

December 10, 2015

PROFESSOR JOSEPH WANG, Chair
Department of Nanoengineering

PROFESSOR JAN TALBOT, Director
Chemical Engineering Program

SUBJECT: Undergraduate Program Review for the Department of Nanoengineering and the Chemical Engineering Program

Dear Professors Wang and Talbot,

The Undergraduate Council has discussed the Nanoengineering and Chemical Engineering 2015 Undergraduate Program Review. The Council supports the findings and recommendations of the review subcommittee and appreciates the thoughtful and proactive response from the Department and Program. The Council's comments centered on the following:

The Council notes that there is a large number of Nanoengineering faculty compared to the much lower number of Chemical Engineering Faculty. Given the number of students in Chemical Engineering, the Council is concerned about the high student to faculty ratio in the Chemical Engineering major. The Council encourages the Department and Program to evaluate their faculty body to ensure that there are enough faculty to support the course requirements for each of the majors and students are provided opportunities for interaction with specialized faculty in their major.

The Council will conduct its follow-up review of the Department and Program in Spring Quarter 2017. At that time, our goal is to learn about the Department and Program's progress in implementing the recommendations of the program review subcommittee and the Undergraduate Council. The Council extends its thanks to the Department and Program for their engagement in this process and we look forward to the continued discussion.

Sincerely,

Geoffrey Cook, Chair
Undergraduate Council

cc: R. Continetti
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UCSD Program Review for NanoEngineering and Chemical Engineering May, 2015

This program review is unique in that it includes both the NanoEngineering (NANO) and Chemical Engineering (CENG) degree programs which are administered and taught through the Department of NanoEngineering at UC, San Diego. This review is the first for the NANO program, which was established in 2010 with the inception of the NanoEngineering department. This is not the first review for the CENG program, which was last reviewed in 1992/1993 when it was housed in the Mechanical and Aerospace Engineering Department. Due to the specialized nature of the individual programs we will provide a separate analysis for each, and following that the committee will provide both program and department-level comments and recommendations aimed at the continued success of the degrees and their offerings.

NANOENGINEERING (NANO)

Program Summary

The committee is impressed with the great quality of the NANO faculty. The program has an ample number of professors involved in teaching (~ 18). The curriculum is strong and the course offerings appear to follow a logical, pedagogically-sound progression. As the UCSD NanoEngineering Department is the first of its kind, the committee is aware of the unique nature of its offerings and is impressed with the accomplishments achieved in a relatively short timeframe. ABET accreditation is on the very near horizon (2016) and it appears that the program and department are aware of what needs to be accomplished in order to succeed. In addition, the program is mindful of the need to improve time to degree, and has taken appropriate steps to reduce required courses.

The advising staff is small (2), especially when considering that they are dealing with over 1000 majors in both NANO and CENG. The staff appear motivated and passionate about their job. It was noted that town-hall meetings are held twice per year to allow students to make the department and advising staff aware of issues. The committee suggests that it would be very useful to add an additional intake advisor to help deal with the large numbers of students.

Efficacy of teaching and instruction is measured officially by CAPE only. CAPE reviews generally appear solid. The above-mentioned town hall meetings provide students with an additional venue to provide feedback for instructors. Moreover, student affairs staff monitor CAPE's with an eye towards improvement of teaching quality.

Recommendations

Specific recommendations for improvement of the NANO program include the following:

- The committee strongly supports the program's belief that NANO is in need of an intermediate-level, lab-based class. Currently there is a gap between the lower division lab based courses and the senior capstone course. An intermediate lab would strengthen the curriculum; moreover, it may strengthen the case for ABET accreditation. The main

issue is lab space, which is already an issue for the capstone lab course. The committee recommends that an intermediate lab class be implemented (it appears that a pilot is planned for 2015-2016) and that if possible more lab space should be provided to better accommodate the classes and students. More resources are needed for undergraduate teaching—specifically, more bench space for chemistry labs and computational lab space would be helpful.

- The committee is concerned that students in NANO are not receiving enough industry exposure and practical/work experience. It would be ideal if more of this type of instruction could be incorporated into the curriculum in order to better prepare students for their careers. This is a general observation with no real specifics; rather, it is hoped that the program will take this recommendation into consideration and endeavor to better improve student job opportunities post-graduation. One option would be for the advising staff to provide more assistance to students in finding internship-type positions. Because the advising staff is stretched thin (also advising CENG) it might be worthwhile to hire a new staff member to act as a student-industry liaison.
- Another mechanism for evaluation of teaching (in addition to CAPE) would be beneficial. This is in line with university guidelines, and would be beneficial not only for the overall improvement of undergraduate instruction, but would also help in promotion/tenure evaluations. Likewise, department-specific TA training would benefit the undergraduate teaching mission (and graduate training) and would provide added value for ABET accreditation purposes.
- The committee is concerned with the “tracks” in the NANO curriculum, but most specifically by the Chemical Engineering track. With a Chemical Engineering major also in the same department this seems redundant and potentially confusing to students. Closer consideration of the usefulness of the tracks might be a worthwhile investment for the department.

CHEMICAL ENGINEERING (CENG)

Program Summary

As with the NANO program, the committee was highly impressed with the faculty members teaching in the CENG program. The curriculum is strong and the instructors we met were highly enthusiastic about their work. The program has a very large number of students (677 at current count) and a small number of professors (5) responsible for teaching the major; although, it has made excellent use of teaching professors (2 assistant-level and 1 senior-level) to accommodate the large instructional load. Advising staff are shared with NANO, and given that the two staff are dealing with over 1000 students at present they are doing well under the circumstances. CENG was granted 6-year ABET accreditation in 2014. Overall it appears that the CENG major is a well-established and well-run program—but one that is facing some unprecedented challenges brought forth by a large undergraduate population and a dwindling core faculty. The

single greatest issue brought up in this review is that due to the significant growth in the major the CENG program faculty is understaffed. As with NANO, impact of the major should help, but the committee was struck by how much is being done with so little.

Recommendations

- More ladder-rank CENG faculty members are needed. Class sizes are very large, in particular the senior classes. The current group of instructors is doing an admirable job offering the major to an overwhelmingly large group of students but they need more personnel. A corollary of hiring more CENG professors is that students will benefit from taking classes from a wider range of faculty members who can provide varied viewpoints and areas of expertise (industry, research, etc.). As is, with such a large cohort of students and limited resources the committee is concerned about the continued success of the program. From the interview process we understand that the situation has apparently led to the retirement of long-time faculty members and the committee is eager for CENG (and the NanoEngineering Department) to make the effort to attract younger, research-minded CENG teaching staff to the program.
- The committee is concerned that students in CENG do not appear to be as prepared as they could be for the job market. A greater focus on providing students with exposure to industry and more practical experience would be helpful. New hires in CENG will help with this. An ideal situation would be to hire a staff member whose focus is on working with students in the major with an eye towards internship opportunities and potential work experience. Another idea brought up by a committee member is for the program to bring in an Ad Hoc or adjunct lecturer from industry to teach the senior capstone/design course. This would provide students with an added bit of professional preparation.
- It would be helpful to have a departmental TA training class that instructs TAs in chemical engineering-specific courses. The training class can provide effective teaching and mentoring approaches for large engineering classes. Furthermore, the training class can help the TAs understand the ABET process and the importance of keeping records for upcoming evaluation cycles. This will also take some burden off of the teaching staff.
- As was mentioned for the NANO program, another means of evaluation of teaching (in addition to CAPE) would be beneficial for the CENG program. The CAPE scatterplot for CENG (“recommend instructor %” for 2009-2014) shows a significant spread of responses. An alternate method of evaluating teaching could benefit both students and faculty and the program is thus strongly encouraged to investigate options.

OVERALL SUMMARY AND OBSERVATIONS

From the committee’s perspective a major issue surfaced during the course of the review: there appears to be a lack of cohesion between the NANO and CENG programs. These are two successful and important programs housed in the same department, but they are not effectively integrated and the committee is concerned about potential departmental issues regarding new

professorial hires and the distribution of resources to the two programs (teaching and otherwise). An imbalance clearly exists between NANO and CENG. Several professors interviewed went as far as to suggest separate departments as a possible solution. The committee did also note positive interactions between the two programs, as NANO faculty members have volunteered to teach CENG courses. However, a more effective integration would seem to be necessary for both to succeed under the NanoEngineering department umbrella.

From an undergraduate education perspective the obvious problem is that the number of instructors teaching in CENG is small, and that the number of NANO faculty is large despite the fact that CENG is a much larger undergraduate program. The committee recognizes that sudden growth of the CENG program coupled with two retirements and loss of faculty to other universities has exacerbated the situation; although, from an alternate viewpoint we consider that the departures could also have been caused by the present situation. Despite the ongoing challenges it appears that the department as a whole has not made a commitment to hiring new personnel to support the much larger CENG program. Impacted status for both NANO and CENG will undoubtedly help to stabilize the situation. Still, the committee hopes to emphasize the importance of hiring new research professors who are able to teach in the Chemical Engineering program in order to more effectively support that major. In addition to the recommendations made above, our independent analysis of the undergraduate programs suggests that it would be sensible for the NanoEngineering Department to strongly consider the needs of CENG in any future decision making process.

A smaller more generic observation is that the sense of community among students in both majors does not appear to be well-developed. Only one student came to speak with the committee, despite it being advertised to the entire majors list in CENG and NANO. We highlight this point in the hopes that the Department will be mindful of the need to provide a better sense of camaraderie and belonging for the students moving forward.

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