

2009 Student-Faculty Conference Report

Electrical Engineering

May 2009

Committee Members

Chair: Gabe Cohn EE, 2009

Undergraduate Members:

Anuj Arora	EE, 2011
Fei Chen	EE, 2011
Thomas Gwinn	EE, 2010
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Faculty Members:

Dr. Michelle Effros	Professor of Electrical Engineering
Dr. Yu-Chong Tai	Professor of Electrical Engineering
Glen George	Lecturer in Electrical Engineering and Computer Science

Overview

The Electrical Engineering Committee for the 2009 Student Faculty Conference (SFC) was formed by current undergraduate student volunteers from different graduating classes within the Electrical Engineering department. The goal of the committee is to work with the current undergraduate students and faculties of the Electrical Engineering department in order to identify areas for improvement regarding the undergraduate educational experience within the Electrical Engineering department, including but not limited to required Electrical Engineering curriculum, suggested electives, student faculty interactions, and availability of research opportunities. In addition to identifying current issues, the committee also suggests and tries to implement changes that would help to resolve these problems.

In general, current undergraduates in the Electrical Engineering Department are satisfied with the current state of their undergraduate experience. From the SFC survey results, 47% of the people who responded were happy with the current course while 33% were not satisfied. Many professors received positive comments for their teaching qualities. These professors include: Azita Emami, Ali Hajimiri, Yu-Chong Tai, Abu-Mostafa, Glen George, and Niles Pierce. Most of the positive comments were related to the organization of their lectures, the quality and usefulness of their lecture notes and examples, and the level of enthusiasm they carried while teaching. At the same time, the survey identified several problems related to the undergraduate education in the Electrical Engineering Department. These issues are dealt with in the later parts of this report.

Summary of Committee Activities

The Electrical Engineering Committee was active from January 2009 until the Student Faculty Conference on April 6, 2009.

During the initial stages, the student members of the committee met weekly to draft a series of questionnaires for the Student Faculty Conference Survey. These questions were intended for the identification of problems in the Electrical Engineering department. They addressed areas such as course scheduling, course quality, availability of electives, research opportunities, quality of faculty advising, and general student faculty interactions. The completed survey was sent out at the beginning of February to all current Electrical Engineering undergraduates.

The second stage of the committee meetings were devoted to analyzing the survey results and coming up with possible solutions to the problems. The committee produced a summary of the survey results and presented it at meetings which included faculty representatives. In addition to the faculty members of the committee, several other faculty attended these meetings. During these meetings, problems identified from the survey were discussed and solutions were proposed.

The most significant change to come from the SFC Committee meetings was the restructuring of the EE curriculum (see Appendix A). Since this change would have a dramatic impact on the Electrical Engineering option, a department-wide meeting was held on Tuesday March 10th to discuss the proposed schedule of required courses. Many undergraduates and several faculty members attended this meeting. The proposed schedule was passed at the meeting and subsequently added to the catalog of the 2009-2010 academic year.

Finally, on April 6, 2009, the Electrical Engineering Committee presented all of its progress since the beginning of January to the Electrical Engineering department followed by a discussion period where the audience expressed concerns and suggestions to some of the proposed changes. Approximately 25 undergraduates and 7 faculty members attended this meeting. The issues discussed at this meeting are presented in the following section.

Issues Addressed

1. Scheduling of Recommended Schedule

Description:

The order of some of the Electrical Engineering required courses currently listed in the recommended schedule in the catalog are illogical, resulting in two terms that have significantly heavier loads than other terms. As a result, very few

students follow the recommended schedule from the catalog. Students commonly take EE/CS 51 and EE/CS 52 in freshman year rather than sophomore year where they are recommended. In addition, certain recommended courses such as EE 40 and EE 160 are offered before the students acquire the required background material, causing students to have a more difficult time with those courses.

Recommendations:

- Due to student feedback about difficulties with EE 160 (Fundamentals of Communication Systems), a new prerequisite for Electrical Engineering undergraduates will be added next year in place of ACM 95c (Partial Differential Equations). ACM 116 (Introduction to Stochastic Systems), offered first term of Junior year, will hopefully provide sufficient background for EE 160.
- EE/CS 51 and EE/CS 52 (a sequence on Embedded Systems) are designed to be sophomore classes. Trying to avoid a heavy load third term sophomore year, many students take these classes 2nd and 3rd terms of freshman year. As a result, students learn less from these classes than they should. To target the concern regarding freshmen taking EE/CS 51 and EE/CS 52, and to target the heavy load 3rd term of sophomore year, the committee decided to change EE/CS 51 and EE/CS 52 to be offered in the fall and winter terms respectively. This allows students to take these courses during sophomore year and still avoid a heavy term in the spring of the sophomore year. This change will also deter freshmen from taking the course, thereby addressing the faculty concerns.
- As a result of EE/CS 51 and EE/CS 52 offered in 1st and 2nd terms, EE 40 and EE 45 are moved to the spring term of the sophomore year. Therefore, by the time students take these classes, they would have gained sufficient background in ordinary differential equations and thermal physics, which are required by EE 40 and EE 45.
- EE 113 (Feedback and Control) is moved to the third term of junior year so that the course load of the sophomore year is not too heavy.
- A new course, EE 1 was proposed, and will be offered during the 2009-2010 academic year. The course will consist of a series of seminars geared toward freshmen, and introduces them to different areas of research in Electrical Engineering at Caltech. The goal of the class is to advertise the Electrical Engineering Department to freshmen and address the concern from faculty that students are not exposed to the systems side of EE until very late in the curriculum.
- With this new proposed schedule, freshmen interested in electrical engineering are encouraged to take APh/EE 9ab, EE 1, EE 5, and the

analytical track of Ph 1bc with Ph 8 (Practical labs) in order to gain an in depth understanding of general physical principles of electrical engineering while still gaining some hands-on experiences with electronic circuits.

- One benefit of the newly proposed schedule is that all the required classes can be completed by the end of the junior year, which leaves the senior year open for more advanced electives, project classes, senior thesis, and preparing for graduate school or the job market.

Feedback from the Student Faculty Conference:

- Some concerns about the one year gap between EE 45 and EE 113 were brought up. Since EE 113 represents a logical, next level course in analog circuits from EE 45, a one-year gap may result in students forgetting a lot of materials previously learned from EE 45. However, some students say that the one year gap may also benefit students in that it will re-emphasize and refresh many of the concepts of analog circuits.
- Concerns about analog circuits not introduced to electrical engineering undergraduates until the end of the sophomore year were also brought up.
- Dr. Babak Hassibi brought up the concern that the systems aspect of Electrical Engineering at Caltech is not introduced until junior year. This may preclude undergraduates from taking advanced systems electives.

Current Progress of Implementation:

- The new schedule has been approved by the faculty board as well as current undergraduates in the Electrical Engineering Department.
- The new recommended schedule will appear in the catalog of the 2009-2010 academic year. Therefore, no short term follow up action is required.
- The new recommended schedule is attached, see Appendix A. Changes made are indicated in red.

2. Information about EE electives in the Catalog

Description:

There is a section in the catalog under Electrical Engineering that describes a number of “tracks” of EE, and lists EE electives related to those tracks. Since undergraduates in Electrical Engineering are not required to choose a track, many freshmen thinking about enrolling in EE feel constrained by certain suggested areas of specializations. In addition, some of the suggested electives are out of

date, as they have not been offered in many years. Finally, students responded through the SFC survey that they would like to see more courses offered in the areas of VLSI, Control, MEMS, and Robotics.

Recommendations:

- The information in the suggested electives section of the catalog needs to be updated. Some of the wording needs to be changed so that it is more clear, and does not suggest that students must choose an area of specialization. The suggestion is to change the wording to “areas of electrical engineering” and update the classes in each area.
- Due to request from students who are hoping to go into industry after graduation, a new area of specialization should be added that prepares students for work in industries instead of graduate schools.
- Regarding new course offerings, the main issue has to do with limited faculty in the Caltech EE department. Without sufficient faculty, it is difficult to offer new courses. As a result, the SFC Committee did not make any recommendations regarding the offering of new courses. The only new course offered next term will be EE 1, a seminar course for freshmen.

Feedback from the Student Faculty Conference:

- The opinion of the creation of EE 1 was generally positive.
- Dr. Babak Hassibi proposed the idea that faculty should play a more active role in advising students in graduate school choices and electrical engineering elective choices so that the electives match up with the students’ research interests. Students are generally in favor of this idea.
- Dr. Yu-Chong Tai would like to see more devices and circuits electives changed to be required courses, such as EE 114a.
- Dr. Babak Hassibi would like to see more systems courses such as EE/CS 145 (Networking) in the required courses. He brought up the idea of creating two different required schedules for electrical engineering at Caltech: devices/circuits and systems.
- Faculty believes that senior thesis, instead of electives, can be used to improve the educational experience in Electrical Engineering.

Current Progress of Implementation:

- The catalog of the 2009-2010 academic year will reflect some of the wording

changes suggested above.

- EE 1 will be offered starting 2009-2010 academic year.
- Additional progress could be taken to look into updating relevant electives under each areas of Electrical Engineering. This task will require talking to professors and undergraduates in the respective areas who are more knowledgeable about the respective areas.

3. Commonly Problematic Courses

Description:

Some of the required courses within the Electrical Engineering Department have commonly been problematic. A list of these course and common problems identified through the SFC survey are included in Appendix B.

Recommendations:

- The new recommended schedule addresses some of the problems identified through the SFC survey, especially when the problems are regarding the order in which courses are offered. In addition, the new recommended schedule addresses some of the problems with under united courses such as EE/CS 51 (which is now 12 units, instead of 9). The new schedule also offers a more spread-out work load over the sophomore and junior year, to deal with work load problems of certain courses.
- The Committee recommends discussing specific course related problems with individual professors.

Feedback from the Student Faculty Conference:

- Dr. Yu-Chong Tai would like APh/EE 9ab to be taught more systematically so that students retain more information from that class and so that it provides a better background for his EE 40 sophomore year. There was almost unanimous agreement among students and faculty with this suggestion.

Current Progress of Implementation:

- The new recommended schedule has solved most of the course specific problems. In addition, the Committee members have talked to EE 113 lecturer to reduce the amount of unnecessary grungy work.
- Future work can be done to address the concern with APh/EE 9ab. This requires talking to Dr. Axel Scherer about reorganizing the class' structure.

4. Student-Faculty Interactions

Description:

From the SFC survey 47% percent of the students who participated reported that they do not have enough opportunities for student-faculty interactions outside of the classroom. Some reported that it is even difficult to meet with their advisors. In addition to student-faculty interaction on a personal level, students have reported that they would like more exposure to possible research areas of Electrical Engineering and more opportunities to participate in research.

Recommendations:

- The Electrical Engineering Committee recognizes that in order to increase student-faculty interaction, initiatives must be taken from students as well as faculty. Thus, it is recommended that advisors invite students to lunch periodically and vice versa. Funding is provided by the ARC and ASCIT to have lunch with professors and TAs. In addition, EE socials with free food are held on the first Friday of every month at 4:00 pm. Everyone is welcome to attend these socials.
- To improve undergraduate exposure to EE research, all students in the Electrical Engineering option are now e-mailed about seminars in EE. In addition, EE 1, a seminar class will be offered starting 2009-2010 academic year.
- EE faculty are encouraged to post undergraduate research opportunities on the SURF opportunities website.

Current Progress of Implementation:

- All the proposed changes have been implemented for this problem. The success of recommendations regarding specific student-faculty interaction on an individual basis will be left up to individual students and faculty.

Recommendations to Follow Up

Short Term:

- Update the suggested electives in the catalog for different areas of EE by talking with different professors and undergraduate students in the respective areas.
- Talk to Dr. Axel Scherer about changing the structure APh/EE 9ab lectures so that

it will be more suitable for freshmen. (ie. using slides designed specifically for the class).

Long Term:

- In a few years, it would be a good idea to check how the undergraduates of the Electrical Engineering Department feel about the new required schedule. Are most of the students following the schedule? The 2011 Student Faculty Conference will be a good time to address this.
- In a few years, it would also be a good idea to see the distributions of undergraduate Electrical Engineers interested in different areas of Electrical Engineering. Is there a balance between students interested in devices/circuits vs. systems? Should considerations be given to starting a new track of EE courses for people interested in the systems side?

Appendix A: New Schedule of Required Courses

Major changes are shown in red.

Freshman Year

Term	1 st	2 nd	3 rd
Ph 1abc	9	9	9
Ma 1abc	9	9	9
Ch 1ab	6	9	-
Bi 1	-	-	9
Menu	-	-	9
HSS	9	9	9
APh/EE 9ab	6	6	-
Total	39	42	45

Sophomore Year

Term	1 st	2 nd	3 rd
Ph 2ab	9	9	-
Ma 2ab	9	9	-
HSS	9	9	9
EE/CS 51	12	-	-
EE/CS 52	-	12	-
EE 40	-	-	9
EE 45	-	-	12
Electives	-	-	9
Total	39	39	39

Junior Year

Term	1 st	2 nd	3 rd
ACM 95ab	12	12	-
HSS	9	9	9
E10, E11	3	3	-
EE 111	9	-	-
ACM 116	9	-	-
EE 160	-	9	-
EE 151	-	9	-
EE 113	-	-	12
EE 90	-	-	9
Electives	-	-	9
Total	42	42	39

Senior Year - Thesis

Term	1 st	2 nd	3 rd
HSS	9	9	9
EE 80abc	9	9	9
EE Electives	9	9	9
Electives	9	9	9
Total	36	36	36

Senior Year - Projects

Term	1 st	2 nd	3 rd
HSS	9	9	9
EE 91ab	12	12	-
EE Electives	9	9	9
Electives	9	9	18
Total	39	39	36

Appendix B: Summary of EE SFC Survey Results

Below is a brief summary of the results of the 2009 Electrical Engineering Student Faculty Conference Survey. 28 students participated in this survey, which accounts for 49% of the students in the Electrical Engineering option. Of the participants, 50% were Sophomores, 23% were Juniors, and 20% were Seniors, and the remainder did not specify.

Classes

Classes that received many negative comments or need improvement

- EE 160
 - Too many assumptions are made about students' background
 - Homework is ahead of lectures
 - Lectures need to be improved
 - Needs a more basic textbook
 - Needs to be scheduled at a later time
 - Needs a better professor
 - Grad students and undergrads should be on different curves
- EE 40
 - Needs a textbook
 - Lectures are not relevant to HW
 - Midterm and final had nothing to do with lecture or HWs
 - Students do not understand lectures or notes
 - Lectures are difficult to understand
 - Course pace is too fast and only briefly covers each topic
 - no one know how to do sets, TAs had to walk everyone through all of the problems
- APh/EE 9
 - Lecture is unrelated to labs and homework
 - Axel does not care about the class
 - Lecture slides are from the advanced class
 - Axel is disorganized and difficult to understand
- EE 90
 - Needs to be more guided
 - Needs a lecture component
 - Needs instruction of *safe* shop use
 - Needs to be more focused on a particular project
 - Professor is never around, not very accessible or helpful
 - The TAs are completely useless
- EE 151
 - Grad students and undergrads should be on different curves
- EE/CS 51
 - Make EE 5 mandatory
 - More TAs
 - Hardware portions of HW taught poorly

- Hardware questions should be removed
 - 12 units
- EE/CS 52
 - Equipment in severe disrepair
 - Reduce the workload
 - 15 units
 - Lectures don't help at all
 - Lectures only give examples for 2 of the 4 projects
- EE 113
 - Less grungy algebra
- EE 119
 - 15 units
- CS/EE 181
 - 15 units
- ACM 95b (with Meiron)
 - Lectures are full of errors
 - Hard to follow lectures
 - Meiron glosses over difficult material
 - Tedious algebra
 - Didn't learn anything

Professors that received many positive comments

- Glen George
- Emami
- Tai
- PPV
- Hajimiri
- Abu-Mostafa
- Pierce (ACM)

Common positive comments:

- Well organized
- Systematic
- Good notes
- Good examples
- Enthusiastic

Students would like to see more classes in the following areas

- Circuits and VLSI
- Control
- MEMS
- Robotics

Students would like to see fewer required classes in the following areas

- Devices
- Embedded Systems

Class Scheduling

- The ordering of courses is no longer logical
- The schedule is unnecessarily front loaded
- There are major scheduling problems with Sophomore year
- EE/CS 52 and EE 113 at the same time is very bad
- EE/CS 52 or EE 113 and EE 90 at the same time is also bad
- EE 40 needs to be after Ph 2b (statistical mechanics)
- EE 40 is too early in the curriculum
- Comments on the order of EE 40, EE 45, and EE 113
 - 47% are happy with current schedule, 33% are unhappy
 - EE 45 should be first term
 - EE 45 should be before EE 40
 - EE 113 should be first term Junior year
- EE 151 would be better after Ph 2 or ACM 95

Catalog Information / Recommended Schedule

- Recommended schedule is not what most people do
 - most people take EE 5x freshman year
 - many also take ACM 95 sophomore year
- Should recommend EE 5x freshman year to relieve Soph. year
- Students should be warned about classes taught alternating years
- APh 9 should be listed on the schedule for freshman year
- Suggested electives section is useless, meaningless, and not helpful

Student Faculty Interaction

- 47% believe that there are NOT enough opportunities for students and faculty to interact outside of the classroom
- Needs to be more interaction with faculty advisor
- Need more seminars publicized for undergrads
- Need more student-faculty lunches and Take-a-Prof-to-Lunch