraft performance
- Principles of stability and control
- Space flight
- Propulsion systems
- Launch vehicles

**Contribution of the course to the requirements of Criterion 5:**

| | |
|---|---|
| 1. College level mathematics and science | 0 unit |
| 2. Engineering discipline | 3 units |
| 3. General Education | 0 unit |
| 4. Others | 0 unit |

**Prepared by:** Dr. Periklis Papadopoulos **Date:** February 3, 2011

***AE 167 – Aerospace Propulsion***

**Required Course:** Yes
**Course Coordinator:** Dr. Periklis Papadopoulos

**Description:** Basic one-dimensional flows: isentropic, area change, heat addition. Overall performance characteristics of propellers, ramjets, turbojets, turbofans, rockets. Performance analysis of inlets, exhaust nozzles, compressors, burners, and turbines. Rocket flight performance, single-/multi-stage chemical rockets, liquid/solid propellants and design problems.

**Prerequisites:** C- or better in AE 160 or ME111, ME113; co-requisite: AE164

**Required Text:** J.D., *Mattingly, Elements of Gas Dynamics*, McGraw-Hill, 2003

**Student Learning Objectives:**

1. By the end of the course, students should be able to:
2. An understanding of quasi-one-dimensional flow;
3. An understanding of the generation of thrust in air-breathing engines and rockets;
4. An ability to carry out simple performance analysis of subsonic and supersonic inlets;
5. An ability to carry out overall performance calculations of turbojets, turbofans, and turboprops;
6. An elementary understanding of combustors, afterburners, and exhaust nozzles;
7. An understanding of axial flow compressors and turbines, and an ability to carry out flow and performance calculations for these;
8. An ability to carry out simple flight performance calculations for rockets;
9. An understanding of the fundamentals of chemical rocket performance;
10. An understanding of how liquid and solid propellant rockets work.

**Course Topics:**

1. Introduction
2. Dynamics and thermodynamics of perfect gases
3. Thermodynamics review, compressible flow
4. Compressible flow
5. Aircraft gas turbine engine
6. Parametric cycle analysis of ideal engines
7. Component performance
8. Parametric cycle analysis of real engines
9. Engine performance analysis
10. Performance of rocket vehicles, chemical rocket engines
11. Liquid rocket engine systems, thrust chambers, propellants
12. Solid rocket motors

**Contribution of the course to the requirements of Criterion 5:**

| | |
|---|---|
| 1. College level mathematics and science | 0 unit |
| 2. Engineering discipline | 3 units |
| 3. General Education | 0 unit |
| 4. Others | 0 unit |

**Prepared by:** Periklis Papadopoulos **Date:** March 29, 2011

***AE 168 – Aerospace Vehicle Dynamics and Control***

**Required Course:** Yes
**Course Coordinator:** Dr. Nikos J. Mourtos

**Description:** Aircraft/spacecraft dynamics, stability and control. Linearization and Euler transformations. Eigenvalues and eigenvectors. State space and transfer function analysis of dynamics of aerospace vehicles. Feedback control design and synthesis using advanced control techniques.

**Prerequisites:** AE 165, AE 140

**Required Text:** Roskam, J., *Airplane Flight Dynamics and Automatic Flight Controls: Vol. I,* DARcorporation, 2003

**Student Learning Objectives:**
By the end of the course, students should be able to:

1. Derive equations of motion for basic aerospace vehicles.
2. Perform linearization to obtain linear dynamic system description.
3. Solve eigenvalue/eigenvector problems.
4. Calculate damping ratio and natural frequency for dynamics systems.
5. Develop basic control law for a set of vehicle dynamics.
6. Apply root-locus and Bode techniques to improve vehicle performance.
7. Formulate state space representation of vehicle dynamics.
8. Apply modern control techniques to improve performance.
9. Explain and calculate the short period and Phugoid modes.
10. Design a simple stability augmentation system (SAS).
11. Use MATALB/Simulink to develop aerospace vehicle control systems.

**Course Topics:**

1. Course organization, Introduction, Linkages, Degree of freedom, Kinematics pairs, Design project discussion.
2. 4-Bar mechanism, mechanism classification, transmission angle, graphical synthesis; Motion generation mech. (two & three positions) mechanical advantage, toggle positions.
3. Graphical synthesis: motion generation mechanisms (2 & 3 positions), synthesis with prescribed timing, adding Dyad to mechanism, synthesis of a quick-return mechanism.
4. Analytical synthesis: complex polar notation, closed loop vector equation, motion generation mechanisms (two to five positions).
5. Analytical synthesis: function & path generation mechanisms, analytical analysis; Position, Velocity and Acceleration.
6. Forces on mechanisms: Matrix method, Graphical method.
7. Review of stress & strain, principal stresses.
8. Review of combined stresses: bending, torsion; column design.
9. Design of thin & thick walled cylinders, press and shrink fits, material selection for design.

10. Failure theories for static loads: maximum shear stress theory, the distortion-energy theory, modified Coulomb-Mohr theory (brittle materials).
11. The concept of stress concentration, Failure theory for cyclic loads (Fatigue), high cycle fatigue; S-N curve.
12. Effect of mean stress on fatigue life (Modified Goodman Diagram), combined stresses,
13. Bolted joint design: thread standards, stresses, bolt and member stiffness.
14. Static & fatigue stress analysis, bolted joints in tensile and shear loads, bolt preload and torque, Design considerations.

Week    Lecture Topic(s)

1. Introduction and class overview
2. Aerospace vehicle dynamics review
3. Classical control systems analysis
4. Feedback control system design
5. Derivation of aircraft equations of motion
6. Small perturbation theorem
7. Longitudinal dynamic stability/control
8. Longitudinal dynamic stability/control
9. State-space representation; eigen analysis
10. Mid-term exam
11. Stability derivatives
12. Lateral/directional dynamic stability/control
13. Lateral/directional dynamic stability/control
14. Design of stability augmentation system (SAS)
15. Design of stability augmentation system (SAS)
16. Summary and review for final exam

**Contribution of the course to the requirements of Criterion 5:**

| | | |
|---|---|---|
| 1. | College level mathematics and science | 0 unit |
| 2. | Engineering discipline | 3 units |
| 3. | General Education | 0 unit |
| 4. | Others | 0 unit |

**Prepared by:** Dr. Nikos J. Mourtos    **Date:** March 25, 2011

***AE 169 – Computational Fluid Dynamics***

**Required Course:** Yes
**Course Coordinator:** Dr. Perklis E. Papadopoulos

**Description:** Physical and Mathematical foundations of computational fluid mechanics with emphasis on applications. Solution methods for the advection, diffusion model equations, the Euter and the Navier-Stokes equations. The finite-volume formulation of the equations. Classification of partial differential equations and solution techniques. Truncation errors, stability analysis.

**Prerequisites:** Math 129A or ME130, AE 160 or ME111

**Required Text:**
*Fundamentals of Computational Fluid Dynamics*, by Lomax, Pulliam and Zingg. Available at Bookstore or Published by Springer-Verlag

**Student Learning Objectives:**

By the end of the course each student should be able to:

1. Be able to use numerical tools
2. Be able to generate computational grids
3. Be able to determine the accuracy of numerical methods
4. Be able to design methods based in linear theory
5. Be able to develop a basic understanding of algorithms and methods of practical value (e.g. methods for the Euler and Navier-Stokes equations).

**Course Topics:**
1. Explicit and implicit time differencing methods
2. Central, upwind and characteristics spatial differencing techniques
3. Classical relaxation methods
4. Multigrid methods
5. Grid generation
6. Practical examples and real life lessons
7. Contempory methods and codes

**Contribution of the course to the requirements of Criterion 5:**

| | |
|---|---|
| 1. College level mathematics and science | 0 unit |
| 2. Engineering discipline | 3 units |
| 3. General Education | 0 unit |
| 4. Others | 0 unit |

**Prepared by:** Dr. Perklis E. Papadopoulos **Date:** February 4, 2011

***AE 171 A & B – Aircraft Design I & II***

**Required Course:** Yes
**Course Coordinator:** Dr. Nikos Mourtos

**Description:** Capstone, senior design, 2-semester course sequence. Students work in teams to develop mission specifications and design an airplane to meet those specifications. Students use the Advanced Aircraft Analysis program to perform the conceptual and a Class I preliminary design of this airplane. Written reports are due approximately every two weeks on each step of the design process. Students may participate in the SAE AERO DESIGN WEST or the AIAA DESIGN – BUILD – FLY competition or work on industry-sponsored projects, which involve the design, manufacture, and flight-testing of RC or UAV airplanes. The course includes field trips as well as guest speakers, discussions and assignments on safety, reliability, professionalism and ethics, global, societal and contemporary issues.

**Prerequisites:**
**AE171A:** C- or better in ME20, AE114, AE 162, AE 165, Engr100W, must be senior in good academic standing; **co-requisites**: AE164, AE167, AE168
***AE171B:*** C- or better in AE164, AE167, AE168, AE171A

**Required Text:** J. Roskam: Airplane Design, Parts I-VIIIRoskam Aviation and Engineering Corp. Route 4, Box 274, Ottawa, Kansas, 66067.

**Student Learning Objectives:**
By the end of the course, students should be able to:

*Design*

1. Define an appropriate set of mission requirements and sketch the mission profile of an airplane.
2. Identify the critical mission requirements of an airplane.
3. Evaluate the configuration of airplanes and describe the connection between configuration choices (ex. high wing, tandem landing gear) and mission requirements.
4. Describe the pros and cons of the various conventional aircraft configurations.
5. Select an appropriate configuration for an airplane with a specified mission.Estimate the takeoff weight of an airplane based on the mission requirements using the weight fraction method (by hand and with AAA).
6. Calculate the takeoff weight sensitivities of an airplane to changes of critical parameters such as L/D, sfc, etc. (by hand and with AAA).
7. Construct a matching graph based on specific performance constraints, such as stall speed, cruise speed, takeoff distance, landing distance, and maneuverability requirements and use it to predict the required thrust / power and wing area for an airplane (by hand and with AAA).
8. Prepare CAD drawings of the cockpit and the fuselage of an airplane based on specific payload requirements.
9. Design the wing, high-lift system, and lateral controls of an airplane (by hand and with AAA).
10. Design the empennage and the directional controls of an airplane (by hand and with AAA).

11. Design the landing gear of an airplane using tip-over and ground clearance Criterion and (for retractable landing gear) show the retraction feasibility with appropriate drawings.
12. Perform a weight and balance analysis for an airplane and draw the cg excursion diagram (by hand and with AAA).
13. Perform static longitudinal and directional stability analysis for an airplane and draw the corresponding x – plots (by hand and with AAA).
14. Perform a critical evaluation of the landing gear design, the empennage, the weight and balance, and the stability and control analysis to ensure that an airplane is not prone to tip-over problems, too much cg travel, too much or too little stability and / or a minimum control speed problem.
15. Estimate the drag polars of an airplane for the takeoff, cruise (low and high speed), and landing configurations (by hand and with AAA).
16. Procure, fabricate, and assemble the various parts for an airplane (RC or UAV).
17. Evaluate the design through flight-testing and identify any modifications / improvements needed to meet the mission requirements.

*Teamwork & Project Management*

18. Work harmoniously and effectively in a team to solve engineering problems related to the design, fabrication and testing of an airplane and to communicate the results in technical reports and oral briefings.
19. Communicate effectively in a team environment, negotiate and resolve conflicts, motivate and coach others in your team, organize and delegate work as needed, develop a team vision and set team goals, and manage resources.
20. Evaluate your own performance as well as that of your teammates using specific Criterion, such as the quality of their work, their commitment to the team / project, leadership skills, responsibility, abilities, communication skills, and personality.
21. Develop a milestone schedule (timeline) for an engineering project and follow it.

*Engineering Ethics*

22. Demonstrates knowledge of a code of ethics.
23. Identify possible courses of action, discuss the pros and cons of each one, and decide on the best one, given a job-related scenario that requires a decision with ethical implications.

*Communication*

24. Write high quality design reports (i.e., using correct language and terminology, correct technical information, and professionally prepared graphs and tables).
25. Give clear, informative, technically correct oral presentations using professionally prepared visual aids.

*Global / Societal Issues*

26. Evaluate the environmental impact of your airplane.
27. Evaluate the health and safety issues related to your airplane.

*Contemporary Issues*

28. List several examples of contemporary issues related to AE and articulate a problem / position statement for each.
29. Explain what makes these issues particularly relevant to the present time.
30. Suggest reasonable theories regarding the root cause(s) of these problems.
31. Identify possible solutions to contemporary problems, as well as any limitations of these solutions,

**Course Topics:**

Week Topic(s)

**AE 171A**

1. Introduction to Aircraft Design.
2. Team building. Mission requirements.
3. Weight sizing. Weight Sensitivities.
4. Performance sizing – stall speed, cruise speed, takeoff, landing
5. Performance sizing – climb, maneuverability, matching graph
6. *Field trip to Hiller Aviation Museum.*
7. **1st oral presentation and oral examination.**
8. **Case study I on aircraft safety, ethics and liability issues: V-Tail Bonanza**
9. Configuration design (conventional).
10. Guest Speaker.
11. Design of the fuselage. **Film – MIT Daedalus Project**
12. Design of the wing, high-lift system and lateral controls.
13. **Case study II on aircraft safety, ethics and liability issues: DC-10**
14. Design of the empennage, longitudinal / directional controls.
15. *Field trip to Oakland Aviation Museum.*
16. **2nd oral presentation and oral examination.**

**AE 171B**

1. Design of the landing gear.
2. Weight and balance analysis.
3. Longitudinal stability analysis.
4. Lateral and directional stability and control.
5. Drag polar estimation.
6. **Case study III on aircraft safety, ethics and liability issues: C5**
7. **3rd oral presentation and oral examination.**
8. *Field trip to Castle Air Museum*
9. **Case study IV on aircraft safety, ethics and liability issues: Space Shuttle**
10. *Field trip to Travis AFB Museum*
11. Guest speaker
12. SAE Competition / AIAA Student Conference
13. **Film: P-51 Mustang**
14. **4th oral presentation and oral examination.**
15. **Film: The Boeing 777**
16. **Student Conference Day presentations**

**Contribution of the course to the requirements of Criterion 5:**

1. College level mathematics and science 0 unit
2. Engineering discipline 6 units
3. General Education 0 unit
4. Others 0 unit

**Relationship of the course to Student Outcomes:**

| 3A | 3B | 3C | 3D | 3E | 3F | 3G | 3H | 3I |
|---|---|---|---|---|---|---|---|---|
| √ | √ | √ | √ | √ | √ | √ | √ | √ |

√: Skills relevant

**Prepared by:** Nikos Mourtos **Date:** March 25, 2011

***AE 172A – Spacecraft Design I***

**Required Course:** Yes
**Course Coordinator:** Dr. Periklis Papadopoulos

**Description:** First semester of a capstone, senior design, 2-semester course sequence. Students work in teams to design spacecraft to specific mission requirements as provided in an RFP (Request for Proposal).

**Prerequisites:** C- or better in: ME20, AE114, AE162, AE164, AE165, Engr100W

**Student Learning Objectives:** By the end of the course, students should be able to:
1. Design spacecraft hardware.
2. Apply the complete product development cycle: Basic idea / societal need / market study / economic and budget analysis;
3. Create the baseline design; Establish the final design; Evaluate / analyze operation and data returned.

**Course Topics:**

| Week | Topic of Discussion |
|---|---|
| 1 | Introduction to Spacecraft Design |
| 2 | Mission Requirements |
| 3 | Systems Specification Documentation |
| 4 | System Decomposition |
| 5 | Subsystems Design |
| 6 | Subsystems Specification Documentation |
| 7 | Subsystems Design Review |
| 8 | System Design and Integration |
| 9 | System / Subsystems Coupling |
| 10 | Subsystems Design Review |
| 11 | Progress Presentations |
| 12 | System Integration |
| 13 | System Integration |
| 14 | Detailed Design Review |
| 15 | Final Design Review |
| 16 | Oral Presentations / Exams |

**Contribution of the course to the requirements of Criterion 5:**

| | | |
|---|---|---|
| 1. | College level mathematics and science | 0 unit |
| 2. | Engineering discipline | 3 units |
| 3. | General Education | 0 unit |
| 4. | Others | 0 unit |

**Relationship of the course to Student Outcomes:**

| 3A | 3B | 3C | 3D | 3E | 3F | 3G | 3H | 3I |
|---|---|---|---|---|---|---|---|---|
| √ | √ | √ | √ | √ | √ | √ | √ | √ |

√ : Skills relevant

**Prepared by:** Periklis Papadopoulos **Date:** March 25, 2011

***AE 172 B – Spacecraft Design II***

**Required Course:** Yes
**Course Coordinator:** Dr. Periklis Papadopoulos

**Description:** Preliminary and detail design of spacecraft. Spacecraft construction, integration, and testing. Ethics, safety, and liability issues.

**Prerequisites:** C- or better in: AE 164, AE 167, AE 168, and AE 172A

**Student Learning Objectives for the course:**
By the end of the course, students should be able to:
1. Design spacecraft hardware.
2. Apply the complete product development cycle: Basic idea / societal need / market study / economic and budget analysis;
3. Create the baseline design; Establish the final design; Evaluate / analyze operation and data returned.

**Course Topics:**
1. To provide senior engineering students a capstone experience in spacecraft design.
2. To offer an opportunity for going beyond a paper product (design report) into actual manufacturing of spacecraft.
3. To develop students' creative abilities in solving open-ended, spacecraft design problems.
4. To develop an appreciation of the interrelationships between aerodynamics, propulsion, structures, flight / orbital mechanics, stability & control, manufacturing, maintenance, and cost in an integrated spacecraft design.
5. To develop students' engineering judgment as well as their confidence in making and accepting responsibility for design decisions.
6. To develop students' oral and written communication skills, necessary to describe the assumptions, methods, and results of engineering analysis, synthesis, and decision making associated with airplane design.
7. To develop the confidence to present technical work in professional (conferences, national design competitions, Tech Museum) and other public settings (local middle and high schools).
8. To make students aware of the importance of teamwork in the design of a spacecraft and provide them with an opportunity to develop team and leadership skills.

**Contribution of the course to the requirements of Criterion 5:**

| | |
|---|---|
| 1. College level mathematics and science | 0 unit |
| 2. Engineering discipline | 3 units |
| 3. General Education | 0 unit |
| 4. Others | 0 unit |

**Relationship of the course to Student Outcomes:**

| 3A | 3B | 3C | 3D | 3E | 3F | 3G | 3H | 3I |
|---|---|---|---|---|---|---|---|---|
| √ | √ | √ | √ | √ | √ | √ | √ | √ |

√ : Skills relevant

**Prepared by:** Periklis Papadopoulos **Date:** March 25, 2011

***AE 180 – Individual Studies***

**Required Course:** No
**Course Coordinator:** Dr. Nikos J. Mourtos

**Description:** Students work with faculty on lab development projects or industry-sponsored projects. The course may be used as one of the two electives in the BSAE curriculum.

**Prerequisites:** Upper Division Standing

**Required Text:** None

**Contribution of the course to the requirements of Criterion 5:**

1. College level mathematics and science — 0 unit
2. Engineering discipline — 3 units
3. General Education — 0 unit
4. Others — 0 unit

**Prepared by:** Dr. Nikos J. Mourtos **Date:** March 25, 2011

*AE 198 – Technology and Civilization*

**Required Course:** No
**Course Coordinator:** Professor Pat Backer

**Description:** History, development, and use of technology in different cultures. Technology's impact on society, global environment, the workplace, cultural values, gender roles, and newly industrialized countries of the world.

**Prerequisites:** Upper division standing, passage of WST and Core GE

**Required Texts:**
Markert, L. R., & Backer, P. R. (2003). Contemporary Technology. Innovations, Issues and Perspectives. Tinley Park, IL: Goodheart-Willcox.
Teich, A. H. (2006). *Technology and the future* (10th ed.). Belmont, CA: ThomsonWadsworth.

**Student Learning Objectives:**

By the end of the course, students should be able to:

1. 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.;
2. Identify the historical context of ideas and cultural traditions outside the U.S. and how they have influenced American culture; and
3. Explain how a culture outside the U.S. has changed in response to internal and external pressures.

**Course Topics:**

1. Nature of Science & Technology
2. The History of Technology and Culture
3. Technology and Work
4. Technology and Gender Issues
5. Technology Transfer and Cultural Issues
6. Quality of Life Issues
7. Technology Ethics and Society

**Contribution of the course to the requirements of Criterion 5:**

| | |
|---|---|
| 1. College level mathematics and science | 0 units |
| 2. Engineering discipline | 0 units |
| 3. General Education | 3 units |
| 4. Others | 0 units |

**Prepared by:** Pat Backer **Date:** March 29, 2011

# Appendix B
# Faculty VITAE

1. **Nikos J. Mourtos** — September 28, 1957
Name — Date of Birth

2.

| Academic Rank | % of Time | Non-academic activity | % of Time |
|---|---|---|---|
| Professor | 100 | | |

3.

| Degree | Field | Institution | Date |
|---|---|---|---|
| Ph.D. | Aeronautical & Astronautical Engineering | Stanford U. | 1987 |
| Engineer | Aeronautical & Astronautical Engineering | Stanford U. | 1983 |
| MS | Aeronautical & Astronautical Engineering | Stanford U. | 1982 |
| BS | Mechanical Engineering | U. of Patras, Greece | 1980 |

4.

| Years of Service on this Faculty | Original Appointment | Advancement in Rank |
|---|---|---|
| 25 | 1987 | Associate Professor, 1991<br>Professor, 1999 |

5. Other Related Experience
- AE Associate Chair, Dept. of Mechanical & Aerospace Engineering, SJSU, 2010-present
- Assistant Director, SJSU Center for Faculty Development & Support, 2006-2008
- Coordinator, AE Program, Dept. of Mechanical & Aerospace Engineering, SJSU, 2004-2006
- Faculty Instructional Development Coordinator, College of Engineering, SJSU, 1996-2002
- Faculty-in-Residence for Innovative Pedagogy, SJSU Institute for Teaching & Learning. 1998-2002

6. Consulting
- Collaborative Concepts: Development of instructional materials for fluid mechanics, 2010
- External evaluator, "Incorporating 3-D Laser Scanning into Land Surveying Curricula", NSF project at Evergreen College, California, 2007-2010
- College of Engineering, King Abdul Aziz U., Jeddah, Saudi Arabia: ABET EC2000 preparation – Associate Member, Academic Accreditation Unit http://engg.kau.edu.sa/AAU/, 2006-present
- "Partnership for Student Success in Science", NSF project to improve K-12 Science Education (collaboration: 9 schools districts, SJSU, Synopsys, Agilent Technologies), California, 2003-2008
- External evaluator, "A Model Curriculum for Civil Engineering Technology", NSF project at Evergreen College, California, 2003-2006

7. Principal Publications of Last Five Years

***Journals***

Mourtos, N.J., *Challenges Students Face when Solving Open-Ended Problems*, International J. of Engineering Education, vol.26, no.4, part 1, 2010.

Mourtos, N.J., *A Sustainable, Systematic Process for Continuous Program Improvement*, Invited Paper, UICEE Global J. of Engineering Educ., vol.10, no.2, 2006, pp. 191-204.

Mourtos, N.J., *The Scholarship of Teaching Engineering at San Jose State University; a Faculty Member's Perspective*, Invited Paper, UICEE Global J. of Engineering Educ., vol.10, no.1, 2006, pp. 73-84.

***Conferences***

Mourtos, N.J., *Teaching Engineering Design Skills*, Proc., IETEC, 2011

Alioto, V., Buttita, J., Epps, A., Nguyen, D.B., Yahaghi, A., Mourtos, N.J., *Design of a Micro-Scale Deployable UAV*, Proc., Aerospace Engineering Systems Workshop, WSEAS, 2009.

Johnson, K.T., Sullivan, M.R., Sutton, J.E., Mourtos, N.J., *Design of a Skydiving Glider*, Proc., Aerospace Engineering Systems Workshop, WSEAS, 2009.

Kasarapu, K.C., Ahmed, R., Thomas, S.K., Mourtos, N.J., *Design of a Combination 310-Passenger / 120-Ton Cargo Aircraft*, Proc., Aerospace Engineering Systems Workshop, WSEAS, 2009.

Morisetty, P., Mourtos, N.J., *Design of a 100 - Seat Regional Aircraft*, Proc., Aerospace Engineering Systems Workshop, WSEAS, 2009.

Mourtos, N.J., *Challenges Students Face in Solving Open-Ended Problems*, Proc., 7$^{th}$ ASEE GCEE, 2008.

Shah, S., Martinez, R., Fernandez, N., Mourtos, N.J., *Double Wedge Shockwave Interaction Flow Characterization*, Proc., Thermal-Fluids Analysis Workshop, TFAWS-08-1033, 2008.

Casas, L.E., Hall, J.M., Montgomery, S.A., Patel, H.G., Samra, S.S., Si Tou, J., Quijano, O., Mourtos, N.J., Papadopoulos, P.P., *Preliminary Design and CFD Analysis of a Fire Surveillance UAV*, Proc., Thermal-Fluids Analysis Workshop, TFAWS-08-1034, 2008.

Anagnos, T., Komives, C., Mourtos, N.J., McMullin, K.M., *Evaluating Student Mastery of Design of Experiment,* Proc., 37th IEEE / ASEE FIE Conf., 2007.

Mourtos, N.J., *An Engineering Approach to Course Design*, Proc., 6th ASEE GCEE, 2007.

Huet, I., Mourtos, N.J., Costa, N., Pacheco, O., *Models for Research-Based Teaching in Engineering Courses: A Case-Study at the Univ. of Aveiro (Portugal) & SJSU (USA)*, Proc., 10th ICEE, 2007.

Mourtos, N.J., Workshop: *Program Educational Objectives and Outcomes: How to Design a Sustainable, Systematic Process for Continuous Improvement*, Proc., 36th ASEE / IEEE FIE. Conf., Oct. 2006.

Mourtos, N.J., Papadopoulos, P., Agrawal, P., *A Flexible, Problem-Based, Integrated Aerospace Engineering Curriculum*, Proc., 36th ASEE / IEEE FIE Conf., 2006.

Mourtos, N.J., *Program Educational Objectives and Assessment: A Systematic Process for Continuous Improvement*, Proc., 5th ASEE GCEE, 2006.

Komives, C., Mourtos, N.J., Anagnos T., McMullin, K.: *Enhancing Inquiry Skills in Engineering through a University-School District Partnership*, Proc., 9th ICEE, 2006.

Mourtos, N.J., *Program Outcomes and Assessment: A Sustainable, Systematic Process for Continuous Improvement*, Lead Paper, Proc., 9th UICEE Conf. on Engr. Ed., 2006 (Bronze Award).

8. Memberships in Scientific and Professional Societies

ASEE, AIAA, Academic Accreditation Unit-College of Engr.-King Abdul Aziz U.-Saudi Arabia, WIETE

9. Honors and Awards

2008 Honorable Mention – Provost's Outstanding Scholarship of Teaching and Learning Award
2008 Σ Γ Τ Professor of the Year Award, Voted by Aerospace Engineering Students
2007 Σ Γ Τ Best Professor Award, Voted by Aerospace Engineering Students
2007 Provost's Assessment Award for Commitment to Program Excellence through Student Learning Assessment, as a member of the SJSU College of Engineering Assessment Committee
2007 Appointed Associate Member of the Academic Accreditation Unit, College of Engineering, King Abdul Aziz University, Saudi Arabia
2006 UICEE Bronze (5th Place) Award for a distinguished contribution in delivering an outstanding paper to the 9th UICEE Annual Conf. on Engineering Education in Muscat, Oman, Feb. 11 – 15

10. Institutional and Professional Service in Last Five Years

*Reviewer for: IJEE, IJQAETE, GJEE, WTETE, UICEE Conf. Proceedings, IGI: Chapter for Book: Work-Integrated Learning in Engineering and Technology: New Approaches and Practices (2010)*

*University: College of Education Recruiting Committee for the Director of the Ed.D. Program (2009-), Member, Advisory Committee, College of Science STEM NSF Grant (2009-), Chair, SJSU Student Evaluation Review Board (2008-2009), SJSU Committee for the Review of the AVP for Academic Technology (2007-2008)*

*Department: Chair Search Committee, Undergraduate Studies Committee (Chair), AE Program Assessment Coordinator, AE Faculty Search (Chair).*

11. Professional Development Activities in the Last Five Years

- Member, Editorial Board, International Journal for Quality Assurance in Engineering & Technology Education (IJQAETE), appointed in 2011.
- Member, Editorial Advisory Board, Global Journal for Engineering Education (GJEE), appointed in 2010.
- ABET Faculty Workshop on Sustainable Assessment Processes w. Gloria Rogers, Las Vegas, 2010.
- Seeing Faculty as Learners: Three Theoretical Frameworks for Faculty Development w. J. Froyd & J. Layne, Professional and Organizational Development Network in Higher Ed. Conf., Portland, 2006.
- Leading your own workshop on Course Design w. Dee Fink, Professional and Organizational Development Network in Higher Education Conference, Portland, 2006.

1 Name: **Periklis E. Papadopoulos**

2

| Degree | Field | Institution | Date |
|---|---|---|---|
| PhD | Aeronautical & Astronautical Engineering | Stanford U. | 1993 |
| MS | Aeronautical & Astronautical Engineering | Stanford U. | 1987 |
| BS | Mechanical Engineering | Illinois Institute Technology | 1980 |

3

| Years of Service On this Faculty | Original Appointment | Advancement in Rank |
|---|---|---|
| 9 | 8/2002 | Professor, 8/2007 |

4 Other Related Experience

| Field | Position | Place | Date |
|---|---|---|---|
| AE | Senior Scientist | NASA Ames Research Center | 1991-2002 |
| Semiconductors | Production Engr. | Hewlett Packard | 1988-1989 |
| AE | Project Assistant | Illinois Inst. Of Technology | 1983-1985 |

5 Principal Publications of Last Five Years

***Journals***

- Papadopoulos, P., Zafiris, V., "Geometric Quality Metrics for Volume Grids," Received March 2006 and accepted for publication in the special issue on "Advances in Grid Generation and Applications" of the International Journal of Computational Fluid Dynamics, Vol. TBD, 2009.
- Papadopoulos, P., Subrahmanyam, P., "Trajectory Based Automatic Grid Generation Tool For Atmospheric Entry CFD Modeling," Received March 2006 and accepted for publication in the special issue on "Advances in Grid Generation and Applications" of the International Journal of Computational Fluid Dynamics, Vol. TBD, 2009.
- P. Papadopoulos, D. K. Prabhu, C. B. Davies, M. J. Wright, E. Venkatapathy, P. Wercinski, "Grid Generation Strategies for Shuttle Contingency Abort Aerodynamics," Received April 2006 and accepted for publication in the special issue on "Advances in Grid Generation and Applications" of the International Journal of Computational Fluid Dynamics, Vol. TBD, 2009.
- Dai, W., Papadopoulos, P., Hauser, J., "Technique For Complex 3D Multi-block Structured Grid Using GridPro," Received and accepted for publication in the special issue on "Advances in Grid Generation and Applications" of the International Journal of Computational Fluid Dynamics, Vol. TBD, 2009.
- Hauser, J., Papadopoulos, P., Dai, W., Muylaert, J.-M., "Physical and Numerical Modeling for Advanced Propulsion Systems," Invited paper to the special issue of the CFD Journal of the International Society for Computational Fluid Dynamics, Vol. TBD, no. TBD, pp. TBD, 2009.
- Papadopoulos, P., Subrahmanyam, P., "Web Based Computational Investigation of Aerothermodynamics of Atomospheric Entry Vehicles," AIAA Journal of Spacecraft and Rockets, Vol. 43, no. 6, ph. 1184-1190, 2006.
- Papadopoulos, P., Subrahmanyam, P., "A Structured Multiblock Compressible Flow Solver SPARTA for Planetary Entry Probes," Advances in Fluid Mechanics VI, WIT Transactions on Engineering Sciences, Vol. 52, pp. 235-243, 2006.

***Conferences***

- A.H. Djamshidpour, B. Yendler, P. Papadopoulos, "High-heat Shield Design Conceptual Study Using Phase Change Materials," TFAWS-08-1031, Thermal and Fluids Analysis Workshop, Hosted by NASA-ARC, August 18-22, 2008.
- A. Firoozam, P. Papadopoulos, "Space Shuttle LOX Bleed System Analysis," TFAWS-08-1025, Thermal and Fluids Analysis Workshop, San Jose State University, Hosted by NASA-ARC, August 18-22 2008.
- Z. Young, K. Boronowsky, Y. Najafi, R. Twiggs, P. Papadopoulos, "Micro Satellites De-Orbiting Analysis," TFAWS-08-1026, Thermal and Fluids Analysis Workshop, Hosted by NASA-ARC, August 18-22, 2008.

- E. Hartman, S. Shah, M. Murbach, P. Papadopoulos, "Thermal Modeling for Atromos Mars Polar Lander's Science Station," TFAWS-08-1027, Thermal and Fluids Analysis Workshop, Hosted by NASA-ARC, August 18-22, 2008.
- A. Deeptanshu, P. Nerio, A. Epps, T. Rouse* (AeroPac), P. Papadopoulos, "Design and Flight Testing of the ARLISS Rocket and CFD Modeling of the Nosecone Region," TFAWS-08-1028, Thermal and Fluids Analysis Workshop, Hosted by NASA-ARC, August 18-22, 2008.
- K. Biba, M. Butin, B. Belley, Z. Young, P. Hopkins, N. Pelster, R. Twiggs, P. Papadopoulos, "Virtual Classroom: Worldwide Real-time Experimental Collaboration," TFAWS-08-1029, Thermal and Fluids Analysis Workshop, Hosted by NASA-ARC, August 18-22. 2008.
- J. Mogannam, R. Benzio, D. Dinh, J. Wooner, Y. Najafi, M. Urquhart, A. Vallejo, N. Mansour, A. Cassell, P. Papadopoulos, "X-Jet Ultrasonic Ablation Thickness Profile Gauging Instrumentation Design, Testing and Analysis," TFAWS-08-1030, Thermal and Fluids Analysis workshop, Hosted by NASA-ARC, August 18-22, 2008.
- N. J. Mourtos, P. E. Papadopoulos, and P. Agrawal, "A Flexible, Problem-Based, Integrated Aerospace Engineering Curriculum," 36th ASEE/ISEE Frontiers in Education Conference, San Diego, CA, October 28-31, 2006.
- P. Papadopoulos and P. Subrahmanyam. "SPARTA: A Structured Multiblock Compressible Flow Solver for Planetary Entry Probes" Advances in Fluid Mechanics, 8-10 May 2006, Skiathos, Greece.
- P. Papadopoulos, P. Subrahmanyam. "Integrated OLAp Cubes Database Driven Aerothermodynamic Trajectory Analysis For Planetary Probes." 4th International Planetary Probe Workshop, Pasadena, CA, 27-30 June, 2006.
- P. Papadopoulos, P. Subrahmanyam, "Trajectory Coupled Aerodynamics Modeling For Atmospheric Entry Probes at Hypersonic Velocities," 44th AIAA Aerospace Sciences Meeting and Exhibit, Reno, Nevada, 9-12 Jan. 2006.

6 Memberships in Scientific and Professional Societies
American Institute of Aeronautics and Astronautics

Honors and Awards

Tau Beta Pi National Engineering Honorary Society
Tau Beta Pi National Mechanical Engineering Honorary Society
Honorary mention for best Ph.D. thesis at Stanford University

Institutional and Professional Service in Last Five Years

Faculty Advisor, Student Chapter of AIAA at SJSU

1. Name: **Nik Djordjevic**

2.

| Degree | Field | Institution | Date |
|---|---|---|---|
| Ph.D. | ME | University of California, Los Angeles | 1982 |
| M.S. | Engr Heat & Mass Transfer | University of California, Los Angeles | 1976 |
| B.S. | Engr. Heat & Mass Transfer | University of California, Los Angeles | 1976 |

3.

| Years of Service On this Faculty | Original Appointment | Rank |
|---|---|---|
| 13 | 1998 | Lecturer |

4. Other Related Experience

| Field | Position | Place | Date |
|---|---|---|---|
| ME | Adjunct Faculty | Santa Clara University, CA | 2010 |
| ME | Associate Faculty | West Valley College, CA | 1991 |
| Engineering | Manager Design | Lockheed Space Systems Co. | 1983–present |
| Engineer | Sr. Engineer | Aerojet Liquid Rocket Company | 1982-1983 |

1. Name: **Jeanine Hunter**

2. Degree, Field, Institution, Date

| Degree | Field | Institution | Date |
|---|---|---|---|
| MS | Aeronautics & Astronautics | Stanford University | 1981 |
| BS | Aeronautical Engineering | Purdue University | 1979 |

3. Years of Service On this Faculty, Original Appointment, Rank

| Years of Service On this Faculty | Original Appointment | Rank |
|---|---|---|
| 10 | 1989 | Lecturer |

4. Other Related Experience

| Field | Position | Place | Date |
|---|---|---|---|
| Math/Sci | Homeschool Teacher | Cameron Park, CA | 1996-2008 |
| AE | Instructor | San Jose State University | 1989-1996 |
| AE | Manager | ESL Inc., Sunnyvale, CA | 1983-1989 |
| AE | Project Engineer | NASA Ames Research Center | 1979-1983 |

5. Principal Publication of Last Five Years

- *Beyond the Abacus: An Asian – American Comparison of Mathematics Pedagogy* (In Review)

1. Name: **Gonzalo Eduardo Mendoza**

2. Degree, Field, Institution, Date

| Degree | Field | Institution | Date |
|---|---|---|---|
| MS | Aerospace Engineering | Wichita State University | 2008 |
| BS | Aerospace Engineering | San José State University | 1998 |

3. Number of Years of Service On this Faculty, Original Appointment, Rank

| Number of Years of Service On this Faculty | Original Appointment | Rank |
|---|---|---|
| 1 | Fall 2010 | Lecturer |

4. Other Related Experience

| Field | Position | Place | Date |
|---|---|---|---|
| AE | Loads and Dynamics | Cessna Aircraft Company | Present |
| AE | General Engineer Specialist | Cessna Aircraft Company | 1998 |

5. Memberships in Scientific and Professional Societies
   American Institute of Aeronautics and Astronautics (AIAA)
   Aircraft Owners and Pilots Association (AOPA)

| 1. Name | | | Date of Birth |
|---|---|---|---|
| **Marcus S. Murbach** | | | 7-30-1957 |

| 3. Degree | Field | Institution | Date |
|---|---|---|---|
| Engineer | Aeronautical & Astronautical Engineering | Stanford U. (finished coursework; thesis not yet submitted) | |
| MS | ME | SJSU | 1987 |
| BS | Engineering (IPA/Bio-Engineering) | Harvey Mudd College | 1979 |

4. Years of Service On this Faculty: 2

Original Appointment: 2009

5. Other Related Experience

- Principal Investigator, SOAREX flight series (1997-current; SOAREX-7 launched 2009; SOAREX-8 planned 2012)
- Principal Investigator, Atromos Mars Companion Mission Proposal, 2006-current

6. Consulting

- Next Generation Acquaculture Project, Sinaloa, Mexico, 2008-2010
- Numerous NASA SBIR proposals, 2005-2011

7. Recent Publications (last two years)

Murbach, M. S., Papdopoulos, P., Boronowsky, K., M., Benton, J., E., and Bruce White, "Summary of the SOAREX 6/7 Mission," IPPW-7, Barcelona, Spain, June 12-18, 2010.

Murbach, M. S., Papdopoulos, P., Boronowsky, K., M., Benton, J., E., and Bruce White, "Atromos 2016 - A Mars Companion Mission" Poster Session, IPPW-7, Barcelona, Spain, June 12-18, 2010.

Murbach, M. S., Boronowsky, K.M., Benton, J.E., and Bruce White, “Options for Returning Payloads from the ISS after the Termination of STS flights,” AIAA/ICES Conference, Barcelona, Spain, June 22, 2010.

1. **Sean S.M. Swei** — November 25, 1961
Name — Date of Birth

2.

| Academic Rank | % of Time | Non-academic activity | % of Time |
|---|---|---|---|
| Adjunct Faculty | | GN&C Lead Analyst (NASA Ames) | 100% |

3.

| Degree | Field | Institution | Date |
|---|---|---|---|
| Ph.D. | Aeronautics & Astronautics | Purdue U. | 1993 |
| MS | Mechanical & Mechanics | Drexel U. | 1986 |
| BS | Mechanical Engineering | National Taiwan U. | 1983 |

4.

| Years of Service On this Faculty | Original Appointment | Rank |
|---|---|---|
| 6 | 2005 | Lecturer |

**5.** Other Related Experience

Spacecraft Related Projects (NASA Ames), 2007-present

- Support of Lunar Atmosphere and Dust Environment Explorer (LADEE) mission

Unmanned Aerial Vehicle Project (NASA Ames), 2000-2007

- Flight control system design for Organic Air Vehicle (OAV) demonstrator and Micro Air Vehicle (MAV)

Manned Flight Vehicle Project (NASA Ames), 2000-2007

- Flight control system design for UH-60, CH-47, and JSF

Assistant Professor (Nanyang Technological U.), 1998-2000

- Robotics related projects such as, Underwater Robotic Vehicle and Pipe Inspection Robot

7. Principal Publications of Last Five Years

***Conferences***

Swei, S., Fusco, J., *Sun Safe Mode Controller Design for LADEE* , to be submitted.

Sridhar, B., Swei, S., *Classification and Computation of Aggregated Delay Using Center-based Weather Impacted Traffic Index*, 7th AIAA Aviation Technology, Integration, and Operations Conference, 2007.

Sridhar, B., Swei, S., *Relationship between weather, traffic and delay based on empirical methods*, 6th AIAA Aviation Technology, Integration, and Operations Conference, 2006.

8. Memberships in Scientific and Professional Societies

AIAA, AHS

9. Honors and Awards

2010 SJSU Part-Time Faculty Award for Excellence in Teaching
2007 AIAA Aerospace Software Engineering of the Year Award

10. Institutional and Professional Service in Last Five Years

*Reviewer for:* Symposium of Coatings for Clean Energy cum the ThinFilms, 2010

11. Professional Development Activities in the Last Five Years

- Judge, 2011 Spirit of Innovation Awards, NASA Ames Research Center

# Appendix C

# Equipment

# AERODYNAMICS LABORATORY

**Director:** Dr. Nikos J. Mourtos

**Purpose:** To provide students with experiments in basic flow measurements and visualization. These experiments include pressure distributions on airfoils, lift and drag measurements of wings and other aerodynamics bodies and boundary-layer measurements. Flow visualization includes study of high-angle-of-attack flow patterns around airfoils, conical bodies and delta wing aircraft.

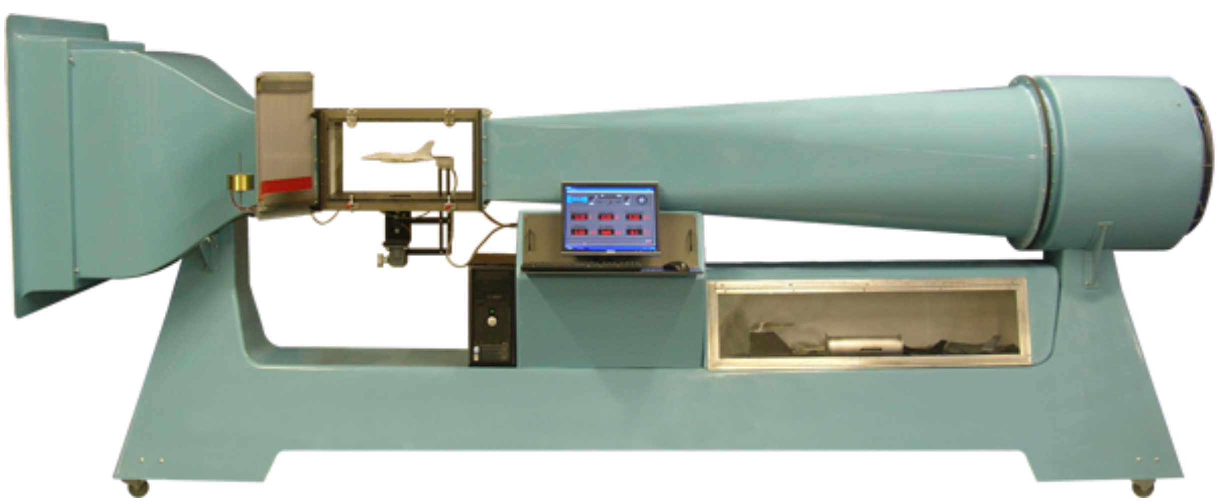
**Courses and Enrollment:**

| | | |
|---|---|---|
| AE 160 | Aerodynamics I | 30 students / year |
| AE 162 | Aerodynamics II | 30 students / year |
| AE 168 | Aerospace Vehicle Dynamics & Control | 30 students / year |
| AE 171B | Aircraft Design II | 15 students / year (on demand) |
| AE 262 | Advanced Aerodynamics | 20 students / 3 semesters |

**Location:** **E-107** **Square Footage:** **1357**

**Existing Stations & Major Equipment:**

1. AEROLAB, LLC: Educational Wind Tunnel (EWT) System



## Performance Specifications:

- Airspeed Range - 10 mph (4.5 m/s) to 145+ mph (65 + m/s)
- Turbulence Level - less than 0.2%
- Reynolds Number (per foot) - 1.4 x $10^6$ /foot

Data Acquisition, Display and Control (DAC) System

- National Instruments hardware and LabVIEW software
  Capable of monitoring: Force/Moment Balance output,

pressures, model angle of attack, and temperature
(additional hardware required)

- Dell desktop computer with required peripherals included
- 3-Component Force / Moment Sting Balance
- Drag Model Set:
  Teardrop
  Backward cup
  Sphere
  Forward cup
  Circular flat plate
  1:48 scale F-16 model
  Wing with adjustable slat and flaps
  Clark Y-14 airfoil
  Pressure cylinder
  Pressure wing
  Boundary layer plate and 10-tap total pressure probe
  Wake rake
  Yaw probe
  Pitot-static probe
  Turbulence sphere
  Multi-column manometer
  Pressure transducer array

2. Water tunnel with dye injection system, control panel, 2D airfoil, conical body, and delta-wing aircraft models.

**Replacement Time Schedule & Cost:**

- Water Tunnel and instrumentation: approximate 5-year lifetime under heavy use.
- Wind Tunnel and instrumentation: approximate 10-year lifetime under heavy use.

Replacement cost approximately: $ 110,000

**No New Stations or Equipment Needed**

# AEROSPACE STRUCTURES LABORATORY

**Director:** Prof. Jeanine M. Hunter

**Purpose:** To demonstrate structural concepts in the design and analysis of aerospace vehicles: bending and torsional strain and stress, shear flow, shear center, nodal displacement, natural frequency and mode shape. Experiment design; strain gage technology and attachment technique.

**Courses and Enrollment:**

| | | |
|---|---|---|
| AE 114 | Aerospace Structures | 30 students / year |

**Location:** **E240** **Square Footage:** **400**

**Existing Stations:**

1. Cantilever Beam (rectangular cross-section) loaded in bending. Instrumented with 2-axis (90°) strain gages on the top and bottom.
   Experiment: Determine Poisson's Ratio.
2. Cantilever Beam (circular cross-section) loaded in torsion. Instrumented with rosette strain gages.
   Experiment: Determine the thickness of the hollow beam shaft.
3. C-shape Channel Section Beam. Instrumented with rosette strain gages on the top and side (neutral axis).
   Experiment: Verify shear center position by measuring bending strain and shear strain; theoretical result calculated in a homework assignment.
4. Beechcraft 200 (King Air) horizontal tail section in cantilever mount and cutaway. Instrumented for bending and torsion.
   Experiment: Determine section area properties; experimentally find shear center position.
5. UH-1H Rotor Blade section, in a cantilever mount. Experiment under development.

**Additional Equipment:**

| | | | |
|---|---|---|---|
| 1. | B & K | 4808 | Shaker Unit |
| 2. | B & K | 2712 | Power Amplifier |
| 3. | B & K | 1050 | Vibration Exciter |

**New Stations & Equipment Needed:**

1. Model of spacecraft truss structure: bars with pin joints
   Experiment: Verify Finite Element Model computation of nodal displacement and truss natural frequency.
2. Photoelasticity apparatus for visualization of stress distribution and concentrations.
   Experiment: Predict stress distributions on structural element loaded in tension using classical and Finite Element Analysis, compare with experimental result.

# COMPUTATIONAL FLUID DYNAMICS LABORATORY

**Director:** Dr. Periklis Papadopoulos

**Purpose:** To provide students with hardware and software in exposing them to the widely used tools utilized in CFD development and application.

**Courses and Enrollment:**

| | | |
|---|---|---|
| AE 164 | Compressible Flow | 30 students / year |
| AE 169 | Computational Fluid Dynamics | 30 students / year |
| AE 171B | Aircraft Design II | 15 students / year (on demand) |
| AE172B | Spacecraft Design II | 15 students / year (on demand) |
| AE 269 | Advanced Computational Fluid Dynamics | 20 students / 3 semesters |

**Location:** **E-272** **Square Footage:** **400**

**Existing Stations and Major Equipment:**

1. Pentium 4 PCs and Printers
2. Various software such as Grid Pro

**Replacement Time Schedule and Cost:**

Upgrade hardware and software: immediate need $15,000

# SPACE ENGINEERING LABORATORY

**Director:** Dr. Periklis Papadopoulos

**Purpose:** To provide students with subsystem and system-level experiments in selected systems comprising modern spacecraft and launch vehicles including payload instrumentation and remote sensors, thermal systems management, communications and power systems. Also to provide students the facilities to construct the microsatellite they design as a part of their senior design project.

**Courses and Enrollment:**

| | | |
|---|---|---|
| AE 110 | Space Systems Engineering | 15 students/year |
| AE 172 A/B | Spacecraft Design I,II | 15 students/year |

**Location:** **E-236** **Square Footage:** **1318**

**Existing Stations & Major Equipment:**

1. (3) Cleanroom hoods with associated materials.
2. Suite of tools for use in spacecraft construction: hand tools, drill press, shop tables, vice, etc.
3. Lab instrumentation: (3) oscilloscopes, (2) logic analyzers, etc.

**Replacement Time Schedule & Cost:**

| | |
|---|---|
| 1. (3) Cleanroom hoods – 15 year lifetime – replacement cost: | $25,000 |
| 2. Suite of tools - 10 year lifetime – replacement cost: | $10,000 |
| 3. Lab instrumentation: - 5 year lifetime – replacement cost: | $10,000 |
| Total replacement cost | $45,000 |

# AIRCRAFT DESIGN LABORATORY

**Director:** Dr. Nikos J. Mourtos

**Purpose:** To provide students with support for all their senior coursework activities, especially the senior design project. Support includes facilities, workspace staging areas, bibliographic data systems, computer resources (networked high-power workstations, software for CAD, modeling and computation / simulation, and electronic data bases)

**Courses and Enrollment:**

| | | |
|---|---|---|
| AE 171 A,B | Aircraft Design I, II | 15 students / year |
| AE 271 | Advanced Aircraft Design | 20 students / 3 semesters |
| AE 164 | Compressible Flow | 30 students / year |

**Location:** **E-164** **Square Footage:** **1,800**

**Existing Stations & Major Equipment:**

1. 10 x HP 9000 3-D color graphics workstations networked with laser printer.

2. Software: Advanced Aircraft Analysis (AAA), LINAIR (multiple nonplanar lifting surface analysis program), Wing Design (aerodynamic analysis and design of wings), PANDA (airfoil analysis and design), SAND (simulation of aircraft nonlinear dynamics), finite element, solid modeling, CAD, FORTRAN & C, Microsoft Office (desktop publishing).

**Replacement Time Schedule & Cost:**

| | |
|---|---|
| Approximately 5-year lifetime, hardware replacement cost: | $25,000 |
| Software replacement cost: | $30,000 |

# SPACECRAFT DESIGN LABORATORY

**Director:** Dr. Periklis Papadopoulos

**Purpose:** To provide students with support for all their coursework, especially the senior design project. Support includes facilities, workspace, staging areas, computer resources with applications software (both PC and UNIX level).

**Courses and Enrollment:**

| | | |
|---|---|---|
| AE 110 | Space Systems Engineering | 15 students / year |
| AE 172 A/B | Spacecraft Design I,II | 15 students / year |

**Location:** **E-272** **Square Footage:** **1975**

**Existing Stations & Major Equipment**

1. HP 9000 computer
2. (4) Pentium PCs and Printers
3. (1) Pentium laptop computer
4. Overhead panel projection system

**Replacement Time Schedule & Cost:**

1. Approximately five-year lifetime.

2. Hardware replacement cost: $ 150,000

3. Software replacement (upgrading) cost: $ 20,000

# ENGINEERING MEASUREMENTS LABORATORY

**Director:** Dr. Burford J. Furman

**Purpose**: To support laboratory instruction in engineering measurements.

**Courses and Enrollment**

| | | |
|---|---|---|
| ME 120 | Fundamentals of Mechatronics Engineering | 180 students/yr. |

**Location:** **E-133** **Square Footage:** **1400**

**Existing Stations & Major Equipment**

1. Lab instrumentation: oscilloscopes, function generators, power supplies (about 6 each)
2. Personal computers (10 each)
3. Brookfield DV II+ Viscometer
4. VTS electrodynamic shaker system
5. HP 3582A Dynamic Signal Analyzer
6. Arbor 5005 electronic scale
7. B & K Sound Power Meter
8. L.A.B. Drop Tester
9. National Instruments DAQ Signal Accessory (7 each)
10. National Instruments 6024E data acquisition cards (9 each)
11. Fowler electronic calipers (5 each)

**Replacement Time Schedule & Cost**

| | |
|---|---|
| 1. Lab instrumentation – 10 year life – repl. cost: | $15,000 |
| 2. HP Laserjet printer – 5 year life – repl. cost | $750 |
| 3. National Instruments DAQ Signal Accessory (10 each) – 5 year life - repl. cost: | $4,750 |
| 4. National Instruments E-series DAQ cards (10 each) – 5 year life - repl. cost: | $5,000 |
| 5. Brookfield DV II+ Viscometer – 10 year life – repl. cost: | $5,000 |
| 6. B & K Sound Power Meter – 10 year life – repl. cost: | $5,000 |
| 7. Agilent 35670A 2-channel Dynamic Signal Analyzer– 10 year life – repl. cost: | $20,000 |
| 8. Electronic scale – 10 year life – repl. cost: | $2,000 |
| 9. Electronic calipers (10 each) – 5 year life | $1,400 |
| 10. Personal computers (10 each) – 5 year life - repl. cost: | $14,000 |
| **Total replacement cost:** | **$72,900** |

**New Stations and Equipment Needed**

| | |
|---|---|
| 1. NI USB-6210 M Series Multifunction DAQ device (10 ea.) | $6,500 |
| 2. NI SC-2075 terminal boards (10 ea.) | $5,000 |
| 3. NI Compact RIO stations (3 ea.) | $15,000 |
| **Total cost:** | **$26,500** |

# Appendix D – Institutional Summary

**The Institution**

- Name and address of the institution
  San Jose State University
  One Washington Square
  San Jose, California 95192

- Name and title of the chief executive officer of the institution
  Dr. Don Kassing, Interim President

- Name and title of the person submitting the self-study report
  Dick Desautel, Interim Chair
  Department of Mechanical and Aerospace Engineering
  Charles W. Davidson College of Engineering

- San Jose State University is accredited by the Accrediting Commission for Senior Colleges and Universities of the Western Association of Schools and Colleges (WASC). It received its initial accreditation in 1962, and its most recent accreditation in 2007.

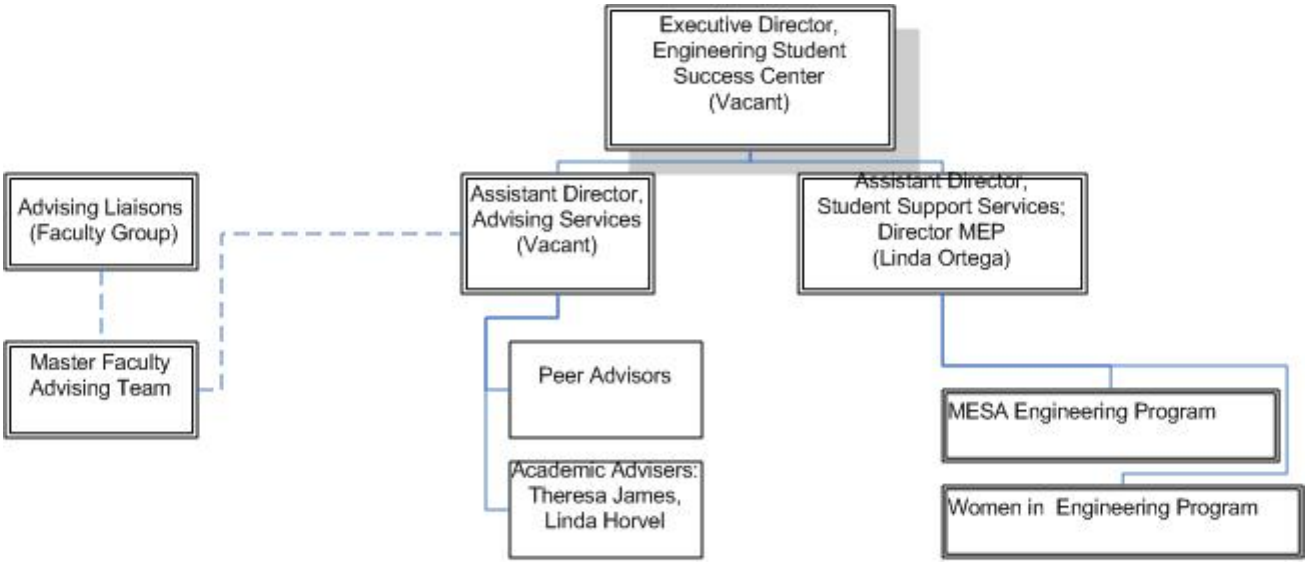
**Type of Control**

The public higher education system in the State of California is comprised of three systems: the University of California (UC), the California State University (CSU), and California Community Colleges (CC). San Jose State University (SJSU) is one of the 23 campuses of the CSU system, and is the oldest public higher education institution on the west coast.

Responsibilities for the California State University system are vested in its Board of Trustees, consisting of ex-officio members; alumni and faculty representatives; and members appointed by the Governor. The trustees appoint the Chancellor of the University system. The President of San Jose State University is the chief executive officer of the campus, and reports to the Chancellor.

**Educational Unit**

The Aerospace Engineering Program is hosted within the Department of Mechanical and Aerospace Engineering. The Department Chair has administrative and budgetary responsibility for the programs in the department, and reports directly to the Dean of the Charles W. Davidson College of Engineering, Dr. Belle Wei. The Dean in turn reports, along with deans of seven other colleges, to the Vice President for Academic Affairs (Provost) Dr. Gerry Selter. The Provost reports to the president of the University, Dr. Don Kassing (with Dr. Mohammad H. Qayoumi scheduled to begin as President on July 1, 2011).




Engineering Student Success Center Organization Chart

**Brief Description of the College**

As noted, the Mechanical Engineering Program is located within the Charles W. Davidson College of Engineering, which is one of the eight Colleges comprising San Jose State University. The Colleges are:

- College of Applied Sciences and Arts
- College of Business
- College of Education
- College of Humanities and The Arts
- College of Science
- College of Social Sciences
- International and Extended Studies.

There were 2,745 undergraduates and 1,772 graduate students enrolled in the College of Engineering in Fall 2010, comprising about 15% of the total university enrollment. There were 82 tenure-track (including faculty members on the Faculty Early Retirement Program (FERP)), 3 full-time temporary and 99 part-time faculty members in the same semester. The College is organized administratively into 6 engineering departments, one non-engineering department (Aviation and Technology), and one non-accredited engineering program, General Engineering. General engineering reports to the Associate Dean for Graduate and Extended Studies (ADGES), while all other departments report to the Dean. The Departments are:

- Chemical and Materials Engineering, Chair: Dr. Gregory Young
- Civil and Environmental Engineering, Chair: Dr. Udeme Ndon
- Computer Engineering, Chair: Dr. Sigurd Meldal
- Electrical Engineering, Chair: Dr. Ray Chen
- Industrial and Systems Engineering, Chair: Dr. Yasser Dessouky
- Mechanical and Aerospace Engineering, Interim Chair: Dr. Dick Desautel
- Aviation and Technology, Chair: Dr. Seth Bates

The six engineering department chairs manage the following nine engineering programs:

- Aerospace Engineering
- Chemical Engineering
- Civil Engineering
- Computer Engineering
- Electrical Engineering
- Industrial and Systems Engineering
- Materials Engineering
- Mechanical Engineering
- Software Engineering (jointly with Computer Science and administered by Undergraduate Studies).

The General Engineering Program serves as an incubator for new engineering concentrations. It also serves entering engineering students who are undecided about their majors. General Engineering is not an ABET accredited program.

Department Chairs report to the Dean of Engineering. The Office of the Dean is organized as follows:

- Dean: Dr. Belle Wei
- Associate Dean: Dr. Emily Allen
- Associate Dean for Graduate and Extended Studies: Dr. Ahmed Hambaba

**Academic Support Units**

All Engineering majors require some courses in math, physics and chemistry. Beginning Fall 2011, the Mechanical Engineering Program also requires a course taught by the Industrial Technology program. The chairs of those non-engineering departments providing courses required for engineers are as follows.

Bradley Stone, Chair of Chemistry Department

Brad Jackson, Chair of Mathematics Department

Kiumars Parvin, Chair of Physics Department

Seth Bates, Chair of Aviation and Technology Department

General Education courses are taught by a wide variety of departments across the campus.

**Non-academic Support Units**

The following lists first the non-academic support units within the College of Engineering, followed by a list of the supporting non-academic units outside the College of Engineering.

**A. Support Units within the College**

The primary units within the College supporting the academic programs and students are the Engineering Student Success Center (ESSC), the MESA Engineering Program (MEP), Engineering computer Systems (ECS) and Central Shop

**Engineering Student Success Center (ESSC)**

The Engineering Student Success Center was established in Spring 2005. The Center provides the following services to all engineering students:

- advising on General Education requirements;
- monitoring and advising of students on probation;
- offering study skills workshops; and
- advising of new students.

The Center is staffed by one engineering advisor, one student assistant, and one General Education advisor from the University Academic Services.

**MESA Engineering Program (MEP)**

The goal of the Mathematics, Engineering, and Science Achievement Engineering Program is to increase the number of engineering graduates entering the engineering profession from groups with low eligibility rates in college admissions. The program provides the following services to MESA students: a student study center, Academic Excellence Workshops, professional development workshops, freshmen orientation, career advising, and support to student organizations.

**Engineering Computing Systems (ECS)**

Engineering Computing Systems develops and supports laboratory, faculty, and staff computer systems; implements, configures and maintains application software; maintains network operating systems; provides Internet connectivity; and manages hardware and software licenses. The ECS ensures the functionality and maximum uptime of laboratory servers and workstations.

The ECS is comprised of four full-time employees. Each individual is assigned an area of specialization as described below. Support of several student assistants is shared among ECS personnel.

<u>Information Systems Analyst</u> (Scott Pham)

Responsibilities include: i) plan, design, specify, evaluate, select, order, configure, install, maintain, and administer software and hardware for servers, clients, and peripherals in academic computer laboratories. (see Section 7.B in the main text.); ii) support faculty and staff as a technical consultant for software, operating systems, and Internet connectivity issues; iii) maintain currency of virus protection; iv) maintain FTP servers with current virus software and updates; and v) maintain frequent email and personal contact with faculty and staff.

<u>Webmaster</u> (Brandon Rose)

Responsibilities include: i) create and manage the information content (words and pictures) and organization of the COE web site; and ii) manage the computer server and technical programming aspects of the web site.

Information Systems Analyst (Ben Rashid)

Responsibilities include: i) maintain, install, repair, and troubleshoot component-level hardware in microcomputer systems and peripheral equipment; ii) maintain local area networks; iii) provide technical support for faculty and staff; and iv) act as liaison with hardware and software vendors.

ECS Director (Kindness Israel)

The ECS Director is responsible for developing, implementing, managing, and maintaining cost-effective College-wide computing and network systems, which include administrative systems, instructional computer labs, and Internet access.

**Central Shop**

The College of Engineering Central Shop is staffed by two full-time machinists and several part-time student assistants. The Central Shop provides a variety of services in the shops and laboratories to meet the teaching and research needs of the instructional programs. The responsibilities of the Central Shop include support to all College departments in : i) maintenance and repair of mechanical equipment; ii) design, fabrication and installation of teaching devices and products in support of instruction, student projects, and faculty research needs; and iii) providing guidance to faculty and students on machine operations.

**B. Support Units Outside the College**

There are many campus units outside the College that support the instructional and operational needs of the Charles W. Davidson College of Engineering. There are three of them that provide the most critical support to the College: 1) the Student Services unit of Students Affairs Division; 2) the San Jose State University Library (Dr. Martin Luther King, Jr. Library); and 3) University Technology Services.

**Student Services**

University Academic Services collaborates with the College in providing academic advising and support to engineering students. Student Services is comprised of four main units: i) the Learning Assistance Resource Center (LARC, www.sjsu.edu/larc); ii) Academic Advising & Retention Services (AARS, www.sjsu.edu/aars); iii) Disability Resource Center (DRC, www.drc.sjsu.edu); and iv) Counseling Services (www.sjsu.edu/counseling).

LARC offers a variety of tutoring services to students, which include:

- individual or group tutoring;
- assistance in developing writing skills;
- assistance in lower and upper division mathematics classes;
- skills improvement seminars;
- group study/adjunct classes in specific courses;

- WST (Writing Skills Test) preparation; and
- support in basic computer skills.

AARS offers a variety of advising services including:

- drop-in advising on General Education requirements, undeclared majors, mathematics and English placement examination, late add and drop processes, academic probation, and disqualification;
- assistance with Academic Advising Reports;
- group advising sessions;
- planning for graduate studies and admission for graduate schools; and
- seminars/workshops on special topics such as academic planning, study skills, and choosing a major.

University Academic Services also offers special services to historically disadvantaged students through the Educational Opportunity Program (EOP) and the Summer Bridge Program. The Summer Bridge Program provides a variety of educational experiences to incoming EOP students during summer.

DRC offers a wide array of support services for students with disabilities including:

- adaptive computer hardware and software for exams
- alternative formats for curriculum related print materials (Braille, enlarged print, CD ROM, audio taped)
- assistive listening device
- extended exam time
- modified testing formats or alternative means of evaluation
- sign language interpreters for all curriculum requirements
- student note-takers
- the Deaf & Hard of Hearing Program provides educational sign-language interpreting and educational real-time captioning services
- one-to-one educational assistant

Counseling Services offers a variety of services including:

- personal counseling to help student identify and accomplish academic and career goals
- educational counseling by providing information and resources on how to reach desired goals
- psychiatric services
- workshops and groups on variety of topics for students

**San Jose State University Library**

Organizational Structure

San Jose State University Library and San Jose Public Libraries have jointly developed and managed a library, Dr. Martin Luther King, Jr. Library, which opened its door on August 1, 2003. The Dr. Martin Luther King, Jr. Library, the King Library, is the first joint library between a university and a city in the country. Its success can be measured by the dramatic increase in its circulation statistics, i.e., the doubling of the number of check-outs by SJSU faculty and students in its first ten months of operations. Its success is also measured by the many awards it has received, including the prestigious national Thomson/Gale 2004 Library of the Year award.

The King Library is jointly managed by the Dean of the University Library, the Director of the San Jose City Public Library System, and four integrated key operational units: Access Services, Information Technology, Reference, and Technical Services. The Dean, Director, and key unit heads make up the King Management Team for issues of common concern. However, all academic and related collection development decisions are the sole responsibility of the University Library. Special attention is paid to areas in which collaboration may yield benefits.

Organizationally, the San Jose State University Library is in the Academic Affairs division. It is headed by the Dean of the University Library, who reports to the Provost.

A detailed description of library resources and services supporting engineering programs is given in Criterion 7.E.

- **Credit Unit**

One semester unit represents one class hour (50 minutes) or three laboratory hours per week. One academic year represents 30 weeks of classes, exclusive of final examinations.

- **Tables**

Table D-1 shows the Aerospace Engineering Program enrollment and degree data for the past five years. Please note that impaction status was placed on the program in Fall 2009 resulting in a decreased enrollment of new 1$^{st}$-year students.

Table D-2 shows the personnel resources supporting the Aerospace Engineering Program in Fall 2010.

Table D.1 – Aerospace Engineering Enrollment and Degree Data

| | Academic Year | | Enrollment Year | | | | | Total Undergrad | Total Grad | Degrees Awarded | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 1st | 2nd | 3rd | 4th | 5th | | | Associate | Bachelor | Master | Doctorate |
| Current Year | F10 | FT | 44 | 25 | 29 | 36 | 0 | 134 | 9 | 0 | | | 0 |
| | | PT | 2 | 3 | 3 | 8 | 0 | 16 | 25 | | | | |
| 1 | F09 | FT | 45 | 32 | 31 | 42 | 0 | 150 | 17 | 0 | 16 | 4 | 0 |
| | | PT | 6 | 1 | 2 | 3 | 0 | 12 | 9 | | | | |
| 2 | F08 | FT | 74 | 23 | 30 | 36 | 0 | 163 | 15 | 0 | 22 | 7 | 0 |
| | | PT | 4 | 2 | 1 | 8 | 1 | 16 | 14 | | | | |
| 3 | F07 | FT | 63 | 18 | 26 | 39 | 2 | 148 | 7 | 0 | 23 | 5 | 0 |
| | | PT | 3 | 1 | 6 | 4 | 0 | 14 | 10 | | | | |
| 4 | F06 | FT | 46 | 15 | 26 | 47 | 1 | 135 | 7 | 0 | 16 | 8 | 0 |
| | | PT | 5 | 0 | 1 | 7 | 0 | 13 | 10 | | | | |

Give official fall term enrollment figures (head count) for the current and preceding four academic years and undergraduate and graduate degrees conferred during each of those years. The "current" year means the academic year preceding the fall visit.

FT--full time
PT--part time

Table D.2 – Personnel Supporting the Aerospace Engineering Program
Year[1]: Fall 2010

| | HEAD COUNT | | FTE[2] |
|---|---|---|---|
| | FT | PT | |
| Administrative[3] | 1 | | 0.5 (Dept) |
| Faculty (tenure-track) | 2 | | 2.0 |
| Other Faculty (excluding student Assistants) | | 1 | 0.2 |
| Student Teaching Associates* | | | |
| Instructional/Student Assistants** | | 5 | 2.0 |
| Technicians/Specialists | 1 | | ~ 0.5 (Dept shared with College) |
| Office/Clerical Employees | 1 | | 1.0 (Dept) |
| Others[4] | | | |

1 Data on this table is for Fall 2010, the fall term of report preparation. An updated table for Fall 2011 (term of visit) will be available when the ABET team arrives.

2 For student teaching assistants, 1 FTE equals 20 hours per week of work (or service). For undergraduate and graduate students, 1 FTE equals 15 semester credit-hours (or 24 quarter credit-hours) per term of institutional course work, meaning all courses — science, humanities and social sciences, etc. For faculty members, 1 FTE equals 15 WTU (12 WTU teaching and 3 WTU service) as a full-time load.

3 Persons holding joint administrative/faculty positions or other combined assignments are allocated to each category according to the fraction of the appointment assigned to that category.

4 Specify any other category considered appropriate, or leave blank.

* Teaching Associates have class responsibility.

** Includes graders (ISA), classroom assistants (SA), and clerical assistants.

## Signature Attesting to Compliance

By signing below, I attest to the following:

That the Aerospace Engineering Program has conducted an honest assessment of compliance and has provided a complete and accurate disclosure of timely information regarding compliance with ABET's *Criteria for Accrediting Engineering Programs* to include the General Criteria and any applicable Program Criteria, and the ABET *Accreditation Policy and Procedure Manual.*

___________________________________

**Dean's Name (As indicated on the RFE)**

___________________________________ _________________________

**Signature** **Date**

# Appendix E – College Policies and Forms

## E.1 Probation in / Disqualification from the Major

This policy can be found at
http://www.engr.sjsu.edu/media/pdf/academic/policies/sjsu_coe_acad_standing_Policy_sp100

CoE Policy Sp10-01
Policy on Academic Standing in the Major
College of Engineering
Policy Adopted Spring 2010
Policy First Implementation Fall 2010

Engineering majors are academically challenging and require more units than other majors. Whereas SJSU cumulative GPA is the metric used for academic standing in the university, SJSU Major GPA is the appropriate metric for determining a student's progress in the College of Engineering. Major GPA refers to the GPA calculated for all courses showing on the major form, including preparation for the major, required courses, and declared technical electives. The SJSU Major GPA includes courses taken both before and after admission to SJSU, and may include courses taken at other institutions after initial admission to SJSU.

This policy provides the conditions necessary for a student to be considered in good standing in the major. The policy deals with four areas:

1. Progress towards Degree for Entering First-Time Freshmen
2. Probation in the Major
3. Disqualification from the Major
4. Reinstatement to the Major

**1. Progress Towards Degree for Entering First-Time Freshmen**

a. The policy described in this section applies to any entering first-time freshman in a College of Engineering major. All such students must complete specific SJSU units for their College of Engineering major within their first 70 units attempted, with grades of "C-" or better, and have an overall cumulative SJSU GPA of at least 2.0. Students failing to complete this requirement may be disqualified from their College of Engineering major. Note that some majors may have degree requirements of C or better for some courses as well.

The specific units required for College of Engineering majors are as follows:

For Engineering majors: Math 30 or 30P, Math 31, Phys 50 or 70, and English 1A.

For Aviation and Technology majors: Math 71 or 30 or 30P, Phys 2A or 50, and English 1A.

b. Students who fail to complete this requirement for progress to degree within the required 70 units of SJSU coursework will be required to change their major.

c. Students may complete these courses at a community college as long as the community college course work articulates to the above SJSU course work or is approved by the student's College advisor as having equivalent course content. These community college units will be counted toward the maximum of 70 attempted units.

d. In cases of error or extenuating circumstances, a student, upon receiving notice from the College that they failed to make required progress to degree, may petition immediately to an appropriate faculty committee at the department level to appeal such an action. In the case of a negative decision, the student may appeal to the Academic Disqualification and Reinstatement Review Committee (ADRRC). After review of the petition, the ADRRC will make their recommendation to the Associate Vice President for Undergraduate Studies to confirm or rescind action.

**2. Probation in the Major**

Note: This policy is adapted from F96-11, Academic Standards; Probation; Disqualification.

a. Any College of Engineering student will be considered to be on probation in the major if at any time the cumulative College of Engineering Major GPA falls below a "C" average (2.0).

b. The Department and/or the College will make reasonable attempts to notify any undergraduate student who is subject to probation in the major; however, it is the student's responsibility to be aware of his or her Major GPA.

c. College of Engineering students on probation in the major must meet with an advisor in the College of Engineering to design a study plan to bring their Major GPA to 2.0 or better.

d. To be removed from probation and restored to good academic standing in the Major, students on probation in the major must continue to earn a term Major GPA of 2.0 or better, every term until their cumulative Major GPA is 2.0 or better.

e. Special circumstances.

i. If a student repeats a course for Grade Forgiveness purposes (University Policy F08-2), the earned grade for Grade Forgiveness is the grade of record. As per F08-2, Section I.B.5, "students may repeat an individual course for Grade Forgiveness only once."
ii. As stated in UP F08-2, Section I.C.1 when a course is repeated using "Grade Averaging," grade points and units for all attempts shall be calculated in the student's major GPA.
iv. Withdrawal from the University while on probation in the major will not result in disqualification. However, the same major GPA requirement will apply upon re-admission to the university.

**3. Disqualification from the Major**

a. Students are subject to disqualification from their College of Engineering major when:

i. They are on probation in the major, and
ii. They have been notified that they have been placed on College of Engineering probation in the major, and
iii. They fail to achieve the minimum term major grade point average of 2.0 or above during the following term.

b. College of Engineering students disqualified under this policy will be notified by the College that they are no longer eligible to continue in their College of Engineering major. Their major will be changed to Undeclared unless another major for which they are qualified is selected and approved by the new major's academic advisor.

c. In cases of error or extenuating circumstances, a student, upon receiving notice of probation or disqualification in the major, may petition immediately to an appropriate faculty committee at the department level to appeal such action. In the case of a negative decision, the student may appeal to the Academic Disqualification and Reinstatement Review Committee (ADRRC). After review of the petition, the Committee will make its recommendation to the Associate Vice President for Undergraduate Studies to confirm or rescind the action taken.

**4. Reinstatement to the Major**

a. A College of Engineering student may be reinstated to the major by petition only at the discretion of the Major department. The student, along with a major advisor, will be required to design a study plan that addresses scholastic deficiencies in the major and demonstrates that she or he is ready to resume rigorous academic work. The study plan must be approved by the Advisor and Chair *before* the student enrolls in the courses. Students will be reinstated to the Major upon successful completion of the study plan only when their Major GPA returns them to good standing in the major.

b. If the student is also disqualified from the university, he or she must follow university guidelines to petition for reinstatement as well as readmission or reactivation to the university, as well as these College guidelines for reinstatement to the major.

## E.2 Change of Major Policy

This policy is located at http://www.engr.sjsu.edu/students/essc/advising/comp.

Are you a new student who was admitted Undeclared to the University and would like to declare a major in the College of Engineering? Are you a current College of Engineering major who would like to switch from one department to another (for example Chemical Engineering to Electrical Engineering)? The College has created a change of major policy which will apply to all students beginning August 2010. Please see below for more details.

- Student must be in good academic standing to be considered for a Change of Major
- Must have attained a SJSU 2.0 minimum GPA at the end of the semester the application is submitted
- Must meet with a Major Advisor to determine a Study Plan (see attached page), consisting of approximately 9 units in the major (6 units for Aviation and Technology majors), to be completed at SJSU
- Major Advisor will sign the Study Plan indicating the student has been advised on what courses to take
- The Study Plan may include upper or lower division courses depending on the student's academic level.
- Student must also have completed the following courses (or their equivalents) with a C- or better:
    - **For Engineering**: Math 30 or 30P, Math 31, Phys 50 or 70, and Engl 1A
    - **For Aviation and Technology**: Math 71 or 30 or 30P, Phys 2A or 50, and Engl 1A
    - These courses **may be as part of the Study Plan, or in addition to the Study Plan**, depending on when the student is applying for Change of Major.
- The Study Plan must be completed with a minimum 2.0 GPA as well as a minimum grade of C- in each course.
- For change of major decisions, the Major Department may take into consideration other academic work completed by the student at SJSU or elsewhere, in addition to the completed Study Plan.
- Applications will be accepted twice per year, with deadlines of **December 20** for spring semester (notification by approximately January 15) and **May 20** for fall semester (notification by approximately June 15). A complete Change of Major application consists of the University's Change of Major form plus the Study Plan.

The department advisor will fill in the Study Plan grades at the end of semester before review.

- Review of applications will occur only after the deadline.
- Applications for Change of Major should be submitted to the office of the Major Department to which the student is applying.
- Final admission into the new Major will depend on the capacity of the Major to accept new students.
- **Due to impaction there is no guarantee of admission to the new Major.**

Questions? Contact the department you want to major in, or the Engineering Student Success Center at success.engineering@sjsu.edu

SAN JOSÉ STATE UNIVERSITY

**COLLEGE OF ENGINEERING**

**Student Semester Study Plan**

## I. Instructions (Use a different form for each semester.)

This Student Study Plan is to be used by students who:

1. Intend to apply for Change of Major into a College of Engineering undergraduate program.
2. Are on Probation status, either by University or in Major (students on probation are limited to 12 units).
3. Are seeking Reinstatement to a Major after Disqualification from University or from Major.
4. Have other reasons for documenting advisor recommendations on classes.

Note that fulfillment of the Study Plan ***does not guarantee*** change of major or reinstatement to the Major.

SJSU ID ____________

Last Name ________________ First ____________ MI ________

Street /Apt# ______________________________

City ________________ State ______ Zip ____________

Phone # ____________ E-mail Address ______________

## II. Additional information

1. Students applying for Change of Major into a College of Engineering undergraduate program will need to attach this Study Plan, signed by an Adviser, to the University's **Change of Major Application** (http://www.sjsu.edu/registrar/forms/) and submit as one packet to the Dept Office by Dec 20 or May 20 each year.

2. Students seeking Reinstatement to a Major, after Disqualification from University or from Major, will need to attach this Study Plan, signed by an Advisor, to the University's **Reinstatement Petition** (http://www.sjsu.edu/registrar/forms/).

## III. Current Status

In Good Standing ________

On Probation (in Major) ________ (in University) ________

Disqualified (from Major) ________ (from University) ________

Current Major/Concentration: ______________________

Requested Major/Concentration (if seeking Change of Major): ______________

## IV. Advisor Recommended Courses (major-related) that may be used to fulfill the Study Plan:

Semester: ____________

Course/Units/Grade ________/____/____ Course/Units/Grade ________/____/____

Course/Units/Grade ________/____/____ Course/Units/Grade ________/____/____

Course/Units/Grade ________/____/____ Course/Units/Grade ________/____/____

## V. Other Advisor Comments

## VI. Approval of Recommended Courses

______________________________

Advisor 's Printed Name/Signature/Date

CoE Study Plan Rev. 3 (November 2010)

Figure E.1 – Study Plan for students changing major

## E.3 Advising and Graduation Forms

# MAE DEPARTMENT: *Academic Advising Guide*

Name(Last): ______________________ (First): ______________________________

SJSU ID: _______________________ Today's Date: ___________________________

Phone No: ______________________ Advisor: ______________________________

E-Mail: ________________________ Major (circle one) ME AE

Academic Status (circle one): Incoming Freshmen Transfer from CC Transfer from other dept. or schools Continuing student

I am a student of the MAE Department with a transcript or an admission letter to present: Yes No

**NOTE:** Students need to bring a transcript or an admission letter along with this form for advising.

Current Semester and Year: Fall ________, Spring _________, Summer _________

| Course No | Title | Units | Estimated Grade |
|---|---|---|---|
| ("EXAMPLE": Math 19 | Pre-Calculus | 5 | B+ ) |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |

Total number of units: ______

Current overall GPA: _______ Number of hours working weekly (at job): _________

Have you completed and filed your graduation Major Form? (circle one) Yes No **Initials:** ___

**NOTE:** Major forms are required to be filed 15 months prior to graduation, otherwise your graduation will be delayed. **Major Forms should be downloaded from the MAE web-site at www.engr.sjsu.edu/mae.**

Semester and Year being advised for: Fall ________, Spring _________, Summer __________

| Course No | Title | Units | Prerequisites or Corequisites |
|---|---|---|---|
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |

Maximum total number of units: _______

1. **I have or will have completed all prerequisites prior to taking the above courses. I understand that I will either be dropped by the instructor or get a failing grade if I take a course without satisfying the prerequisites.**
2. **I will *NOT* change the above schedule without visiting and receiving approval of an academic advisor.** **Initials:** ____
3. **I understand that I need to come for advising each semester for the following semester prior to the final exam week.**

_______________________________ _______________________________

Student's Signature Advisor's Signature

## Mechanical & Aerospace Engineering Department

### ACADEMIC COURSE LOG: ***Aerospace Engineering***

Name: ______________________
SJSU ID: ______________________
Phone No: ______________________
E-mail: ______________________

Entered SJSU (Semester and Year): ______________
Entered as (circle one):
CC Transfer    Dept. Transfer    Other Transfer
Advisor: ______________________

| Required Math & Science Courses (33/35 units) | | | | |
|---|---|---|---|---|
| COURSE | Units | SJSU | OTHER | Grade |
| Math 30 | 3 | | | |
| Math 31 | 4 | | | |
| Math 32 | 3 | | | |
| Math 129A | 3 | | | |
| Math 133A | 3 | | | |
| Chem 1A | 5 | | | |
| Phys 70/50 | 4 | | | |
| Phys 71/51 | 4 | | | |
| Phys 72/52 | 4 | | | |
| Phys 53 | 2 | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

| AE Core Courses (27 units) | | | | |
|---|---|---|---|---|
| COURSE | Units | SJSU | OTHER | Grade |
| AE 114 | 3 | | | |
| AE 140 | 3 | | | |
| AE 160 | 3 | | | |
| AE 162 | 3 | | | |
| AE 164 | 3 | | | |
| AE 165 | 3 | | | |
| AE 167 | 3 | | | |
| AE 168 | 3 | | | |
| AE 169 | 3 | | | |
| Capstone Course (6 units minimum) | | | | |
| AE171A, B | 6 | | | |
| AE172A, B | 6 | | | |
| Technical Electives (6 units) | | | | |
| | 3 | | | |
| | 3 | | | |

| Engineering Core Courses (30 units) | | | | |
|---|---|---|---|---|
| COURSE | Units | SJSU | OTHER | Grade |
| Engr 10 | 3 | | | |
| ME 20 | 2 | | | |
| ME 30 | 2 | | | |
| Engr100W | 3 | | | |
| CE 99 | 2 | | | |
| CE 112 | 3 | | | |
| EE 98 | 3 | | | |
| MatE 25 | 3 | | | |
| ME 101 | 3 | | | |
| ME 113 | 4 | | | |
| ME 120 | 2 | | | |

| Advisor's Notes: |
|---|
| |

Figure E.2 – Academic Advising Guide (AAG)

Figure E.3a – BSAE Academic Course Log (ACL), page 1

## General Education Courses

I entered SJSU as a (circle): Freshman Transfer

College transferred from: ______________________

I am on the following GE track (circle): Humanities Honors
American Studies
Core GE courses

***PLEASE SEE SCHEDULE OF CLASSES***

| Area | Course | Units | SJSU | Other School | Grade |
|---|---|---|---|---|---|
| A1/Oral Comm. | | 3 | | | |
| A2/Written Comm I | English 1A* | 3 | | | |
| C1/Arts | | 3 | | | |
| C2/Letters | | 3 | | | |
| C3/Written Comm II | English 1B* | 3 | | | |
| D1/Human Behavior** | | 3 | | | |
| D2/Comp. Systems | | 3 | | | |
| D3/Soc. Issues | | 3 | | | |
| E/Human Under&Dev | | 3 | | | |
| S/Self, Soc.& Equality | | 3 | | | |
| V/Cul.,Civ& Glo. Und. | | 3 | | | |
| Kinesiology (PE) | | 1 | | | |
| Kinesiology (PE) | | 1 | | | |

*Not required for students completing Humanities Honors Track
** Not required for students completing American Studies 1A, 1B

Have you satisfied Area F (circle): Yes No

Advisor's Comments:

Figure E.3b – Academic Course Log (ACL), page 2

San José State UNIVERSITY

**COLLEGE OF ENGINEERING**
**Major Form for**
**Bachelor of Science in Aerospace Engineering**

MAE

**Name:** Hernandez, Gilberto
(last) (first) (MI)

**Proposed Graduation Date:** Spring 2011
Semester Year

Catalog Year for Graduation: 2010 - 2012

Focus Area (Optional): Aircraft Design

**Minimum No. of units for the Degree: 134 (139)**

| Required Courses For Major (69 units) | | | | | Required Courses For Major (cont.'d) | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Dept. | No. | Title | Units | Grade | Dept. | No. | Title | Units | Grade |
| 1. Engr | 10 | Intro. To Engineering | 3 | A- ✓ | 13. AE | 114 | Aerospace Structures | 3 | A- ✓ |
| 2. ME | 20 | Design and Graphics | 2 | B ✓ | 14. AE | 140 | Rigid Body Dynamics | 3 | B- ✓ |
| 3. ME | 30 | Comp. Applications | 2 | B ✓ | 15. AE | 160 | Aerodynamics I | 3 | B- ✓ |
| 4. Engr | 100W | Engineering Reports | 3 | B+ ✓ | 16. AE | 162 | Aerodynamics II | 3 | B- ✓ |
| 5. CE | 99 | Statics | 2 | B+ ✓ | 17. AE | 164 | Compressible Flow | 3 | C- ✓ |
| 6. CE | 112 | Mech of Materials | 3 | C ✓ | 18. AE | 165 | Aerospace Flight Mechanics | 3 | A ✓ |
| 7. EE | 98 | Intro to Circuit Analysis | 3 | A- ✓ | 19. AE | 167 | Aerospace Propulsion | 3 | B ✓ |
| 8. Mat E | 25 | Intro to Materials | 3 | C- ✓ | 20. AE | 168 | Aerosp. Vech. Dyn. & Cont. | 3 | B- ✓ |
| 9. ME | 101 | Dynamics | 3 | C+ ✓ | 21. AE | 169 | Comp. Fluid Dynamics | 3 | |
| 10. ME | 113 | Thermodynamics | 4 | C ✓ | Capstone Courses (6 Units) | | | | |
| 11. ME | 120 | Experimental Methods | 2 | | 22. AE | 171A | Aircraft Design I | 3 | A ✓ |
| 12. Math | 129A | Linear Algebra I | 3 | B ✓ | 23. AE | 171B | Aircraft Design II | 3 | |
| | | | | | Technical Electives (6 Units) | | | | |
| | | | | | 24. ME | 114 | Heat Transfer | 3 | C+ ✓ |
| | | | | | 25. AE | 135 | Intro. Composite Matls | 3 | |

* Course taken at SJSU

| Courses Required in Preparation for the Major (33 units) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Dept. | No. | Title | Units | Grade | Dept. | No. | Title | Units | Grade |
| 26. Chem | 1A | Chemistry for Engineers | 5 | B+ ✓ | 30. Math | 133A | Ord. Diff. Equations | 3 | C+ ✓ |
| 27. Math | 30 | Calculus I | 3 | B+ ✓ | ~~31. Phys~~ | ~~70~~ | ~~Univ. Physics: Mechanics~~ | 4 | |
| | | | | | Phys * | 50 | Univ. Physics: Mechanics | 4 | B+ ✓ |
| 28. Math | 31 | Calculus II | 4 | B+ ✓ | ~~32. Phys~~ | ~~71~~ | ~~Univ. Physics: E & M~~ | 4 | |
| | | | | | Phys * | 51 | Univ. Physics: E & M | 4 | B ✓ |
| 29. Math | 32 | Calculus III | 3 | C+ ✓ | ~~34. Phys~~ | ~~72~~ | ~~Univ. Physics: Atomic~~ | 4 | |
| | | | | | Phys * | 52 | Univ. Physics: Heat & Light | 4 | A- ✓ |
| | | | | | Phys * | 53 | Univ. Physics: Atomic | 2 | C ✓ |

To qualify for a baccalaureate degree in Aerospace Engineering, a student must receive a grade of 'C-' or better in all courses required for the program (Major and Technical Electives) and earn a cumulative grade point average of at least "C" (2.0) in each one of the following categories: all college work (the overall average), all units attempted at SJSU, all units in the major, and all units in a minor (if any).

[signature] 2/15/11
Associate Chair for Aerospace Engineering | Date

[signature] 2/15/11
Department Chair of Mechanical & Aerospace Engineering | Date

Figure E.4 – Example of a BSAE Major Form

# Engineering General Education Worksheet

SAN JOSÉ STATE UNIVERSITY

Last Name (print) [redacted] First [redacted] Student ID # [redacted]

Catalog Year Major ME Minor

| Core General Education | Course | Units | Where Taken | Grade |
|---|---|---|---|---|
| **A. Basic skills (9 units)** Complete one course in each area. Categories marked with * require a grade of C or better | | | | |
| A1 Oral Communication * | Comm 20 | 3 | SJ | A- |
| A2 Written Communication 1A* | Engl 1A | 3 | SJ | B |
| A3 Crtical Thinking * | ----Cleared by Completion of Engineering Major---- | | | |
| **B. Science & Math (9 units)** Complete one course in each area. Categories marked with * require a grade of C or better | | | | |
| B1 Physical Science | ----Cleared by Completion of Engineering Major---- | | | |
| B2 Life Science | ----Cleared by Completion of Engineering Major---- | | | |
| B3 Laboratory Science | ----Cleared by Completion of Engineering Major---- | | | |
| B4 Mathematical Concepts * | ----Cleared by Completion of Engineering Major---- | | | |
| **C. Humanities & Arts (9 units)** Complete one course in each area. | | | | |
| C1 Arts | AMS 1AB | 3 | SJ | A- |
| C2 Letters | AMS 1AB | 3 | SJ | B |
| C3 Written Communication 1B | Engl 1B | 3 | SJ | B+ |
| **D. Social Sciences (9 units)** Complete one course in each category. | | | | |
| D1 Human Behavior | area cleared by AMS 1AB for Engr major | | | |
| D2 Comparative systems | AMS 1AB | 3* | SJ | A- |
| D3 Social Issues | AMS 1AB | 3* | SJ | B |
| **E. Human Understanding & Development (3 Units)** | Hlm 10 | 3 | SJ | B |

**Prerequisites to SJSU Studies**

Pass Writing Skills Test yes [X] N/C [ ] Upper Division Standing yes [X] no [ ]

| SJSU Studies | Course | Units | Where Taken | Grade |
|---|---|---|---|---|
| **Complete one course in each area.** | | | | |
| Area R Earth & environment | ENGR 100w | 3 | SJ | A |
| Area Z Written Communication II* | ENGR 100w | | | |
| Area S Self, Society & Equality in the U.S. | | | | |
| Area V Culture, Civilization & Global Understanding | ME 198 | | SJ | Spr 11 |

| Graduation Requirements | Course | Units | Where Taken | Grade |
|---|---|---|---|---|
| **American Institutions** | | | | |
| F1 U.S. History | AMS 1AB | * | see | |
| F2 U. S. Constitution | | * | area | |
| F3 California Government | | * | D.2, D.3 | |
| **Physical Education Activity (2 courses)** | | | | |
| 1 | Kin 20A | 1 | SJ | A- |
| 2 | Kin 21 | 1 | SJ | A |

Completed by: [signature] Date: 2/9/11

REGISTRATION HOLDS WILL BE LIFTED BY THE MAJOR ADVISOR ONLY!

Figure E.5 – Example of a GE Checklist

SAN JOSÉ STATE UNIVERSITY

# Application for Graduation Information

Office of the Registrar, One Washington Square, San Jose, CA 95192-0009

**Graduation Application**

**Deadlines**

**Summer and Fall Graduation:**

**March 1st** We encourage you to apply at least 2 semesters in advance of the graduation date, if you have completed 90 semester units.

**Spring Graduation:**

**July 1st** of the preceding year, if you have completed 90 semester units.

**APPLICATION CHECKLIST**

- ☐ Please read this brochure carefully.
- ☐ Review all graduation requirements in the Catalog under which you will graduate.
- ☐ View your Degree Progress Report (http://degreeprogress.sjsu.edu/) to determine what General Education (GE) requirements you may still have outstanding to complete your degree. You can keep track of your progress toward earning your Bachelor's degree by checking your Degree Progress on MySJSU, which will also give you detailed GE information.
- ☐ Please have your major department submit your completed Major/Minor forms in a **separate sealed** department envelope with your application for Graduation to the Student Service Center – Attn: Office of the Registrar(extended zip 0009) **by the application deadline shown above.**
- ☐ Effective July 1, 2010, all graduation application packets (with major and minor forms) must be submitted to the Office of the Registrar.
- ☐ **Complete all outstanding requirements by your graduation date.**
- ☐ Register with the Career Planning and Placement Office (Optional).

**Application Processing**

If your application is submitted to our office by the deadline date, a graduation worksheet of outstanding requirements will be mailed to you the semester prior to your graduation term. Please review this worksheet carefully. You must complete all requirements and submit all paper work by the last day of the term of graduation. Students will be given additional time to submit other documents (i.e. substitution forms, petitions, etc.)

**Second Baccalaureate Degree**

If you currently have a bachelor degree and have matriculated at SJSU into the second baccalaureate program, you should apply for graduation by the deadline. Please review the requirements for a second baccalaureate degree in the SJSU catalog.

To be eligible for the degree, you must complete all course work which constitutes the second degree with at least two additional semesters of work with a minimum of 30 units beyond the first degree in accordance with the University residence requirement. Second baccalaureate degree candidates must meet the academic regulations required of all undergraduate students.

**Attendance at another College or University**

Students planning to attend a college or university other than SJSU during their final semester must notify their Graduation Evaluator. Courses must be completed the semester of graduation, and transcripts received within one month after graduation.

**Changing Your Date of Graduation**

**All requirements must be completed by your graduation date.** If you discover that you will not be able to complete all requirements by the end of your anticipated graduation term, 1) you must meet with your major advisor who needs to approve your graduation date change form. 2) After your date change request has been approved, you will need to pay the $10 processing fee at the Bursar's Office, 3) the completed Graduation Date Change Form must be submitted to Window "R" (Registrar) in the SSC **no later than the first day of classes for the intended graduation term.**

**Official Notification of Degree**

The notification of graduation is mailed to the diploma mailing address you indicated on your Application for Graduation. If your diploma address has changed, please update your diploma and email address on my.sjsu.edu (view or update this information under your personal data) or contact your Graduation Evaluator as soon as possible to insure receipt of your correspondence.

Diplomas are mailed on a rolling basis as soon as final semester grades are posted and requirements are cleared (normally four to six weeks after the close of the semester).

**Commencement**

Degrees are conferred three times a year: August (Summer), December (Fall) and May (Spring). The date of the diploma reflects the term for which you applied and completed all degree requirements.

There is one Commencement Ceremony each academic year. It is held in May. Student who graduated in August or December of the previous year, and those who have applied for May graduation are eligible to participate in the ceremony. The Office of the President will mail commencement information to you in April of the year you qualify for participation.

**Please note:** If you apply after the application for graduation deadline date, or do not submit your graduation date change to your Evaluator on or before the first day of classes for the term of graduation, your name will not appear in the commencement book.

**Graduate Admission**

**Once you are granted your degree, you are no longer an enrolled student. Should you wish to continue your enrollment as a graduate student, you must file a new admission application on-line at: www.csumentor.edu**

If you require further information, please call (408) 283-7500.

Figure E.6 – Application for Graduation, page 1

SAN JOSÉ STATE
UNIVERSITY

# Application for Graduation Baccalaureate Degree

Office of the Registrar, One Washington Square, San Jose, CA 95192-0009

**Check one box to indicate the term and fill in the blank line to indicate the proposed year of graduation. Deadline to apply is right next to each option.**

☐**Summer** ________ ( March 1st ) ☐**Fall** ________ (March 1st ) ☐**Spring** ________ ( July 1st of previous year )
4 digit year 4 digit year 4 digit year

**Please note:** You are encouraged to apply by the deadline; however, applications must be in our office by **the last day to add classes** of the graduation term. Delays may occur and names may not appear in commencement book if not filed by the deadline.

**SJSU ID:** ______________________ or Social **Security number (optional):**______________________

**Legal name as it appears on your SJSU records (Please also provide previous names, if any) :**

Last name First name Middle

**Diploma name as you wish it to appear on your diploma** (Last name must be the same as on your SJSU record, or you will need to file a name change with the Office of the Registrar in the SSC Building):

Last name First name Middle

**Diploma Mailing Address for all graduation materials** (including your graduation worksheet and diploma):
**Note:** It is the student's responsibility to update this information on MySJSU(http://my.sjsu.edu/). Please be sure to view or update your current diploma mailing address and email address under your Personal Information. The university will not be held responsible if it is not updated.

Street number Street name Apartment

City State Zip Code email address

**Home Telephone:** **Work Telephone:** **Gender:** ☐male ☐female

Area Code Number Area Code Number Ext.

**What is your degree objective?** ______________________ *e.g.* BA , BS, BFA , B of Music, Second Baccalaureate

**Major** ______________________ College ______________________

**Concentration, or Double Concentration, if any** ______________________ Minor, if any ______________________

**Double Major** ______________________

**Non-SJSU College work not yet submitted to San José State University (Previously taken, in progress, or planned):**

**List the college courses in which you are currently enrolled at SJSU:**

**Applicant's signature** **date**

**Major Advisor's printed name & signature** **date**

Figure E.6 – Application for Graduation, page 2

# Appendix F – AE Advisory Board

**Gonzalo Eduardo Mendoza**
Engineer Specialist
Advanced Design Aircraft Loads and Dynamics
Cessna Aircraft Company
Wichita Kansas 67277-7704
Phone: (316) 517 – 4623
GEMendoza@cessna.textron.com

**Marcus S. Murbach**
Principal Investigator, SOAREX Flight Series
MS213-13
NASA Ames Research Center
Moffett Field, CA 94035-1000
Phone: (650) 604 – 3155
marcus.s.murbach@nasa.gov

**Anna Rapo**
Director, Missions Operation Department
Space Systems / Loral
3875 Fabian Way, Palo Alto, CA 94303
rapoa@ssd.loral.com

**Brian P. Emma**
Systems Engineer Manager
Lockheed – Martin
P321 Segment Test Lead and Manager
Desk phone: 408-756-7098
brian.p.emma@lmco.com

**Tony Strawa**
Atmospheric Physics Branch
NASA-Ames Research Center
Mail Stop 245-4
Moffett Field, CA 94035-1000
astrawa@mail.arc.nasa.gov
Phone: (650) 604-3437 (W)

**Erik Levine**
Systems Engineering Manager, AsiaSat – 7 / TerreStar
Space Systems / Loral
3825 Fabian Way, Palo Alto, CA 94303-4604
Phone: (650) 852-5511
levine.erik@ssd.loral.com