UNIVERSITY OF SOUTH CAROLINA
College of Engineering and Computing

**INDUSTRY ADVISORY BOARD MEETING**
**ELECTRICAL ENGINEERING**

**NOVEMBER 2016**

| | | | |
|---|---|---|---|
| **Document Type:** | MINUTES | | |
| **Date of Meeting:** | November 4, 2016 | **Time:** | 10:00 AM |
| **Meeting Facilitator:** | Dr. Roger Dougal | **Location:** | Swearingen Center room 3A75 |

**IAB member Attendees**

| Name | Company | E-mail | Phone |
|---|---|---|---|
| Tom Abrams | Santee Cooper | Tom.abrams@santeecooper.com | 843-761-8000 ext 5200 (W) |
| Tracey Blackmon | Duke Energy | tracy.blackmon@duke-energy.com | 704-607—1079 (M) |
| Jeff Cain | AVX | jeffcain727@gmail.com | |
| Al Emondi | SPAWAR Systems Center | al.emondi@navy.mil | 843-218-5435 |
| Brian Parris | Intel Corporation | brian.w.parris@intel.com | 803-941-7028 |
| Bobby Scott | REI Automation | bscott@reiautomation.com | 803-791-8550 (O) |
| Steve Tibrea | Savannah River National Lab | steven.tibrea@srs.gov | 803-645-7432 (M) |
| Marty Wilson | Flextronics | marty.wilson@flextronics.com | 803-413-2517 (M) |
| Lee Xanthakos | South Carolina Electric and Gas | pxanthakos@scana.com | 803-217-1821 (M) |

**IAB members Absent**

| Name | Company | E-mail | Phone |
|---|---|---|---|
| Bob Bush | Altron | bbush@altroninc.com | 843-224-1191 (M) |
| Peter Zmolek | Continental<br>resigned due to career move, need to identify a replacement | peter.zmolek@conti-na.com | 704-583-8770 |
| Harry Weatherford ,Jr. | Nucor | Harry.WeatherfordJr@Nucor.com | 843-3442497 (M) |

**Faculty and Staff Attendees**

| Name | Title | E-mail |
|---|---|---|
| Dr. Roger Dougal | Professor and Chair | dougal@cec.sc.edu |
| Dr. Enrico Santi | Associate Professor | santi@cec.sc.edu |
| Dr. Grigory Simin | Professor and Undergraduate Director | simin@engr.sc.edu |
| Valuncha (Nat) Paterson | Assistant to the Chair | valuncha@cec.sc.edu |

## Approval of Spring 2016 Meeting Minutes

The minutes were previously approved via email.

## Announcements

- **2nd Curriculum Retreat (undergrad) was held May 13, 2016 --** Retreat was followed by a Course Review Panel to review courses which had not recently undergone an instructor peer review
- **Assessment Plan for BSE program** -- received praise from USC, and is now highlighted by the university as an exemplar for others to follow
- **Research web pages** – undergrad assistant hired to redevelop content. Research presence is once again online and will continue to improve.
- **Outreach Activities** -- ran a very successful week-long Summer Camp for 40 students in the "Accelerate" pre-engineering program of the Governor's School for Science and Math
- **Research Funding** -- For the first time in at least five years, we expect to start receiving some of the indirect cost recovery generated by research programs. This will help to maintain research facilities.

## Follow up on Action Items from last Meeting

- Undergraduate Program Retention – responding to IAB request at last meeting, student retention data from the fall 2013 entering cohort was presented. See Appendix A.
- Diversity of student population, and graduation success – enrollment data from spring 2016 and projected spring 2017 class were presented (see Appendix B). The overall graduation success rate of first-time entering freshmen is roughly 50%.
- Review of Course Outcomes & Topics – Prior to the meeting, IAB members were asked to review syllabi of undergraduate courses germane to their industry and to recommend any desired changes. Comments or recommendations will be forwarded to the Undergraduate Program Committee for consideration. Collected comments appear in Appendix C.

## Internships

Recent data on EE students who have completed internships and co-ops were presented (see Appendix D). USC's *Graduation with Leadership Distinction* program recognizes the contribution of internship and co-op experiences to leadership skills. We want more of our students to complete this program. Generally, it is helpful if a student completes at least two internship experiences, which means that internships need to start earlier in a student's program – after freshman year if possible, but no later than after sophomore year.

IAB members were requested to pass information about GLD to their HR departments and to continue using our Career Center as the route for recruiting interns.

It was suggested that the department and the IAB should work together to develop a more formal process for mentoring and following-up with interns. Although some companies already do it well, some additional structure might be helpful. If schedule allows, this will be a focus topic for the spring 2017 meeting on April 28, 2017.

## Diversity and Inclusion

Dr. Csilla Farkas, Associate Dean for Diversity, Engagement and Inclusion, delivered a short presentation on college objectives with respect to diversity, especially faculty diversity since a large hiring program will begin

soon. The presented data indicated there are opportunities to increase diversity in both faculty and student populations. Dr. Farkas invited IAB members to contact her if they have ideas about how to collaborate with respect to increasing our diversity and creating a positive work environment for everyone.

## Graduate Program Evaluation

Data regarding Graduate Programs in EE (ME, MS, PhD) were presented. Since the college is developing more-detailed plans for formal evaluation of Graduate Programs, the IAB deferred review action at this time.

## Meeting with Student Advisory Board

IAB members met with six representatives from the Student Advisory Board. Recommendations resulting from that meeting were presented to the Department Chair and that content appears later in these minutes.

Student Representatives were –

- Vanu Kapoor – Senior graduating in May 2017
- Jeanne Marsh – Senior graduating in May 2017
- Anthony Matrejek – Senior graduating in May 2017
- Brett Melancon – Senior graduating in December 2016
- Brent Wingard – Junior
- Andrew Wunderlich – Senior graduating in May 2017

## Installation of new IAB Chair and Election of Vice Chair

Mr. Steve Tibrea's term as Chair ends on December 31, 2016. Mr. Marty Wilson, Vice Chair, will assume the Chairmanship on January 1, 2017. The board elected Mr. Lee Xanthakos as the new Vice Chair, also to start on January 1, 2017.

Mr. Tibrea was thanked for his time and effort for serving as Chair for the last two years, and also for his many years of service on the board.

## IAB Debriefing to Department

- **General Observations**
  - **Retention –** IAB appreciated the detailed data on retention, graduation and diversity. They would like to also see data relative to male/female graduation rates at the next meeting.
  - **Diversity –** IAB members understand the need to increase diversity in the college and will attempt to help the department through existing programs such as Partners for Minorities in Engineering and Computer Science (PMECS), internships, etc.
    - **Recommendations:**
      - Increase EE involvement in the Engineering Living Community at Bates. This is similar to RiSE (Residents in Science and Engineering) at Clemson.
      - Increase collaboration with industry to address diversity issues. Focus on extending/including freshmen or sophomores in internship programs. The members recommended that we increase our participation in many programs that their companies also participate in, like Partners for Minorities in Engineering and Computer Science (PMECS), South Carolina Alliance for Minority Participation (SCAMP), etc.

- **Undergraduate Program Recommendations --**
  - **Course Outcomes & Topics –**
    - Utility members of the IAB requested additional review of power related courses in a separate meeting. (The meeting was held by teleconference on December 6, 2016 and results appear in Appendix E). Briefly: contents of both undergraduate and graduate courses in power systems were discussed. Statistics of graduations in the power area were described. Recommendations were made to increase offerings of power system classes at the 300 or 500-level.
  - **Internships –** The Board recommends to develop a departmental survey to collect internship data from students in order to better understand and track our students' participation. (Career Center might have some of this data.)
  - **Career Plan** -- promote discussions of the EE Career Plan web page and career options in EE so that freshmen and sophomores are more aware early in their studies.
- **Issues raised by the Student Advisory Board** –

| Problems/Issues | Recommendations/Feedbacks | Rationale |
|---|---|---|
| • Limited opportunities for students to participate in IEEE Student Section activities | Try to schedule more activities per semester, and vary the times so that students can attend when they are not in class. Invite IAB members to speak to classes or to talk at IEEE meetings. | Often IEEE meetings and seminars have been scheduled at the same time as some classes. More events at varying times will provide more options for students to participate. |
| • Some students feel that they have not been adequately advised, perhaps especially by new or young and inexperienced faculty advisors.<br>• Upon graduation, only a few students felt that they knew their advisors well enough (and vice-versa) to ask them for job recommendations | • Match high-need or at-risk students to more experienced faculty advisers.<br>• Encourage students and advisors to build better relationships so students are more comfortable talking to their advisor, especially about their future careers.<br>• Offer additional advisement training for new and young faculty | Students had widely varying experiences from great experiences to poor. Mainly the complaints were towards new or young faculty advising new students, so neither was well-prepared to help the other. |
| • Students lack software tools to plan their course schedules through to graduation. The EE Advisor Tool only allows to plan one semester ahead. | Implement a semester-by-semester planner, through to graduation. | This is important, since there are a number of series strings of prerequisites. Failing to enroll in a class on the critical path can delay graduation. |
| • Inadequate instruction in C++. Students would like a full course (rather than Java) | Change freshman programming course to C++ | |
| • Student workload in ELCT 301 is too large. Students think they should earn 4 credit hours for it. | Reduce number of classes during the first-semester junior year, when ELCT 301 is taken, from six to five. | Reduce student overload. |

| Problems/Issues | Recommendations/Feedbacks | Rationale |
|---|---|---|
| • ECON 421 content does not fit or relate to what is needed in the Senior Design Projects. | Consider revising the content<br>Consider teaching the content in EE instead | Only EE majors take this course so content change is feasible. |
| • EMCH 220 is not going well due to five instructors teaching the one course, each in two week segments | This is a temporary problem due to unexpected loss of instructors. Change is already planned for next semester. | |
| • Students had positive response to the elimination of a semester-long project assignment in ELCT 101. Students appreciated multiple small projects which allowed them to experience different topics to better understand the broad spectrum of Electrical Engineering | Continue with format of several-small-projects rather than reverting to a semester-long project. | . |
| • Students complemented the friendliness, helpfulness, and efficiency of the departmental office staff. | Keep them! | |

**Action Items**

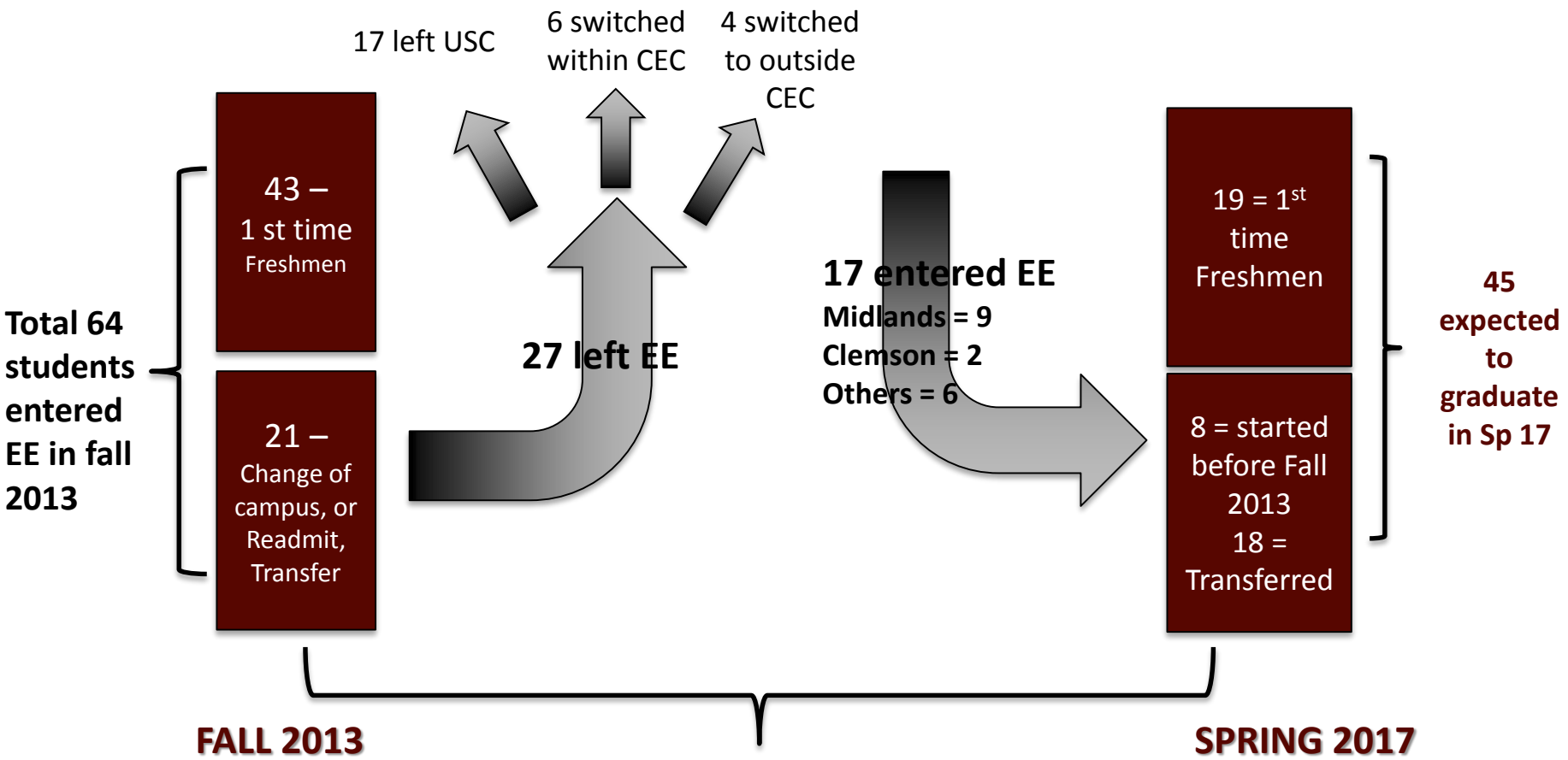
| Actions | Assignee | Due Date |
|---|---|---|
| Send meeting requests to put the next two meetings on calendars | Dr. Dougal | 12/19/2016 |
| Send the draft Fall 2016 meeting minutes for approval | Dr. Dougal | 12/19/2016 |
| Forward all IAB recommendations to appropriate committees for follow-up actions | Dr. Dougal | 1/10/2017 |
| Develop a draft of mentoring program for discussion at April 2017 meeting | | 2/28/2017 |

**Next Meetings**

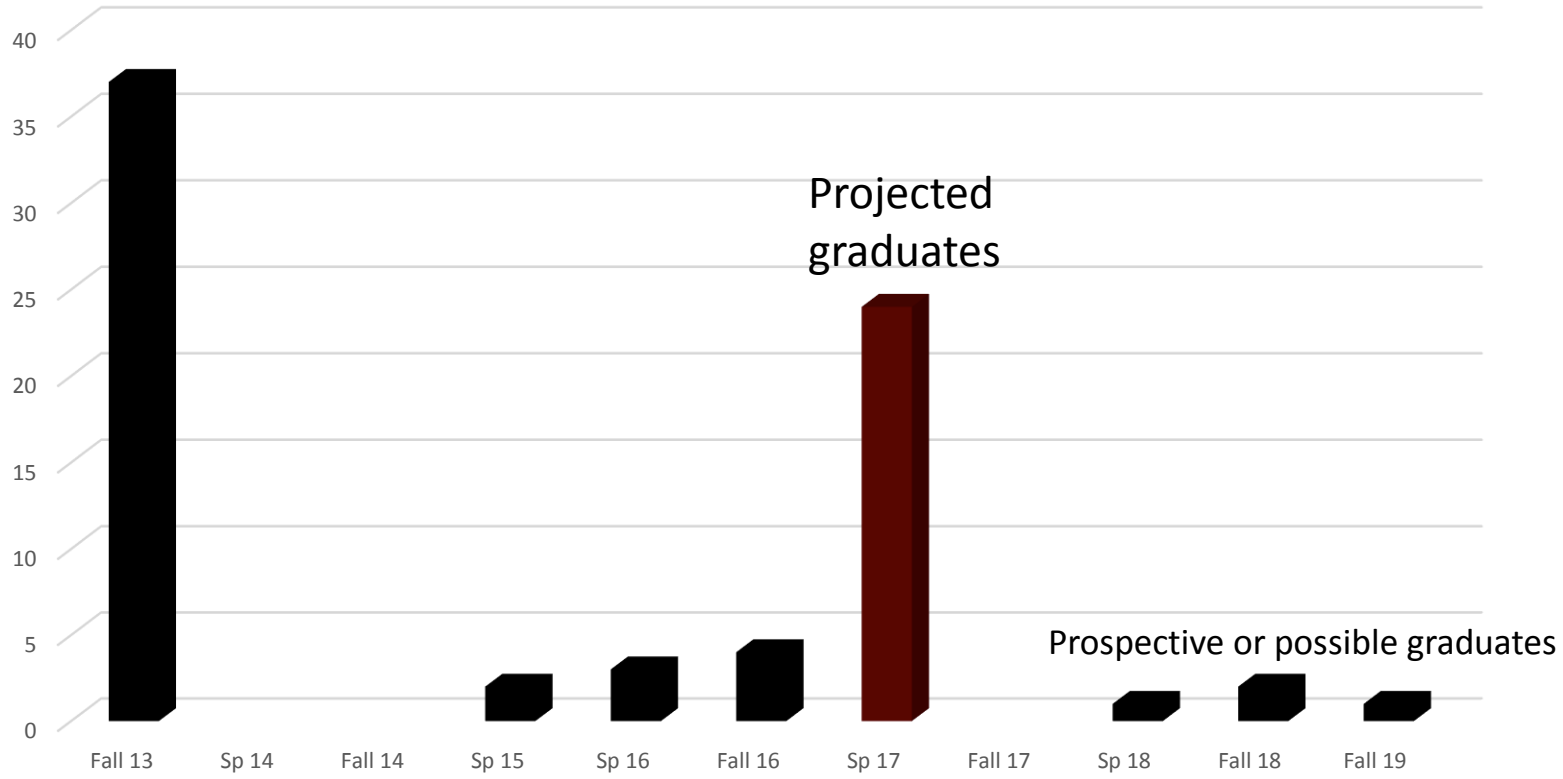
| Term | Date | Confirmation status |
|---|---|---|
| Spring 2017 | April 28, 2017 | Confirmed |
| Fall 2017 | November 3, 2017 | Tentative |

Meeting adjourned at 3:00 PM.

Appendix A


17 left USC
6 switched within CEC
4 switched to outside CEC
Total 64 students entered EE in fall 2013
43 – 1 st time Freshmen
21 – Change of campus, or Readmit, Transfer
27 left EE
17 entered EE
Midlands = 9
Clemson = 2
Others = 6
19 = 1st time Freshmen
8 = started before Fall 2013
18 = Transferred
45 expected to graduate in Sp 17
FALL 2013
SPRING 2017

# Fall 2013 entering cohort



Appendix B

# Graduation Rates of Student Populations

## (total from entering classes of 2012, 2013)

- Total entering students = 103

| Hispanic | Asian | African American | Caucasian | Mixed |
|---|---|---|---|---|
| 2 | 5 | 14 | 74 | 6 |

- Graduated within four years – 32

| Hispanic | Asian | African American | Caucasian | Mixed |
|---|---|---|---|---|
| | 2 | 1 | 25 | 4 |
| | 40% | 7.14% | 33.78% | 66.67% |

- Graduated within five years – additional 34

| Hispanic | Asian | African American | Caucasian | Mixed |
|---|---|---|---|---|
| | 1 | 7 | 19 | |
| | 60% | 57.14% | 59.45% | |

Appendix C

# Review of Feedback on Course Topics & Outcomes

| Courses | Comments | Recommendations |
|---|---|---|
| 101 | • No "Course Contribution to Program Outcomes" section was included. (BB) | |
| 102 | | |
| 221 | • Provides basic understanding of circuits used in modern computer systems as well as understanding of simulation tools and schematics that could be used to design modern computer system boards or packages. (BP) | |
| 222 | | |
| 201 | | |

| Courses | Comments | Recommendations |
|---|---|---|
| 301 | • We like it for hands on experience and principals taught. Would suggest they add "storage oscilloscopes" to the "Other Materials", as they need to understand how to take the data from multiple waves and do signal integrity issue type analysis. They need to be capable of taking all the data and trend/analyze it. We think that more emphasis could be placed on the usage of Test Instruments and software control of these instruments. (MW) | |
| 302 | • The syllabus has a note to provide a definition of "teaming skill" SEE: teaming skill (define what this is). But it was not completed… (BB)<br>• The use of GPS and Gyro systems would be a nice add to the course topics. (MW) | |
| 321 | | |
| 331 | | |
| 350 | • Continues to build on basics from ELCT 221/222 and reinforces the need for programming skills in electrical and computer engineering disciplines. (BP)<br>• This could be the most valuable class to us. Need people that understand and can model just about any type of electrical circuit. Should almost be a follow on to this that goes even deeper (JC)<br>• We like the hands on experience programming, as we use this everywhere. C++ is probably the best foundational programming language to start with, as it's OOP (Object Oriented Programming). Question we would have is it Windows based or does it cover both Windows and Linux operating systems, as they are somewhat different. The industry trend is toward Linux, so this really needs to be covered. Suggestion may be to have them create a Windows program and convert it to Linux. (MW) | |

| Courses | Comments | Recommendations |
|---|---|---|
| 363 | • Provides basic understanding of semi-conductor devices used in modern computer systems. (BP)<br>• Not sure what the value of this course is in 2016. If it were to focus on a specific are - say power - might be more relevant (JC) | Nothing mentioned in the outcomes or topics relating to limitations of physical size, manufacturing process or current fab process node scale, all of which could be interesting literature research for computer engineering oriented students. |
| 371 | Need to tie this to simulation environment. I also do not see switch mode power supplies. (JC) | |

| Courses | Comments | Recommendations |
|---|---|---|
| 403 | | |
| 404 | | |
| 510 | | |
| 521 | Glad they are using Pozar's book. Outcomes are good, but need to tie in some type of EM software with this class. | |
| 530 | This course is exactly what we do in manufacturing – testing and controlling some UUT (Unit Under Test) in an automated fashion. This is an excellent skill set to have for what we do. Automotive communication buses such as CAN, LIN, and Flex Ray could be added to the communication protocols discussed | |
| 531 | | |
| 551 | | |
| 553 | | |
| 554 | | |

| Courses | | |
|---|---|---|
| 562 | | |
| 563 | | |
| 564 | | |
| 566 | | |
| 572 | | |
| 582 | | |

Appendix D

# # of EE students who reported internships

| Term | # of EE Students | Total CEC | EE Share |
|---|---|---|---|
| Spring 2014 | 0 | 23 | 0% |
| Summer 2014 | 2 | 29 | 7% |
| Fall 2014 | 2 | 21 | 10% |
| Spring 2015 | 4 | 28 | 14% |
| Summer 2015 | 3 | 32 | 9% |
| Fall 2015 | 1 | 19 | 5% |
| Spring 2016 | 2 | 21 | 10% |
| Summer 2016 | 9 | 63 | 14% |
| Fall 2016 | 4 | 26 | 15% |

For reference, EE students constitute XX% of the CEC student population

# EE students have reported internships with …

| Term | # of EE Students | Companies |
|---|---|---|
| Fall 2015 | 1 | Hartness International (Greenville) |
| Spring 2016 | 2 | R.E.Mason Company (Charlotte), KapStone Paper & Packaging (N. Charleston) |
| Summer 2016 | 10 | AREVA Federal Services (Aiken), SCANA (Jenkinsville, Goose Creek), GE (Columbia), Robert Bosch (Charleston), MetLife (Cary), R.E Mason Company (Charlotte), Duke Energy (Hartsville), BMW (Greer) |
| Fall 2016 | 3 | KapStone Paper & Packaging (N. Charleston), BMW (Greer), Textron (Augusta) |

**We KNOW there were more!**

# Power Curriculum Discussion

By telemeeting on 2016-12-06

Attendees: Tracy Blackmon – Duke Energy, Lee Xanthakos – SCE&G, Tom Abrams – Santee Cooper, Roger Dougal, Enrico Santi, Andrea Benigni, Herb Ginn, Moinul Islam – all USC

The purpose of the meeting was to review undergraduate and graduate course content related to Power Engineering. This was a more-detailed follow-up to the general review of EE undergraduate curriculum during the November Industry Advisory Board meeting.

Class listing and syllabi can be found at http://sc.edu/study/colleges_schools/engineering_and_computing/study/areas_of_study/electrical_engineering/courses.php

The following courses were discussed:

**Undergraduate courses:**

ELCT 350: Computer Modeling of Electrical Systems. This contains some modeling and simulation methods that might have formerly been taught in a power engineering class. This is a required course in the BSE program – students have taken it before the take a course on introduction to power systems.

**Senior Undergraduate electives or Entry Graduate courses related to Power Systems**

ELCT 551(A): Power Systems Design and Analysis. This class is typically taken by more than half of our EE undergrads. A transcript review of all BSE graduates over a two-year period showed that this class was taken by 55% of our graduates.

ELCT 553(A): Electromechanical Energy Conversion. This is a “machines” class, but also covers some aspects of electronic drives. Roughly 30% of our recent graduates have taken this class.

ELCT 554(A): Integration of Photovoltaics in Modern Power Systems. This is a new class developed at USC under the FEEDER (DOE-funded) program. It will enroll roughly 30 of our students during spring 2017 and several students at other schools in the FEEDER consortium.

ELCT 572(A): Power Electronics: This class has been taken by 63% of our recent BSE graduates.

**Related senior electives:**

ELCT 530: Industrial Controls

ELCT 531(A): Digital Control Systems

ELCT 510: Renewable Energy Technologies: Photovoltaic Devices and Systems

Summarizing undergraduate student interest in power-related coursework, 67% of our BSE graduates during the past two years took two or more courses in the area of power systems, and 47% took three or more. This is a higher concentration of students in this technical area than nearly any other EE program in the country.

**Graduate power courses:**

ELCT 751: Advanced Power Systems Analysis. There was some discussion of moving content of this class (nominally, the second half of the same text used by 551) to the 500-level, perhaps as a course numbered 552 to follow 551. It would have 551 as a pre-req. We would need to estimate student interest in the class to be sure that it would have sufficient enrollment, and of course it would compete with other power offerings for that enrollment.

ELCT 752: Power System Grounding and Transients. There is no current plan for next offering of this class. Some aspects of transient analysis are already handled in other classes.

ELCT 883: Power Systems Stability & Control. There is no current plan for next offering of this class, but some aspects of it are likely covered in a more-general sense in graduate courses on control theory.

We do not currently have any of these classes on the schedule for offering in the near future.

Not discussed, but remembered post-meeting: There was formerly a graduate class called “Power system planning and operation” which was taught by Prof. Brice. It has not been taught recently and I believe it was removed from the list of course offerings. This probably had content similar to that in the textbook referred to by Tracy (Power Generation Operation and Control, by Allen)

**Related graduate courses:**

ELCT 753: Electrical Drives

ELCT 772: Advanced Power Electronics

ELCT 870: Computing Methods for System Simulation

Other important concepts from the conversation:

Many topics that were historically covered in power systems classes are now covered in other classes that have arisen or evolved during the past decades. Thus some topics that might appear to be missing maybe still be present, but in a different context – either the same principles applied in a different EE sub discipline, or being taught at a different level. (For example, the basic sophomore circuit theory course now includes some content on transformers and three-phase circuits.)

In the current EE program, there are no elective courses at the 300-level. Only “core” concepts are taught at the 300-level and then students take all specialty courses at the 500-level. This may change in the future as the department grows and more specialty areas are added. If it becomes necessary to offer more 300-level classes, then it will also become mandatory for students to choose between them.

Once it becomes possible to begin specializing at the junior level, then it may become possible to move an intro to power systems class to that level. In general, that will be feasible only if the size of the EE faculty increases.

Action Items:

Tracy will send a link to a book containing desired content: (Done – here is the link: https://www.amazon.com/Power-Generation-Operation-Control-Allen/dp/0471790559/ref=sr_1_1?s=books&ie=UTF8&qid=1481057569&sr=1-1&keywords=power+generation+operation+and+control

Herb –graduate committee (with help of undergrad committee as needed) to assess possible demand for a 552 class having content roughly equivalent to the second half of the Overbye book.

Herb – graduate committee assess future demand for power engineering classes to decide whether teaching faculty should be hired in order to offer those classes, probably in the form of online classes for working engineers. (Tracy, Lee, Tom – is it possible for you to estimate the number of people per year that you would expect to hire with those skills? And how many people are currently employed at your companies who would want to take them (as part-time, distance-education students) to improve their own job skills)? Courses that might be offered this way could include 751, 752, 882, and a restarted course on power system operations.