

**Program Review for Mechanical and Aerospace engineering, UCSD**  
**4/29/13-4/30/13**

This is the first undergraduate program evaluation that the Department of Mechanical and Aerospace Engineering (MAE) in the Jacobs School of Engineering (JSOE) has had under the new system of program reviews, which were implemented in recent years. Over a one and a half day period, the committee met with a number of groups representing or interacting with the department including faculty and lecturers, administrative and laboratory support staff, undergraduate students, and graduate students that are involved with the program primarily as teaching assistants. The department offers undergraduate degrees in Mechanical Engineering (ME), Aerospace Engineering (AE), and Environmental Engineering; a major in Engineering Science was recently disestablished. It should be noted that the ME and AE majors are impacted, which is important to reduce the undergraduate student/faculty ratio and provide stability for the program going forward. The Environmental Engineering program (created in 2009), however, is not impacted and is an increasingly popular engineering discipline that is experiencing moderate, but noteworthy, growth.

Overall the committee was impressed by the state of the MAE undergraduate programs. The faculty is genuinely enthusiastic and energetic about undergraduate education, while maintaining a strong mission in research and in graduate education. The academic and lab staffs are effective and are strongly concerned for the students' well-being. The students we met were enthusiastic about the department's offerings and were generally positive about the educational climate. The curricula for all three programs are strong, with a good mix of theory, computation, and experiment as well as design-oriented classes. Additionally, students take a series of design courses, starting in the lower division and ending with a senior capstone experience. The committee also recognizes and commends the department for its "service" to other JSOE departments (such as Structural Engineering and Bioengineering) through the large number of outside majors being accommodated in the popular and highly-effective MAE 170 and MAE 3 classes.

Although our impressions are mainly positive, several points of interest arose during the review that the committee wishes to communicate in the hopes of improving the program. These are delineated below:

**GENERAL OBSERVATIONS**

- The student/faculty ratio is high (currently 30:1) and is a concern for both students and faculty. Consequently, class sizes are too large, which is hindering the ability of students to gain personal, one-on-one, access to faculty. Faculty members feel that the higher student/faculty ratio is doing a disservice to the students. Since the ME and AE majors are impacted and will therefore be stabilized, projections for future student/faculty ratios, especially considering Environmental Engineering (below) would be of interest.
- Environmental Engineering is a newer major that is relevant to society, increasingly popular with students, and growing in size. The committee is excited about the potential impact that the Environmental Engineering program can have on UCSD and the MAE department, its

faculty, and its students. We have no specific recommendations regarding direction of the major, but we urge the department to assess how it wants to utilize, develop, and grow the program in the context of the overall MAE undergraduate program. For example, do they wish to make it a large thriving part of the program? Or, would they prefer to use it as a complement to existing strengths? Do they plan to seek ABET accreditation in the future? Whatever the vision, the committee strongly encourages the department to assess its intentions regarding the program before issues, especially those involving increasing enrollment, arise in the near future. The committee feels that this is an area in which new faculty hires are possible, and would be beneficial, particularly if these hires can be jointly shared between other JSOE departments or even other entities on campus where faculty have crossover with MAE interests.

- The 4-year graduation rate in engineering majors is typically somewhat lower than other majors on campus. Steps to monitor this carefully and implement steps to achieve average times close to 4 years will be important in the near future.

## **CURRICULUM AND TEACHING**

- Although the curricula are strong and well-balanced, the committee recommends that the department examine required courses and look for overlapping content between ME and AE in order to reduce requirements and allow for more technical electives (the AE program allows for only one technical elective). While we realize that the curriculum is somewhat restrictive out of necessity, we suggest that allowing students more leeway might empower and excite them even more about their major. In addition, it could be helpful if students are counseled that AE is essentially a specialized Engineering curriculum, so by its very nature, the number of electives in AE will be relatively small.
- Currently 196 units are required for the individual majors. This is a large number of credits, particularly since time-to-degree is a concern. The requirements of individual colleges are heavy to very-heavy compared to many peer and top-ranked undergraduate departments. An assessment of both Engineering and HSS courses, in conjunction with the colleges might allow for streamlining within the curriculum. We encourage the department to involve individual colleges in reassessment of the overall curriculum requirements.
- CAPE reviews are the main means of formally and consistently assessing teaching quality. The faculty conducts year-end meetings in which curriculum and teaching are discussed; this is excellent and should be continued. Minutes from such meetings would be helpful to document the main points, and to serve as a useful archival record. Peer-review of faculty is conducted on an Ad-Hoc basis by the chair, providing the department with an in-house mechanism to evaluate teaching. Faculty members and lecturers should continue to be encouraged to improve teaching quality, which may involve utilizing campus resources (such as the CTD) and continued in-department interactions.
- The department is making excellent use of its LSOE's and lecturers. The teaching faculty appears to be integral to the department, fill in gaps especially related to practice as well as classroom course instruction, and are very well-received by the students we spoke with.

- The committee felt that TA support for classes was sufficient. However, the committee recommends that the department explore ways to offer greater training opportunities for TA's (in addition to what is offered by the campus), and to investigate methods to more effectively assess TA performance.
- Numerous faculty members in the department expressed concerns with student writing skills, particularly scientific writing skills. An idea formulated during the review is for the MAE department (perhaps in conjunction with JSOE) to investigate the possibility of creating a technical writing class that could either augment or replace some of the College writing requirements.
- Other smaller but noteworthy coursework issues brought up by students that may be worth considering (keeping in mind that the sample set of students was small,  $n \sim 10$ ):
  - Faculty and students suggested that Environmental Engineering needs a course in wastewater.
  - MAE155A is viewed by some students as an advanced version of a lower division MAE course (MAE 2), and would prefer that MAE 155A and B be linked more, with more design in MAE 155A.
  - A number of students complained that organic chemistry is not necessary for the ME/AE majors and that physics 2CL was not useful or necessary for the majors.
    - Again, a curriculum assessment could be helpful to streamline requirements and perhaps alleviate these minor issues.
  - A few students requested more flexibility for prerequisites. The committee recognizes that there are institutional policies in place and are variably flexible.

## **ADVISING AND STUDENT SUPPORT**

- Overall, the committee feels that the academic advising staff is doing well. As is typical, the advising staff have some challenges in communicating with students, who can be somewhat apathetic at times regarding advisement. Consequently, the advising staff has tried creative avenues to get information to students, such as multimedia that includes a large electronic display in the advising offices, and various forms of social media. The committee recommends that the staff continue to adopt this multidimensional approach, and we commend them on their ingenuity.
- Transfer students make up a large proportion (25%) of the undergraduate student body in the department. An additional option might be to re-adopt hands-on, large-format advising meetings and events with students in order to update them on changes relevant to the major, especially for transfer students who have newly arrived at UCSD.
- Environmental Engineering essentially has three different course tracks due to changes in requirements and curriculum. Although we understand that this cannot be helped, some students we met with expressed confusion (and frustration). There was some discussion that

consolidated tracks could be approved by campus committees. This issue should resolve with time and future major modifications can be integrated with existing requirements.

- Communication between the MAE advising staff and the colleges is good, in part due to the virtual advising system at UCSD. The committee feels that it is especially important for the department to continue strong communication with the colleges in order to keep college-level advisers abreast of changes in classes/plans/curriculum. Over the years, the major + college specific, finish-in-four templates appear to have been useful.
- Some students expressed a desire for more career-oriented advising. The committee suggests that an elective senior-level course or seminar may be considered to help MAE students transition from college to the workplace.
- The Department and JSOE have a number of resources for students, such as IDEA and the Career Center to help students. In addition, there is the take-the-professor-to-lunch program. One faculty member indicated that encouragement of this program to a group of students resulted in 30 individual lunch sessions. Making students more aware of these resources may help curb their concerns and requests for more advising.

## **FACILITIES AND COMPUTING**

- Overall the committee was highly impressed by the lab spaces. However, faculty and administrative staff expressed concerns regarding modernization of equipment. Specifically, lathes and mills required for hands-on projects in classes such as MAE 156A and B are degrading. Additionally, safety issues are always a concern in a machine shop, and were noted by faculty and staff. The committee recommends that funds be allocated from the university to support modernization of machinery, particularly to enhance safety. The department indicated that normalization of one of the machinist positions be done. The committee recommends that this sort of request be described with justification and forward-looking projections to provide certainty that such a machinist will be needed in the permanent future.
- The Department has contracted with ACMS to provide computer support in the teaching laboratories. Reports suggest that this arrangement is in transition and has the potential to work very well, especially to provide upgraded computer support to the laboratories via campus (non-Departmental) resources. The committee commends the program on pursuing this direction.

## **SUMMARY**

In summary, the committee has a highly positive view of the undergraduate programs offered by the MAE department. We believe that there are some opportunities for improvements but that the curricula for all three programs in the Department are strong, the faculty and staff are dedicated, and the teaching facilities are impressive and effective.

The greatest concern that arose from this review is in regards to the Environmental Engineering program. It is an increasingly popular academic major, particularly given the societal relevance of the subject matter. The department needs to assess the goals of the major in the context of increasing enrollment and evaluate how this will affect the MAE Department. The committee sees this as an opportunity for new faculty hires, and as a potential for interaction with other departments and schools on campus. A growing environmental program will undoubtedly require extra resources, and the committee recommends that the university provide this support to the MAE department.

New admission data show that the number of incoming freshmen students in the Environmental Engineering program has surpassed those both for AE and ME. Additionally, the MAE Department has only four faculty members who are primarily dedicated to the Environmental Engineering major. Before new hires and resources can be invested to grow this program, control of admission to the Environmental Engineering program is recommended so that the excess burden in the increased number of students will not negatively impact quality—not only in Environmental Engineering, but also in the already strong ME and AE programs.

**Geoffrey W. Cook**

**Robert Sah**

**Feng Liu**

December 18, 2013

**PROFESSOR SUTANU SARKAR, Chair**  
**Department of Mechanical and Aerospace Engineering**

SUBJECT: Undergraduate Program Review for the Department of Mechanical and Aerospace Engineering

Dear Professor Sarkar,

At its October 11, 2013 meeting, the Undergraduate Council discussed the Department of Mechanical and Aerospace Engineering's Undergraduate Program Review. The Council supports the findings and recommendations of the review subcommittee and appreciates the thoughtful response from the Department. The Council's comments centered on the following:

**1. Teaching Assistant (TA) Training and Development**

The Council agrees with the review subcommittee's recommendation that the department explore ways to offer greater training opportunities for TAs (in addition to what is offered by the campus), and to investigate methods to more effectively assess TA performance. The Council also recommends that MAE faculty be more engaged in the training and mentorship of TAs. The Center for Teaching Development (CTD) should serve as a complementary resource to the training provided by faculty.

**2. Incorporation of Writing Skills into Existing Coursework**

The review subcommittee suggested that the Department investigate the possibility of creating a technical writing class to either augment or replace some of the College writing requirements. The Council agrees with the recommendation to incorporate writing into the curriculum, however, the Council suggests that integration into current MAE coursework would be more effective. Improving writing for MAE students is of paramount importance but the structure of the College writing programs may not allow such a course substitution. Given the campus initiatives to review time to degree and the majors' unit requirements, it would also not be recommended as an addition to the current curriculum. For these reasons, the Council suggests incorporation of writing skills into existing coursework.

The Council will conduct its follow-up review of the Department in Fall 2014. At that time, our goal is to learn about the Department's progress in implementing the recommendations of the subcommittee and the Undergraduate Council. The Council extends its thanks to the Department for its engagement in this process and we look forward to the continued discussion.

Sincerely,



James Nieh, Chair  
Undergraduate Council

cc: G. Boss                      K. Pogliano  
L. Carver                      R. Rodriguez  
A. Pisano                      B. Sawrey