EE Undergraduate Curriculum Recent Activities

The BSEE program has gone through some substantial changes in the past 3 years and is continually being revised to keep the curriculum relevant for a distinct undergraduate experience at Mines. These changes have been made on a “need-to-do” basis which might not be ideal but with no long-term plan or strategy in place, the faculty have been trying to meet student expectations, demands and meeting learning objectives with the resources available. These changes are also motivated by a common goal of trying to set the EE department apart.

Faculty in the EE department strive to make existing courses at Mines better serve the undergraduate student population, filling in any pre-existing gaps; as well as develop new courses based on recent innovations in technology. Some initiatives and past developments are listed below:

1. **Field Session Revamp:** The EE field session is a 3-credit hour 3-week course taught in summer. The course was designed to teach 3 different modules in 3 weeks covering material that is not taught in regular course-work. Examples include practical low-level skills such as soldering, as well as high-level skills such as use of lab-view and open-ended design. As the name implies the course is supposed to give students experience they would get in the field. It is a unique and distinct experience for students at Mines not offered at peer institutions. However, the course hasn’t been updated in a while. The EE department started looking into revamping Field Session based on student surveys in 16 – 17 while also keeping some ABET outcomes in mind. Some of the ABET outcomes not covered in other classes include: “ability of a student to be a life-long learner”, “ability of a student to demonstrate professional and ethical behavior”, and “demonstration of contemporary issues”. These outcomes directly relate to what students need to be capable of doing in the field. 16 – 17 was spent coming up with ideas and ways of offering field session in a way that is not resource-hungry, but still offers students the field experience needed; and keeping the distinct flavor that it offers to a degree at Mines. Some execution strategies include, moving field session to the regular academic year, offering it as 1 credit-hour modules instead of a single 3 credit-hour course, and including more field-trips and industry visits.

*Why revamp:* Student surveys suggested that the field session experience was not adding value to their education. It was interfering with summer internships students could accept. It was also getting increasingly difficult to get full-time faculty involved in summer to teach field session. Reliance on adjuncts along with an old course curriculum was proving to be an experience of little worth to the students.

*Intended Outcomes:* Since the course is being redesigned to be offered as 1 credit-hour modules during the regular academic year, it provides students a variety of options based on their interest, future plans, availability and scheduling convenience. Industry visits will help students network and get an on-site visual of what happens in the field. It will also free up faculty time over summer, resulting in less reliance on adjuncts, and freeing up students to take on summer internships without any hurdles or hoops to jump through. Involvement of full-time faculty in teaching field session will also result in better student experience.

2. **Development of SEED Lab (EENG 450):** Systems Exploration and Engineering Design (SEED) Lab was designed in Summer 2015 and piloted in Fall 2015. This is a 1-credit hour
project-based lab course with gives students hands-on, system-level design experience before they head in to their capstone project. It focuses on skills such as being able to effectively function in multi-disciplinary teams, reflection, and learning from failure. It happened to replace MEL III in the EE curriculum giving students exposure to the use of modern technology such as Arduinos and Raspberry Pis. The course is designed to emulate industry practices with mid-semester design reviews and final presentations. The course is rigorous enough that faculty are planning on making it 1.5 or 2 credit-hour course to match the work and effort required off the students. Funding for development of this course in-fact came from a local industry, who happens to hire Mines graduates and was interested in the development of the professional skills mentioned above. The project changes every year along with the implementation technologies being used, therefore keeping the course relevant as time goes on.

**Why design:** This course is one of the signature courses at Mines with several unique characteristics. It is a course, students can take multiple times, therefore giving students an opportunity to work on different projects or work on the same project from a different perspective. Having a project-based, stand-alone lab course (not tied to any lecture content) in the curriculum is not something you see in other EE degree plans very often. The course does not have any lecture and truly follows the philosophy of “learning by doing”. It is one of the most valuable hands-on design experiences for students at Mines.

**Intended Outcomes:** In addition to providing a unique and distinct experience to student who choose to pursue a BSEE at Mines, it is also a source of funding for the department in the area of engineering education research. Since the course is unique in the way it is executed, funding can be expected from NSF as well as local industry. The IAB of the EE department has been extremely supportive of this initiative. We expect to publish results from the course in engineering education publications and journals. The understanding of how to work in a multi-disciplinary team to produce a functioning product should also improve students’ experience when going through the capstone project.

3. **Emphasis Areas in the EE degree:** In 16–17, the EE department decided to start offering the degree in conjunction with emphasis areas. The 4 emphasis areas being, the areas of expertise of the different EE faculty which also aligns with the research going on in the department: Energy Systems and Power Electronics (ESPE), Antennas and Wireless Communications (AWC), Information Systems and Science and Controls (ISS), and Digital Integrated Circuits and Electronics (DICE). The technical electives offered in the department now fall in to one of these 4 categories. Students are encouraged to fulfill their “EE Elective” requirements by taking courses in one emphasis area. This is optional for students to do. The department will present a proposal to the university’s undergraduate council in Fall 2017 to start offering an EE degree with specialties in one of the 4 areas. A student’s transcript will read BSEE with an emphasis on AWC as an example.

**Why change:** Expose undergraduate students to and educate them about the research areas in the department. Provide students an opportunity to gain in-depth knowledge in a specific area and tout that to future employers.

**Intended Outcome:** Provide students with multiple paths to graduation since students can choose to take all electives in the same area based on their interest, availability and what works with their schedule. Possible recruitment of students in to the graduate program by exposing them to possible research avenues they can pursue early on. Making our undergraduates more
attractive to the employers especially if they are looking for someone with a thorough background in one specific area. This also sets Mines apart from other peer institutions in the area making this a distinct experience for students who choose to come here.

4. **Minor in Computer Engineering:** When EE and CS were put together in one department in 2011, the ideal crossover was a degree in computer engineering. However, a degree would require resources that were not available. A compromise was to start offering a minor in computer engineering. The computer engineering minor came to fruition in collaboration with CS in 16 – 17.

   **Why offer:** Senior exit surveys from both, EE and CS students indicated an interest in this area.

   **Intended Outcome:** Provide students more opportunities, and options while getting a degree at Mines which in turn should attract more students to our programs.

5. **Offering New Tech Electives:** The number of EE electives has been steadily increasing over the past couple of years. Student exit surveys indicated a lack of elective options. In order to meet varied student interest, various new electives have been designed and developed. These include Active RF Microwave Devices, Passive Microwave Devices, and Introduction to Antennas in the area of AWC; VLSI Design, Semiconductor Device Physics and Design the area of DICE; Renewable Resources and Electricity, in the area of ESPE. EE faculty are continually working on offering modern and state-of-the art electives to meet student demands and interests. These include piloting courses in computational electromagnetics and a lab course on induction motor control drives.

6. **Participation in Trefny’s Intensive Course Revision Program:** Three EE faculty have gone through Trefny’s Intensive Course Revision Program targeting sophomore, junior and senior level courses. This is because faculty at in the EE department are dedicated to providing an exceptional classroom experience to students who choose to come to Mines. The incorporations of innovative and effective pedagogical techniques in the classroom is what will increase student satisfaction, foster better faculty-student relationships and overall increase the reputation of the department not only at Mines but also in the state of Colorado.

7. **Credit-Hour Reduction from 139 to 129.5:** The foundation for the BSEE degree was a legacy degree (BSE with an EE specialty), which resulted in a high number of credit hours. The EE undergraduate curriculum went through a rigorous review process in 2013, enabling the program to remove certain courses not pertinent to the degree, and making the curriculum credit-hour efficient. Examples include: removal of EPICS II, giving students a choice between Statics and Thermo, instead of both being mandatory courses, and development of EENG 282 (an EE-specific Circuits class).

   **Why change:** Peer institutions offer an EE degree with 125 – 128 credit hours which was putting Mines at a disadvantage.

   **Intended Outcome:** Provide students the opportunity to graduate with less financial debt while putting Mines in a position to compete with peer institutions in the area.