# ABET

# Self-Study Report

Bachelor of Science

Electrical Engineering

Weber State University

Ogden, Utah

June 2018

# Contents

## BACKGROUND INFORMATION

### A. Contact Information

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### B. Program History

The institution has offered two-year and four-year degrees in various engineering technology disciplines for many years. When Weber State College was granted university status by the Utah State Board of Regents in 1991, degrees were offered in Electronics Engineering Technology, Mechanical Engineering Technology, Manufacturing Engineering Technology and Design Graphics Engineering Technology (now called Product Design & Development). These engineering technology degrees continue to be offered today. WSU also offers a two-year degree in Pre-Engineering, a program designed to facilitate the transfer of engineering students to in-state universities. Our Pre-Engineering program has experienced substantial growth in recent years, indicating a high demand for engineering degrees. With the growth of Pre-Engineering and heightened demand from local industries for engineers, it became apparent that WSU should offer its own four-year engineering degree.

The Utah State Board of Regents granted WSU a Bachelor of Science in Electronics Engineering in the summer of 2010. Electronics Engineering was the program of choice in order to address the acute demand for electrical and electronics engineers in the Northern Utah aerospace industry. The curriculum was designed by our Electronics Engineering Technology faculty with substantial input from local engineering employers.

The EE program is housed in the Department of Engineering, which was formed July 1, 2011, as part of a reorganization in the College of Applied Science and Technology. At that time, the new Electronics Engineering program and the Pre-Engineering program were bought together under the same department, whereas all the engineering technology programs were brought together under the Engineering Technology Department, formerly called the Manufacturing and Mechanical Engineering Technology Department. The program produced its first graduate fall semester 2011. As of June 2018, the Electrical Engineering program has produced 119 graduates.

Upon recommendation of the EE Industrial Advisory Board (IAB), the program name Electronics Engineering was changed in 2015 to Electrical Engineering to give the program better name recognition and to more accurately reflect its academic and professional content. The same year, the name of the college was changed to Engineering, Applied Science &Technology (EAST).

In 2016 two new engineering programs were added to the Department of Engineering, a BS in Computer Engineering and a MS in Computer Engineering, which prompted the department to assign all electrical and computer engineering courses the ECE prefix. In 2018 a MS degree in Electrical Engineering was approved.

**C. Options**

There are no special options, tracks or concentrations in the Electrical Engineering program.

**D. Program Delivery Modes**

All Electrical Engineering courses are taught in a traditional face-to-face lecture/laboratory format. Electrical Engineering courses are typically taught during the day, but limited rotating day/evening course offerings facilitate the schedules of students who are employed full time.

All day-time courses are offered at the main Ogden campus. Evening courses are offered at both the Ogden campus and the Davis (County) campus in Layton, Utah, a 20 minute drive from Ogden. We have a classroom/computer laboratory at the Davis campus.

The program has a required internship, ECE 3890, in which the student works at an engineering company off campus. The company, which is typically selected by the student, must be approved by program faculty.

**E. Program Locations**

Courses in the program are offered at two locations, the Ogden campus and the Davis campus in Layton, Utah. The addresses of the Ogden and Davis locations, respectively, are as follows:

Weber State University
3750 Harrison Blvd.
Ogden, Utah 84408

Weber State University-Davis
2750 N. University Park Blvd.
Layton, Utah 84041

The Department of Engineering office is located in Room 236 of the Engineering Technology (ET) Building at the main Ogden campus.

## F. Public Disclosure

Program Educational Objectives (PEOs), Student Outcomes (SOs), annual student enrollment and graduation data are posted annually on the Department of Engineering website:

http://www.weber.edu/engineering/ABET_Accreditation.html

## G. Deficiencies, Weaknesses or Concerns from Previous Evaluation(s) and the Actions Taken to Address Them

The WSU Electronics Engineering program received its first on-site accreditation visit September 23–25, 2012. The accreditation team cited two weaknesses and one concern, which are quoted verbatim below from the ABET Final Statement.

<u>Weakness 1</u>

Criterion 4. Continuous Improvement

“This criterion requires that a program regularly uses appropriate, documented processes for assessing and evaluating the extent to which the program educational objectives are being attained. Furthermore, the results of these evaluations should be systematically utilized as input for continuous improvement of the program. A survey instrument has been developed for assessing program educational objectives. This survey is administered to graduating students, and the current plan is to administer the same survey to students a few years after graduation. Both the survey and its administration are problematic. Regarding administration, students are not in a position to judge their attainment of program educational objectives at the time of graduation. Regarding the survey, it asks students’ their opinions about the importance of the program’s student outcomes, as well as their judgements regarding their attainment of those same outcomes. These opinions about outcomes will then be used to infer attainment of program educational objectives. The collection of survey data related to program educational objectives from students as they exit from the program, and the manner in which program educational objectives are assessed through student opinions regarding student outcomes, produces a weak strength of compliance at best, and may lead to a situation wherein the strengths and weaknesses of the program, relative to the attainment of program educational objectives, cannot be accurately determined.”

Corrective Action Taken

The part of the graduate survey that asked for students' judgements of the importance of student outcomes was removed from the survey. The graduate survey continues to be administered, but it only asks graduating students how effectively the program meets student outcomes. A five-point Likert scale is used to quantify their responses. If the mean response for a given student outcome falls below a threshold or trigger point, program improvements for that student outcome are initiated.

Weakness 2

Program Criteria

"Program criteria for electrical, computer and similarly named engineering programs require the curriculum to include probability and statistics, including applications appropriate to the program name. Although there is a required probability and statistics course taught by the math department, the evidence shows that only those students choosing the communications circuits and systems elective may be exposed to applications of probability and statistics related to electronics or electrical engineering. Thus, some program graduates will lack the ability to apply probabilistic methods to real-world engineering problems."

Corrective Action Taken

In consultation with faculty in the Mathematics Department, engineering applications were added to the probability and statistics course, Math 3410 Probability and Statistics I. To confirm that engineering applications continue to be covered in Math 3410, Engineering faculty met with Mathematics faculty fall semester 2017.

Concern

Criterion 8. Institutional Support

"This criterion requires that an institution supply students support sufficient to attract and retain a well-qualified faculty and provide for their professional development. Tenure track faculty members are judged on teaching, scholarship, and service. Present faculty teaching workloads of 12-16 credit hours may actually result in 20-22 contact hours when additional hours for laboratories are accounted for. With the already rapid growth in enrollment, faculty will find it increasingly difficult to maintain scholarship or pursue professional development, thereby hindering their ability to advance through the academic ranks. Additional staff support such as a lab technician and/or an increase in faculty size will be required to maintain the quality of the program as it grows."

Corrective Action Taken

Since the on-site ABET visit September 2012, four tenure track faculty have been hired into the Department of Engineering, bringing the total number of faculty to eight. With the additional hires, Electrical Engineering faculty are able to pursue scholarly activities and professional development while effectively teaching their courses.

## CRITERION 1. STUDENTS

### A. Student Admissions

New students who are accepted into the Electrical Engineering Program fall into one of three general categories:

1. Recent high school graduates
2. Current students at WSU
3. Transfer students

Any student who wishes to major in Electrical Engineering is first admitted to WSU. The university admission process is handled centrally. The student then meets with the Electrical Engineering Program Coordinator (Advisor), an assigned faculty member who is given three credit hours of release time per semester for this duty. The program coordinator extensively uses Cattracks, a WSU computer-based degree evaluation and planning tool. Cattracks enables the program coordinator to track the student's progress toward graduation by showing the courses taken and grades received, courses still required, grade point average, transfer credits and other pertinent information.

1. Recent high school graduates

A recent high school graduate who desires to major in Electrical Engineering meets with the program coordinator, who determines the preparation of the student in college-level mathematics. If the student is not prepared to take college-level mathematics courses, developmental mathematics is required to bring the student up to the Calculus I level before the student can take the first course in circuits or the first course in physics. The program coordinator meets personally with the student to evaluate his or her academic record and to map a plan of course work. The Electrical Engineering major is then officially declared on the student's record in the WSU Banner system.

2. Current students at WSU

Any current student, traditional or non-traditional, at WSU can be accepted into the Electrical Engineering Program, as there are no special entrance requirements. However, like the recent high school graduate, if the student is not prepared to take college level mathematics courses, developmental mathematics is required to bring the student up to the Calculus I level before the student can take the first circuits course or the first calculus-based physics course.

The process for accepting recent high school graduates and current WSU students into the program is the same. Paying particular attention to previous courses taken in college level mathematics, the program coordinator meets personally with the student to evaluate his or her academic record and to map a plan of course work. The Electrical Engineering major is then officially declared on the student's record in the WSU Banner system.

3. Transfer students

A student who transfers to WSU from another institution meets personally with the program coordinator, who evaluates the student's courses taken at the transfer institution(s). Particular attention is given to transfer courses in engineering, mathematics and science. The majority of transfer students come to WSU from institutions within Utah, where lower division courses transfer as part of a state-wide articulation agreement. If a student transfers from an institution outside Utah or the United States, the program coordinator evaluates each course individually and may ask the student to provide course syllabi, textbooks or other materials to show equivalence with WSU courses. Once the transfer courses are recorded in Cattracks, the program coordinator maps a plan of course work for the student.

**B. Evaluating Student Performance**

Students are evaluated in each course they complete by assigning them a letter grade corresponding to a standard 0.0 to 4.0 scale. Grades are assigned by the course instructor. A grade of C (2.0) is required in all Electrical Engineering courses and support courses in mathematics, science, computer science and technical writing. If a student receives a grade of C− or lower in any of these courses, the student must repeat the course.

The program coordinator uses Cattracks, a WSU computer-based degree evaluation and planning tool, to monitor student progress. Cattracks is programmed to track student advancement in the declared major by showing which courses have been taken and which courses are still required for graduation. Because the WSU general catalog constitutes the official contract between the institution and student, Cattracks is programmed to precisely match the degree requirements stated in the student's contract-year catalog. Within Cattracks the program coordinator can perform course substitutions or forced completions if warranted. The program coordinator can also record dated notes in order to document advisement meetings with and recommendations to the student.

The program ensures that students meet prerequisites by integrating them directly into the Banner registration system. If a student attempts to register for a course without the prerequisite(s) stated in the catalog, the system will not allow the student to register for the course. However, the program coordinator can perform a prerequisite override if it is justified.

**C. Transfer Students and Transfer Courses**

Transfer students are admitted to WSU through the same admission process as new high school graduates, with the exception that transcripts from previously attended colleges and universities are included. The Utah State Board of Regents mandates a state-wide articulation in which specific courses transfer between the nine state-operated institutions.

Faculty in all disciplines from all nine institutions meet annually in the state-wide "Majors Meetings" to coordinate and maintain articulation agreements. In these annual meetings, engineering faculty focus on the articulation of lower division courses since these courses are common across all institutions, including the four-year schools and community colleges. Faculty strive to maintain consistency in the content and course number for every lower division engineering course, assuring a smooth transfer of credit when a student transfers from one state institution to another. State institutions maintain articulation lists that define course equivalencies.

**D. Advising and Career Guidance**

Advising

The program coordinator, an assigned faculty member who is given three credit hours of release time per semester for this duty, is responsible for advising Electrical Engineering students with respect to courses within the major and technical support courses in mathematics, science and computer science. The program coordinator's advisement with respect to general education is augmented by that of advisors in the WSU Student Success Center and the college advisors in the Dean's office. Students are required to meet with the program coordinator annually. Cursory advising (supplying students with informational brochures, directing students to faculty, scheduling advising appointments, etc.) may be performed by the department administrative assistant.

As stated in Section 1.A, the program coordinator extensively uses Cattracks, a WSU computer based degree evaluation and planning tool. Cattracks enables the program coordinator to track the student's progress toward graduation by showing the courses taken and grades received, courses still required, grade point average, transfer credits and other pertinent information. Students can also access Cattracks for the purpose of monitoring their progress in the program, but students cannot make changes of any kind to their academic record.

Career Guidance

A staff member in the Dean's office serves as a career advisor for all departments in the College of Engineering, Applied Science & Technology. The duties of this staff member are to provide career counseling to students, forward employment opportunities to students for full-time and part-time work and internships, help the WSU Career Services Department conduct job fairs and interviews on campus and promote WSU students and graduates to local companies. Because all our engineering faculty have industrial experience with local engineering firms, they may also offer career guidance to students.

**E. Work in Lieu of Courses**

Credit for Calculus I and Calculus II may be granted through Advanced Placement (AP) examinations. These mathematics courses, among others, are required for the BS in Electrical

Engineering. There are no advanced placement courses for EE courses per se. Course credit for life experience is not given. While rare, a challenge examination for a course may be given a student at the discretion of the program coordinator and the faculty member who teaches the course in question.

Typically, industrial work experience does not count for credit in Electrical Engineering courses. Industrial work in lieu of a course is considered only in exceptional cases in which the quality and quantity of the work closely corresponds with the content of the course. This work may be in the military or the private sector. For work to be substituted for course credit, the student must supply evidence (design documents, test reports, employer's letter, etc.) to support the substitution. The program coordinator decides whether the substitution is warranted based on the evidence supplied by the student.

**F. Graduation Requirements**

The name of the degree awarded is the Bachelor of Science in Electrical Engineering.

The degree has the following graduation requirements:

| | |
|---|---|
| Total credit hours: | 121 |
| Required EE credit hours: | 49 |
| Elective EE credit hours: | 6 |
| Support course credit hours: | 27 |
| Upper division credit hours: | 40 |
| Residency credit hours: | 30 |
| Minimum overall GPA: | 2.5 |
| Minor: | not required (1) |
| General education: | as defined in the WSU general catalog |

(1) If EE majors take Math 2270 and Math 2280 in lieu of Math 2250, they fulfill the requirements for a minor in Mathematics.

The above information was obtained from the 2017-2018 WSU general catalog, which is published online: catalog.weber.edu.

Specific courses required for graduation are listed in the catalog and the program web site. A student must earn a grade of C or better in all EE courses and support courses, which are defined as courses in mathematics, physics, chemistry, computer science and technical writing. If a student gets a C− or lower in any of these courses, the student must repeat the course.

After registering for courses in the final semester in the student's program, the student meets with the program coordinator in a concluding advising session to assure that all degree requirements will be met by the time of graduation. This final advising session typically occurs in the fall semester of the student's senior year. As with all advising sessions conducted by the program coordinator, Cattracks is used to check the student's progress. After the student's final semester has commenced but prior to the graduation application deadline, the program coordinator conducts a final check of the student's progress. In order to graduate, the student must still pass his or her "in-progress" courses.

## G. Transcripts of Recent Graduates

Transcripts of recent graduates will be submitted to the visiting team upon request. Detailed explanations of the transcripts will be given at that time.

## CRITERION 2. PROGRAM EDUCATIONAL OBJECTIVES

### A. Mission Statement

The mission statement of Weber State University:

*Weber State University provides associate, baccalaureate and master degree programs in liberal arts, sciences, technical and professional fields. Encouraging freedom of expression and valuing diversity, the university provides excellent educational experiences for students through extensive personal contact among faculty, staff and students in and out of the classroom. Through academic programs, research, artistic expression, public service and community-based learning, the university serves as an educational, cultural and economic leader for the region.*

The three core themes of the mission, and the objectives of each:

**1. Learning**

a. Students experience an engaging learning environment founded on extensive personal contact among faculty, staff and students in and out of the classroom.
b. Students receive effective educational support.
c. Students learn to succeed as educated persons and professionals.
d. Students and faculty learn, explore and create in an environment that sustains free inquiry and free expression.

**2. Access**

a. Weber State University offers responsive associate, baccalaureate and master's degrees in liberal arts, sciences, technical and professional fields.
b. Students' progress in their programs of study.
c. Weber State University provides access to higher educational opportunity.

**3. Community**

a. Weber State University contributes to pre-K through 12 education in the region.
b. Weber State University contributes to the richness of the regional culture.
c. Weber State University contributes to the economic development of the region.

### B. Program Educational Objectives

Program educational objectives are career and life accomplishments that the program prepares graduates to achieve within a few years after graduation. The program educational objectives were defined by the faculty and approved by our Industrial Advisory Board, which consists of faculty, local engineering employers and at least one senior student in the program. The educational objectives of the Electrical Engineering Program are to produce graduates who are able to

- Design and develop electrical systems.
- Effectively communicate technical information and participate in a team environment.
- Engage in life-long learning through continuing education and industrial practice.
- Demonstrate professional ethics and social awareness.

The program educational objectives are publicly available on the Electrical Engineering web site:

http://www.weber.edu/engineering/ABET_Accreditation.html

**C. Consistency of the Program Educational Objectives with the Mission of the Institution**

1. Design and develop electrical systems.

This objective is strongly connected to the first core theme, *learning*. The institution fosters an environment conducive to learning by providing extensive contact with faculty in and out of the classroom. Weber State University is first and foremost a teaching institution that focuses on student learning and the development of students into educated, capable professionals in their field.

The first program educational objective is also associated with the second core theme, *access*. Weber State University offers the Electrical Engineering degree to satisfy the demand for engineers who can design and develop new electrical systems for local engineering companies. Being strategically located near those companies, WSU provides access to the education that industry requires.

2. Effectively communicate technical information and participate in a team environment.

The core theme, *learning*, encompasses this objective. Communication of technical information and working in a team environment are key components of the Electrical Engineering Program, particularly in the senior project and internship courses.

3. Engage in life-long learning through continuing education and industrial practice.

Two core themes, *learning* and *community*, encompass this objective. In the Electrical Engineering Program, students are taught to continue their learning through involvement with professional engineering societies, attendance at technical presentations and seminars and reading professional publications. Through continued industrial practice, graduates learn procedures and practices of the industry in which they are employed.

4. Demonstrate professional ethics and social awareness.

Again, two core themes, *learning* and *community*, encompass this objective. In engineering seminar, internship and senior project courses, students learn their ethical and professional responsibilities. As students transition from the university to the industrial community, they contribute to the economic development of the region and enrich the regional culture.

**D. Program Constituencies**

There are two constituencies of the WSU Electrical Engineering Program, students and engineering employers.

1. Students

At WSU, students are considered our "customers" in the sense that our institution is a student-centered university focused on the progress and success of students. The Electrical Engineering Program was established in part due to the desire of many Pre-Engineering students, who would otherwise transfer to another institution to complete their BS degree, to remain at WSU.

Design is the core of any engineering program. Consequently, the first program educational objective is central to furnishing the student with the knowledge and ability to design an electrical system. Design is specifically taught in the senior project course, and analysis, which is an integral part of design, is taught in virtually every other course except seminar and internship.

Like engineering design, communication and working in teams, the second program educational objective, is central to the education of an engineering student. The students' senior projects are conducted in teams, and communication is an integral part of senior project design reviews and engineering seminar.

The third program educational objective is life-long learning. Students are urged to continue their learning inside and outside the classroom while in school and particularly after graduation.

Professional ethics and social awareness are attributes of a successful, ethical and educated person in engineering or any other field. This program educational objective is addressed primarily in the engineering seminar and internship courses.

Students are represented by one or more Electrical Engineering seniors on the Industrial Advisory Board.

2. Engineering Employers

Addressing the needs of local engineering employers for electrical engineers is the primary reason that the WSU Electrical Engineering Program was established. Local engineering employers, particularly aerospace companies, have an acute need for engineering graduates who can design and develop state-of-the-art electrical systems. Employers often remind us that the most important “soft skills” are communication and the ability to work in a team environment. Employers also demand engineering graduates who are willing to further their knowledge and skills in their areas of expertise. Furthermore, employers require employees who act professionally and ethically.

Engineering employers are represented by engineering managers on the Industrial Advisory Board. Table 2-1 gives the composition of the IAB, which meets annually each spring semester.

**Table 2-1. WSU ECE Industrial Advisory Board Composition**

| Company | Business Sector | Members |
|---|---|---|
| Orbital ATK | Aerospace | 1 |
| BAE Systems | Aerospace | 2 |
| Hill Air Force Base | U.S. Air Force | 2 |
| IM Flash | Semiconductors | 1 |
| Lockheed-Martin | Aerospace | 2 |
| Northrop Grumman | Aerospace | 2 |
| Parker Hannifin | Aerospace | 1 |
| WSU (faculty, staff, student) | Education | 12 |

## E. Process for Review of the Program Educational Objectives

The program educational objectives were defined by the faculty and approved by the Industrial Advisory Board (IAB) prior to the initial accreditation visit in 2012. The approach used for the review of the program educational objectives is described below.

The Industrial Advisory Board, which consists of program faculty, engineering managers from local engineering companies, and at least one senior Electrical Engineering or Computer Engineering student, is tasked with reviewing and potentially revising the educational objectives of the program. This board convenes once per year in the spring semester. Topics and issues discussed by this board include, but are not necessarily limited to, the following:

1. Review of program educational objectives
2. Program structure
3. Content of courses
4. Declared majors and course enrollments

5. Graduate projections
6. Internship opportunities
7. Full-time hiring projections

Since the initial accreditation visit in 2012, the Department of Engineering has held six IAB meetings. Since the creation of the Computer Engineering (CE) program in 2016, the IAB meetings have been joint meetings in which both the EE and CE programs are discussed. While the EE program educational objectives have been reviewed but not revised, actionable recommendations of the IAB have been reviewed and implemented. These are discussed in the Criterion 4 Continuous Improvement section of this report.

## CRITERION 3. STUDENT OUTCOMES

### A. Student Outcomes

Student outcomes describe what students are expected to know and be able to do by the time of graduation. The student outcomes of the WSU Electrical Engineering Program are identical to those defined in Criterion 3 for the 2018-2019 ABET accreditation cycle of engineering programs.

Graduates of the WSU Electrical Engineering Program will have

a. An ability to apply knowledge of mathematics, science and engineering.
b. An ability to design and conduct experiments, as well as to analyze and interpret data.
c. An ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability and sustainability.
d. An ability to function on multi-disciplinary teams.
e. An ability to identify, formulate and solve engineering problems.
f. An understanding of professional and ethical responsibility.
g. An ability to communicate effectively.
h. The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental and societal context.
i. A recognition of the need for, and an ability to engage in, life-long learning.
j. A knowledge of contemporary issues.
k. An ability to use the techniques, skills and modern engineering tools necessary for engineering practice.

Student outcomes are published on the WSU Electrical Engineering web site:

https://www.weber.edu/engineering/ABET_Accreditation.html

### B. Relationship of Student Outcomes to Program Educational Objectives

Figure 3-1 illustrates the relationship of student outcomes to program educational objectives. Program educational objectives are assessed using instruments at the program level, whereas student outcomes are assessed using instruments at both the program and course levels. These assessment instruments are fully described in Criterion 4 Continuous Improvement. By virtue of the relationships shown in Fig. 3-1, the degree to which program educational objectives are achieved is a reflection, to a great extent, of the degree to which student outcomes are achieved.


Figure 3-1. Relationship of student outcomes to program educational objectives.

Design is the heart of any engineering discipline. Student outcomes (a), (b), (c), (e) and (k) are directly linked to the first program educational objective, "Design and develop electrical systems." In order for a graduate to design and develop electrical systems, the graduate must be able to apply his or her knowledge of mathematics, physical sciences, engineering and computing sciences. Furthermore, the ability to design and conduct engineering experiments, design the hardware and software of a system within realistic design constraints, solve engineering problems and use techniques and tools of the trade are critical to engineering design. These elements constitute the foundational knowledge areas, analytical tools and skill sets of the engineering graduate.

In the second program educational objective, “effective communication of technical information” and “participation in a team environment” are grouped together because of the close association of these two activities in engineering industry. As shown in Fig. 3-1, student outcomes (d) and (g) are directly related to this objective. For the engineer, technical communication encompasses oral, written and visual methods.

The third program educational program objective, “Engage in life-long learning through continuing education and industrial practice,” is reflected in student outcomes (h), (i) and (j). In order to stay abreast of their field and understand the impact of engineering solutions on society and the environment, graduates must continue to learn and develop professionally.

The fourth and last program educational objective, “Demonstrate professional ethics and social awareness,” is reflected in student outcomes (c), (f), (h) and (j). Engineering design must be conducted within the constraints of ethical and social considerations as well as professional practices of the industry in which the graduate works. Professional and ethical responsibility, an understanding of engineering solutions on society, and knowledge of contemporary issues are all manifested in this objective.

## CRITERION 4. CONTINUOUS IMPROVEMENT

### A. Student Outcomes

Student learning outcomes are listed in "CRITERION 3. STUDENT OUTCOMES." Table 4-1 is a listing and description of the assessment processes that are used to gather data upon which the evaluation of student outcomes are based. For each assessment instrument, the table gives the frequency with which the process is carried out, the expected level of attainment for each of the student outcomes, a summary of the results of the evaluation process, and the manner in which the results are documented and maintained. Detailed explanations of the assessment instruments and how the data is used for continuous improvement are given in Section B.

Table 4-1. Processes for the assessment of student outcomes

| Assessment Instrument | Frequency of Application | Expected Level of Attainment | Summary of Results | How results are (1) documented (2) maintained |
|---|---|---|---|---|
| Course Rubrics | Each time the course is taught | S = 3 or S = 4 (1)<br>X > 2.67 (2) | Triggered 50 times at course level.<br>Triggered one time at program level.<br>See Section B.1 | (1) spreadsheet<br>(2) department chair |
| Graduate Survey | At the graduation of each cohort | X > 3.5 (3) | Not triggered.<br>See Section B.2 | (1) spreadsheet<br>(2) department chair |
| Internship Employer Survey | Annually | X > 3.5 | See Section B.3 | (1) spreadsheet<br>(2) department chair |
| Traceable Progress System (TPS) | Ongoing | Improvement(s) as defined | See Section B.4 | (1) TPS reports from faculty<br>(2) department chair |
| Industrial Advisory Board recommendations | Annually | Improvement(s) as defined | See Section B.5 | (1) minutes of IAB meetings<br>(2) department administrative assistant |
| Senior Assessment Exam | At end of ECE 4010 and ECE 4020 | (under discussion) | See Section B.6 | (1) ChiTester<br>(2) department chair |

(1) S = Performance Indicator (PI) score for a given student outcome.

(2) X = mean PI score for a given course. Prior to fall 2014, this threshold was 2.0. After discussion, faculty decided to raise the threshold to 2.67.

(3) X = mean PI score on a five-point scale.

## B. Continuous Improvement

This section discusses how the assessment processes summarized in Table 4-1 are used to continuously improve the Electrical Engineering program.

### B.1. Course Rubrics

When the EE program was first established in 2010, the faculty spent a great deal of effort defining a matrix of courses and student outcomes. For each course in the curriculum, a level of applicability for each student outcome was assigned. The levels of applicability are *low*, *medium* and *high*, designated by a blank, M and H, respectively, in the matrix. Table 4-2 is the matrix of courses and student outcomes. Only the student outcomes that ranked *high* in the matrix were assigned a performance indicator (PI) in the course rubric. Levels of applicability were assigned to courses outside the EE program as well, but none of them ranked higher than *medium*, so they were not connected to a PI and are therefore not shown in Table 4-2.

Table 4-2. Matrix of ECE courses and student outcomes.

| | Student Outcomes | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **ECE Course** | **a** | **b** | **c** | **d** | **e** | **f** | **g** | **h** | **i** | **j** | **k** |
| ENGR 1000 Introduction to Engineering | | | | M | | M | | | | | |
| ECE 1270 Introdution to Electrical Circuits | H | M | | | H | | M | | M | | H |
| ECE 2260 Fundamentals of Electrical Circuits | H | M | | | H | | M | | M | | H |
| ECE 2700 Digital Circuits | H | M | | M | H | | | | | | H |
| ECE 3000 Seminar | | | | | | H | H | H | H | H | |
| ECE 3110 Microelectronics I | H | M | | | H | | M | | M | | H |
| ECE 3120 Microelectronics II | H | M | | | H | | M | | M | | H |
| ECE 3210 Signals and Systems | H | M | | | H | | M | | M | | H |
| ECE 3310 Electromagnetics I | H | M | | | H | | | | | | H |
| ECE 3610 Digital Systems | H | M | M | M | H | | | | | | H |
| ECE 3710 Embedded Systems | H | H | H | M | H | | H | | | | H |
| ECE 3890 Internship | | | | H | | H | H | H | H | H | H |
| ECE 4010 Senior Project I | | | H | H | | H | H | | H | H | |
| ECE 4020 Senior Project II | | H | H | H | | H | H | | H | H | |
| ECE 4100 Control Systems | H | H | M | | H | | | | | | H |
| ECE 4210 Digital Signal Processing | H | M | | | H | | | | | | H |
| ECE 4310 Electromagnetics II | H | M | | | H | | M | | M | | H |
| ECE 4410 Communication Circuits and Systems | H | M | M | | H | | M | | M | | H |
| Blank = low applicability | | | | | | | | | | | |
| M = medium applicability | | | | | | | | | | | |
| H = high applicability | | | | | | | | | | | |

At the conclusion of each semester, faculty prepare a rubric for each ECE course they taught by assigning a level of achievement to each PI for the student outcomes in the rubric. The levels of achievement are (1) unsatisfactory, (2) developing, (3) satisfactory and (4) exemplary. A recent example of a course rubric is shown in Table 4-3.

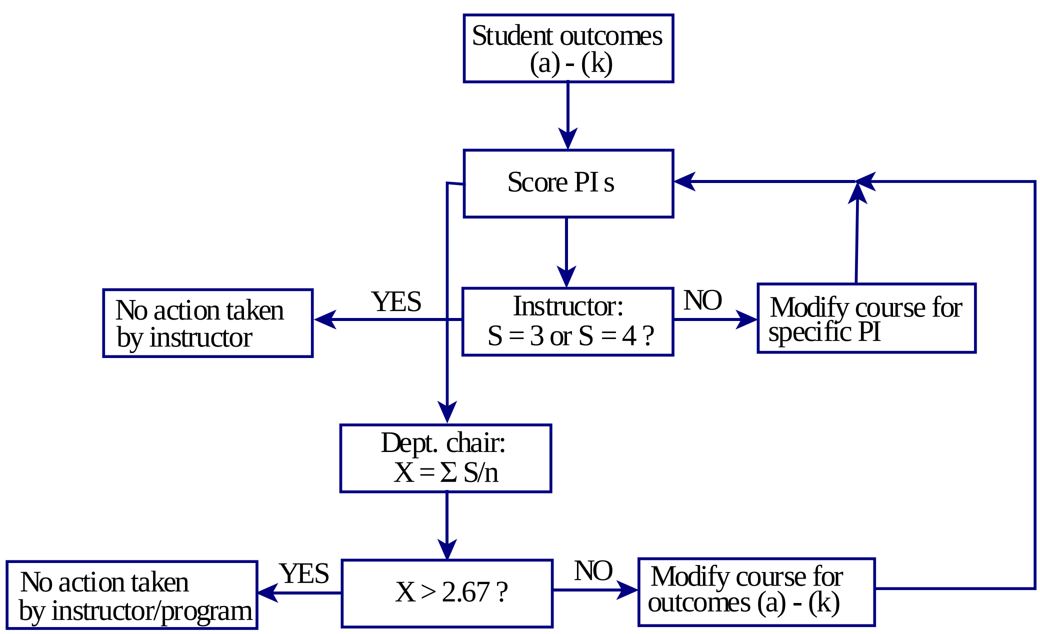
Table 4-3. Course rubric example for ECE 3710 Embedded Systems.

| ELECTRONICS ENGINEERING COURSE RUBRIC | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| COURSE | ECE 3710 Embedded Systems (4), 2 Sections | | | | | | | |
| SEMESTER | Spring | | | | | | | |
| YEAR | 2018 | | | | | | S = 1 or 2: action initiated by instructor | |
| INSTRUCTOR | Nair | | | | | | S = 3 or 4: no action initiated by instructor | |
| Performance Indicator (PI) | Student Outcomes | 1 Unsatisfactory | 2 Developing | 3 Satisfactory | 4 Exemplary | Score (S) | Initiate action by instructor ? | Action to be initiated |
| Write a computer program in assembly language. | a, e, k | Cannot write a program that assembles. | Writes a program that assembles but does not work. | Writes a program that assembles and works but is poorly organized and documented. | Writes a program that assembles, works and is well organized and documented. | **3.5** | No | |
| Write code to handle interrupts. | a, e, k | Cannot write interrupt handlers, or interrupt handlers cause the system to crash. | Writes interrupt handlers that do not cause the system to crash. | Writes interrupt handlers that work. | Writes interrupt handlers that work and are well documented. | **3** | No | |
| Debug a computer program using both hardware and software tools. | a, e, k | Debugs computer programs using trial and error. | Debugs computer programs using an interactive debugger only. | Debugs computer programs using an interactive debugger and basic laboratory equipment. | Debugs computer programs using an interactive debugger and a logic analyzer. | **2.5** | Yes | Students were required to use an oscilloscope to verify their measurements in only 2 labs, and so they used it only then. Apart from that, they were relying only on the debugger. In future, lab equipments for debugging should be introduced in one of the earlier labs, and used more often to make it a habit. |
| Interface peripherals to a microcontroller or microprocessor using a bus. | a, e, k | Cannot interface peripherals to a microcontroller or microprocessor. | Interfaces peripherals using I/O ports only. | Interfaces one peripheral using a bus. | Interfaces multiple peripherals using a bus. | **3** | No | |
| Document the hardware and software of an embedded systems design. | c, g | Cannot document a design using an acceptable format. | Uses an acceptable format to document a design but leaves out important aspects. | Uses an acceptable format to document all the important aspects of a design. | Uses an acceptable format to document a design completely, clearly and concisely. | **3.5** | No | |
| Design a test plan and use it to verify that a system satisfies its requirements and costraints. | b | Can only perform tests on an ad hoc basis. | Designs a test plan but fails to verify the system satisfies the requirements or constraints. | Designs a suitable test plan and verifies that the requirements and constraints are satisfied. | Designs a suitable test plan and documents the requirements and constraints verified by each test. | **2** | Yes | Students do verify that their system works and requirements are met, but their test plan is mostly vague and not reproducible. Test plans were only briefly mentioned in this class. In future, they need to be emphasised and covered in detail in the class. |
| | | | | | Average Score for Course = | **2.9** | | |
| | | | | | (Transfer this number to course continuous improvement record) | | | |

The process for using the rubrics to improve courses is illustrated in Figure 4-1. The continuous improvement process for courses occurs on two levels--the course level and the program level. At the course level, the instructor makes independent improvements to the course. When the score, S, for a given PI is 3 or greater, no action is taken by the instructor to improve the course. When S falls below 3, the instructor identifies corrective actions to implement the next time that he/she teaches the course.

At the program level, the instructor, with input from department faculty, makes improvements to the course. If the mean score for a given course is 2.67 or greater, no action is taken to improve the course, but a mean score of less than 2.67 suggests deficiencies in the course that require discussion and correction by the instructor and/or program faculty. For the rubric shown in Table 4-3, action is to be initiated by the instructor for two PIs, but no program level action is required.

As stated in the footnote of Table 4-1, prior to fall semester 2014, the program-level triggered point was increased from 2.0 to 2.67 because the faculty felt that the threshold for triggering improvements at the program level as too low.




Definitions: PI = Performance Indicator for a specific student learning outcome

S = PI score

$X = \Sigma S/n$ (mean PI score for the course)

Figure 4-1. Course rubric application for continuous improvement.

We have been using course rubrics as a student outcome assessment instrument since fall semester 2011. Since that time, the course-level threshold has been triggered 50 times. With the exception of ECE 3120 and ECE 4410, all ECE courses have been triggered at least once. When a course-level trigger occurs, it is the responsibility of the faculty member to initiate action and implement improvement in that particular course. Table 4-4 summarizes the courses for which the rubrics have been triggered and improved at the course level.

ECE 3000 Seminar has been triggered seven times at the course level and one time at the program level. This course, unlike most of the other courses in the program, is devoted largely to the "soft" skills such as communication, professionalism, ethics, etc. Consequently, ECE 3000 is often the most challenging course to assess. The corrective actions for ECE 3000 summarized in Table 4-4 are indicative of the improvements that faculty have made over the past several years in this course.

Table 4-4. Course rubric triggers and resulting corrective actions at the course level.

| Year/Sem | Course | Performance Indicator (PI) | Outcomes | Corrective Action |
|---|---|---|---|---|
| 2011/Fall | EE 3000 | Explain ethical responsibilities in engineering.<br>Understand interviewing techniques.<br>Attend technical presentations, short courses, etc. | f<br>g<br>i, j | Modify case studies report.<br>Have Career Services teach interviewing.<br>Increase extra credit for attending IEEE talk. |
| 2011/Fall | EE 3110 | Explain differences between BJT and MOSFET amplifiers | a, e, k | Devote more lecture time to covering differences. |
| 2011/Fall | EE 3890 | Demonstrate ethics in the workplace. | f | Develop internship employer survey. |
| 2011/Fall | EE 3890 | Discuss how the company provides engineering solutions in a global, economic, environmental, and social context. | h | Develop internship employer survey. |
| 2011/Fall | EE 3890 | Explain how the company stays abreast of contemporary issues. | j | Develop internship employer survey. |
| 2011/Fall | EE 3890 | Analyze and interpret experimental data. | b | Develop a graduate survey to measure. |
| 2011/Fall | EE 3890 | Design and conduct experiments. | b | Develop a graduate survey to measure. |
| 2011/Fall | EE 3890 | Design a system, component, or process to meet desired needs within realistic constraints. | c | Develop a graduate survey to measure. |
| 2011/Fall | EE 4100 | Describe state space. | a, e, k | Lecture on state space models. |
| 2011/Fall | EE 4100 | Utilize root locus concepts to estimate system response | a, e, k | Add a lab on root locus. |
| 2011/Fall | EE 4100 | Determine transfer functions characteristics from experiment data. | a, e, k | Enlarge transfer function lab. |
| 2011/Fall | EE 3610 | Analyze microprocessor architecture. | a, e, k | Include a RISC processor design into the project. |
| 2011/Fall | EE 4010 | Define the requirements of a design. | c | Require students to submit requirements or specifications with the project plan. |
| 2011/Fall | EE 4010 | Fulfill assigned duties as a team member. | d | Develop a survey to obtain more accurate data. |
| 2011/Fall | EE 4010 | Contribute individual expertise to the group. | d | Develop a survey to obtain more accurate data. |
| 2011/Fall | EE 4010 | Describe the concepts and knowledge areas required for a senior project that are not covered in other engineering courses. | i | Develop a survey to obtain more accurate data. |
| 2011/Fall | EE 4010 | Describe how the student's senior project addresses contemporary issues. | j | Develop a survey to obtain more accurate data. |
| 2012/Spring | EE 2260 | Construct simple passive filters. | a, e, k | Spend additional lecture discussing multipole filters along with additional laboratory. |
| 2012/Spring | EE 3310 | Apply Biot-Savart's and Ampere's equations to magnetostatic problems. | a, e, k | Reallocate lecture time towards magnetostatics. |
| 2012/Spring | EE 4310 | Describe intrinsic, conductance and radiated noise sources. | a, e | Expand lectures on noise sources. |
| 2012/Spring | EE 4310 | Utilize advance circuit simulation tools | k | Incorporate more simulation tools in homework assignments. |
| 2012/Spring | EE 2700 | Analyze circuits that use medium scale integrated devices. | a, e, k | Extend lecture on analysis of sequential circuits. Add one or two examples. |

Table 4-4. (Cont.) Course rubric triggers and resulting corrective actions at the course level.

| Year/Sem | Course | Performance Indicator (PI) | Outcomes | Corrective Action |
|---|---|---|---|---|
| 2012/Spring | EE 3710 | Document the hardware and software of an embedded systems design. | c, g | Require the introduction, scope and design overview sections be turned in earlier to correct misunderstandings. |
| 2012/Spring | EE 4020 | Enumerate design requirements and constraints, then create a design that conforms to them. | c | Require separate sections in the design documentation for requirements and constraints. |
| 2012/Fall | EE 3110 | Design and model semiconductor circuits. | a, e, k | Add additional design experiment with realistic constraints, then assess on 1st exam. |
| 2012/Fall | EE 4010 | Define the requirements of a design. | c | Require students to submit requirements or specifications with the project plan. |
| 2013/Spring | EE 2700 | Analyze circuits that use medium scale integrated devices. | e, k | Extend lecture and examples, and assign additional homework on this topic. |
| 2013/Spring | EE 3710 | Document the hardware and software of an embedded systems design. | c, g | Previous remedy for this shortcoming was ineffective. New remedy is to write an example design document that students can use as a model. |
| 2014/Spring | EE 3710 | Document the hardware and software of an embedded systems design. | c, g | Example document from previous remedy was too large, and students did not read it. A simpler document is needed but for something different enough that copying will not be a problem. |
| 2014/Fall | EE 3000 | Explain ethical responsibilities in engineering. | f | Use a worksheet that directly asks how ethics directly applies to them. |
| 2014/Fall | EE 3000 | Define engineering professionalism. | f | Use a worksheet that directly asks how ethics directly applies to them. |
| 2014/Fall | EE 3000 | Summarize a major engineering failure. | h | Add discussion of engineering failures and an assignment on it. |
| 2014/Fall | EE 3000 | Explain the role of general education as it pertains to engineering. | h, i , j | Use a worksheet that directly asks students how general education applies to them. |
| 2014/Fall | EE 3000 | Students shall understand the role of professional societies and publications. | i, j | Incorporate more appropriate articles into the course. |
| 2014/Fall | EE 4010 | Develop a project plan. | c, f | Spend 10-15 minutes first lecture explaining project plan then refresh in individual meetings. Do no rely on written explanation. |
| 2014/Fall | EE 4020 | Write a test plan. | b | Stress the importance of the test plan in individual meetings near the end of the semester when test plan is due. |

Table 4-4. (Cont.) Course rubric triggers and resulting corrective actions at the course level.

| Year/Sem | Course | Performance Indicator (PI) | Outcomes | Corrective Action |
|---|---|---|---|---|
| 2014/Fall | EE 1270 | Derive Norton and Thevinin equivalent circuits. | a, e, k | Show more examples of Thevinin equivalents and ideal transformers. |
| 2015/Spring | ECE 2260 | Construct simple passive filters. | a, e, k | Students currently work 2nd order filter problems but do not get a chance to practice with them in a lab. A 2nd order Lab needs to be designed. |
| 2015/Spring | ECE 4010 | Manage a budget. | f | While most teams budgeted very well, some did not. Need to stress importance of budgeting in lecture. |
| 2015/Fall | ECE 3210 | Perform discrete and continuous time convolution. | a, e, k | More emphasis will be placed on convolution in the time-domain when the course is next offered. |
| 2016/Spring | ECE 3710 | Debug a computer program using both hardware and software tools. | a, e, k | Require students to use the oscilloscope or DVM for some of the lab exercises. |
| 2016/Spring | ECE 4010 | Define the requirements of a design. | c | Require students to turn in a list of requirements with their project plan (perhaps add to project plan) |
| 2016/Fall | ECE 3890 | Explain how the company stays abreast of contemporary issues. | j | Stress the importance of identifying contemporary issues during initial lecture. If this is not effective, add a question on this subject to the progress report. |
| 2017/Spring | ECE 4010 | Maintain an engineering logbook. | f | Will check log books at weekly meetings rather than at the end of the semester |
| 2017/Spring | ECE 1270 | Define Norton and Thevinin equivalent circuits. | a, e, k | Taught Thevenin-source conversion to Norton. Future will focus more on Norton. |
| 2017/Fall | ECE 3000 | Explain the role of general education as it pertains to engineering. | h, i, j | There was no significant assignment or discussion on this topic. Need to include an assignment or discussion session in the seminar class to cover the importance of general education for engineers. |
| 2017/Fall | ECE 3210 | Program simple scripts and functions in MATLAB. | k | Emphasize independent MATLAB script writing earlier in the semester. |

Note: Course prefix changed from EE to ECE spring 2015.

Table 4-4. (Cont.) Course rubric triggers and resulting corrective actions at the course level.

| Year/Sem | Course | Performance Indicator (PI) | Outcomes | Corrective Action |
|---|---|---|---|---|
| 2018/Spring | ECE 3710 | Debug a computer program using both hardware and software tools. | a, e, k | Students were required to use an oscilloscope to verify their measurements in only 2 labs, so they used it only then. Apart from that, they were relying only on the debugger. In future, lab equipment for debugging should be introduced in one of the earlier labs and used more often to make it a habit. |
| 2018/Spring | ECE 3710 | Design a test plan and use it to verify that a system satisfies its requirements and constraints. | b | Students do verify that their system works and requirements are met, but their test plan is mostly vague and not reproducible. Test plans were only briefly mentioned in this class. In future, they need to be emphasized and covered in detail in the class. |
| 2018/Spring | ECE 4210 | Demonstrate knowledge of Linear Prediction and Optimum Linear filters | a, e, k | Future course schedule will continue to reduce review material (LTI and Impulse response) and IIR filter implementation exercises. |

**B.2. Graduate Survey**

The graduate survey is an eleven-question survey instrument administered to seniors at graduation. Each question asks graduates to indicate the degree to which the student learning outcome was achieved in their program. The responses are given on the following five-point Likert scale: 1 = strongly disagree, 2 = disagree, 3 = neither agree nor disagree, 4 = agree, 5 = strongly agree. The trigger point was set by faculty at 3.5. This instrument has been administered to graduating seniors since fall semester 2014. Table 4-5 is a summary of the graduate survey results. Numbers in the table are mean values for the graduating cohort. The survey also asks the graduate to provide feedback on the strengths and weaknesses of the ECE programs. The survey in its entirety is given in the Optional Appendices section of this report.

Table 4-5. Graduate survey results.

| | Student Outcome | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Year/Sem | a | b | c | d | e | f | g | h | i | j | k |
| 2014/Fall | 4.9 | 5.0 | 5.0 | 5.0 | 5.0 | 4.9 | 4.9 | 4.9 | 4.9 | 4.9 | 5.0 |
| 2015/Spring | 4.8 | 4.8 | 4.4 | 4.4 | 4.6 | 4.4 | 4.3 | 4.2 | 4.6 | 3.8 | 4.3 |
| 2015/Fall | 4.6 | 4.6 | 4.6 | 4.6 | 4.7 | 4.9 | 4.4 | 4.6 | 4.7 | 4.1 | 4.4 |
| 2016/Spring | 4.8 | 5.0 | 4.3 | 4.8 | 5.0 | 5.0 | 4.3 | 4.3 | 5.0 | 4.3 | 4.8 |
| 2016/Fall | 4.6 | 4.5 | 4.4 | 4.3 | 4.7 | 4.8 | 4.6 | 4.3 | 4.8 | 4.2 | 4.6 |
| 2017/Spring | 4.8 | 4.8 | 4.5 | 4.2 | 4.7 | 4.8 | 4.2 | 4.5 | 4.5 | 4.4 | 4.7 |
| 2017/Fall | 5.0 | 4.8 | 4.5 | 4.5 | 4.8 | 4.8 | 4.5 | 4.5 | 4.8 | 4.3 | 4.8 |
| 2018/Spring | 4.9 | 5.0 | 4.6 | 4.4 | 4.9 | 4.3 | 4.3 | 4.1 | 4.3 | 4.0 | 4.6 |

With the exception of student outcome (j) in spring 2015, all responses indicate that graduates at least *agree* that student outcomes were achieved in their program. That outcome (j), a knowledge of contemporary issues, has the lowest score on the survey is not surprising. As shown in Table 4-5, outcome (j) was triggered a total of seven times, four times for ECE 3000 Seminar, two times for ECE 3890 Internship, and one time for ECE 4010 Senior Project. Faculty continue to seek ways to improve courses that include this outcome and the other non-technical outcomes in the curriculum.

**B.3. Internship Employer Survey**

The internship employer survey is a ten-question survey instrument administered on behalf of students who are enrolled in ECE 3890 Internship, a required course in the ECE programs. The survey is completed by the employer, not the intern. Seven of the ten questions ask the employer to supply a response using the same five-point Likert scale that is used for the graduate survey. These questions are

1. The intern performed his/her duties on schedule.
2. The intern reported to work on time.
3. The intern demonstrated professionalism and ethical behavior.
4. The intern demonstrated an ability to learn new concepts, skills, procedures, policies, etc. that are pertinent to the job.
5. The intern was an effective communicator.
6. Overall, I am satisfied with the performance of the intern.
7. If there was a full-time engineering position open at my company, I would hire this intern.

Responses to the other three questions require a yes/no answer, multiple choice answer or brief comments. This instrument has been administered to students since the 2013-2014 academic year. Table 4-6 is a summary of the internship employer survey results for the seven five-point scale questions. Numbers in the table are mean values for the students enrolled in ECE 3890 during the year indicated. Like the graduate survey, the trigger point was set by faculty at 3.5. The survey in its entirety is given in the Optional Appendices section of this report.

Table 4-6. Internship employer survey results.

| | Question | | | | | | |
|---|---|---|---|---|---|---|---|
| Academic Year | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 2013-2014 | 4.8 | 4.9 | 4.8 | 4.6 | 4.5 | 4.8 | 4.6 |
| 2014-2015 | 4.8 | 4.9 | 4.7 | 4.8 | 4.4 | 4.5 | 4.8 |
| 2015-2016 | 4.3 | 4.8 | 4.8 | 4.7 | 4.7 | 4.3 | 4.3 |
| 2016-2017 | 4.6 | 4.8 | 4.7 | 4.6 | 4.5 | 4.6 | 4.7 |
| 2017-2018 | 4.6 | 4.8 | 4.4 | 4.9 | 4.8 | 4.9 | 4.3 |

The data in Table 5-6 clearly show that employers of our ECE interns are largely satisfied with students' performance. No compelling reason to modify ECE 3890 Internship is indicated.

**B.4. Traceable Progress System**

The Traceable Progress System (TPS) is used to initiate and document course-level and program-level improvements initiated by the department faculty. The use of the course-level TPS may be triggered by a low PI in a course rubric or by a reason that lies outside the formal quantitative process. The use of the program-level TPS is for the addition of new courses, deletion of existing courses, and other curricular changes. The Traceable Progress System was added to our continuous improvement efforts to facilitate improvements that may lie outside the regular assessment process. Tables 4-7 and 4-8, respectively, summarize course-level and program-level improvements for which the TPS has been used.

Table 4-7. Traceable Progress System course-level improvements.

| Yr/Sem | Course | Action Plan | Implementation |
|---|---|---|---|
| 2012/Fall | ECE 3610 | PI "analyze microprocessor architecture" scored 2 in rubric. Strengthen this topic. | Add two lectures and two homework assignments on MIPS RISC processor. |
| 2012/Fall | ECE 4010 | Several soft skills were scored weak in rubric. | Implemented a survey to measure students' soft skills. |
| 2013/Spring | ECE 4020 | PI "enumerate design requirements and constraints" scored 2 in rubric. Strengthen this topic. | Modify the design document so that a separate section is required for constraints. |
| 2013/Spring | ECE 4010 | PI "conduct a design review" scored 2 in rubric. Strengthen this topic. | One week before their presentation, students will required to show their slides to the instructor. |
| 2013/Spring | ECE 4010 | PI "define the requirements of a design" scored 2 in rubric. Strengthen this topic. | Require students to submit requirements and/or specifications with their project plans. |
| 2013/Spring | ECE 3710 | PI "document the hardware and software of an embedded systems design. Strengthen this topic. | Require students to submit the introduction, scope and design overview earlier in the semester. |
| 2013/Spring | ECE 2700 | PI "analyze circuits that use medium scale integrated devices" scored 2 in rubric. Strengthen this topic. | Add one lecture focused on analysis of sequential circuits, including two examples. |
| 2014/Spring | ECE 3710 | PI "document the hardware and software of an embedded systems design. (Same problem from last year) Strengthen this topic. | Write an example design document for the students. |
| 2014/Spring | ECE 2700 | PI "analyze circuits that use medium scale integrated devices" scored 2 in rubric. (Same problem from last year) Strengthen this topic. | Added two homework assignments of circuit analysis using medium scale integrated devices (muxes, counters, etc.) |
| 2015/Spring | ECE 4020 | PI "write a test plan" scored a 2 on rubric. | Emphasize test plans in one-on-one meetings with students two weeks before plans are due. |
| 2015/Fall | ECE 3000 | PIs on ethics, professionalism, interviewing and general ed scored 2 in rubric. | Questions on these topics were added to assignments. |
| 2015/Fall | ECE 3000 | PI on role of prof. societies and publications scored a 2 in rubric. | Students are now required to present a topic from a professional journal article. |
| 2015/Fall | ECE 3000 | PI on engineering failures scored a 2 in rubric. | Added one lecture on engineering failures. |
| 2016/Spring | ECE 4010 | PI "manage a budget" scored a 2 in rubric. | Budgets were emphasized at least twice in team meetings. |
| 2016/Fall | ECE 3310 | Electromagnetics is a very challenging topic. Students were struggling, so instructor wanted to make a major change to help students. | The class was flipped. Lectures were recorded in a WSU studio and made available to students online. Lecture time was devoted to working on problems. |

| | | | |
|---|---|---|---|
| 2017/Spring | ECE 3710 | PI "debug a computer program" scored a 2 in rubric. | Students are now required to use an O-scope to collect a waveform to debug a program. |
| 2017/Spring | ECE 3890 | PI "stay abreast of contemporary issues" scored a 2 in rubric. | Students were assigned to observe how the company stays abreast of contemporary issues. |
| 2017/Fall | ECE 3210 | Signals and Systems is a very challenging topic. Students were struggling, so instructor wanted to make a major change to help students. | A set of lecture notes with incorporated exercises were disseminated to students in advance. Lecture time was devoted to working on problems. |
| 2018/Spring | ECE 4210 | Set up access to Linux lab to use MATLAB for creating Digital Signal Processing exercises. | Student comments suggested that change was useful. They can now use MATLAB to learn DSP concepts. |
| 2018/Spring | ECE 3120 | Timeline for final project was too short. Streamlining of course needed. | The final project is now incorporated into Lab 5 and focuses on a single theme, audio amplifiers. |

Table 4-8. Traceable Progress System program-level improvements.

| Yr/Sem | Action Plan | Implementation |
|---|---|---|
| 2015/Fall | ECE 3000 Seminar received a mean score of 2.4 in the Fall 2014 rubric. Modify assignment questions so a valid assessment can be made. Include one lecture on engineering failures. Direct students to select more rigorous publications for presentations. | A mean score of 3.4 was achieved fall 2015, indicating that the PIs in question improved significantly. |
| 2018/Fall | With the removal of computer literacy from the university requirements, additional credit hours will be available in the program. | The additional credit hours will be used to add two electives to the program, increasing the total credit hours for electives from six to twelve. Will take affect fall 2018. |
| 2018/Fall | Students do not understand how to manage a project in their ECE 4010 and 4020 courses. A one credit hour course in project management will be added to the program. | ECE 3090 Project Management will be taught starting fall 2018.<br>A resulting reduction in one credit hour to ECE 3890 Internship. |
| 2018/Fall | ECE 5510 Power Systems is not taught at the appropriate senior/graduate level. Change the course number to ECE 3510. | ECE 5510 Power Systems was moved to ECE 3510 Power Systems because it is more appropriate as a junior level course. Require students to take either ECE 3510 or ECE 3610 Digital Systems, and make ECE 5510 an elective. Will take affect fall 2018. |

Blank TPS forms are given in the Optional Appendices section of this report.

**B.5 Industrial Advisory Board recommendations**

The Industrial Advisor Board (IAB) consists of program faculty and staff members, engineering managers and engineers from local engineering companies and at least one senior ECE student. The primary role of the IAB is to periodically evaluate the ECE programs and make recommendations for improvement. Board members sometimes represent the companies with whom our graduates are employed, so they have a unique and direct impact on the direction and educational objectives of the program.

The IAB typically convenes once per year in the spring semester. Topics and issues discussed by this board include, but are not necessarily limited to, the following:

1. Review of program educational objectives
2. Program structure
3. Content of courses
4. Declared majors and course enrollments
5. Graduate projections
6. Internship opportunities
7. Full-time hiring projections

Since the program was accredited in 2013, we have held five IAB meetings. While the program educational objectives have been reviewed but not revised, actionable recommendations of the IAB have been reviewed, and to the extent possible, implemented. Table 4-9 is a summary of IAB recommendations over this five-year period and corresponding actions taken.

Table 4-9. Industrial Advisory Board recommendations and actions taken.

| Year | Recommendation | Action Taken |
|---|---|---|
| 2014 | Program name change from Electronics Engineering to Electrical Engineering. (Joint recommendation from IAB and WSU faculty) | On hold for political reasons. (Name changed in 2015) |
| 2015 | Creation of a BS/MS in Computer Engineering. (WSU faculty recommendation with IAB support) | Passed through internal approvals, waiting Board of Regents approval. |
| 2016 | Increase numbers of graduates. Industry (especially HAFB) desperately needs them. | Department of Engineering has hired new faculty members, and is beginning to open more sections as program grows. |
| 2017 | Teach more ethics in program.<br><br>Create joint ventures between EE program and industry. | Invite industrial partners to speak in seminar course about ethics.<br>Bring in guest lecturers from industry to speak in IEEE Tech Talks. |
| 2018 | Improve communication skills of graduates. | Have industrial partners attend and critique senior project presentations. |

**B.6 Senior Assessment Exam**

Over a year ago, engineering faculty decided that we needed an instrument to directly and globally assess the technical knowledge of our senior students. We discussed using the Fundamentals of Engineering (FE) examination administered by the National Council of Examiners for Engineering and Surveying (NCEES). However, we did not want to be constrained by the lack of detailed score reporting, cost, and timing of the FE examination, so we designed an internal exam that resembles the FE exam. Questions similar or identical to those in old FE review manuals were chosen to build the exam.

The exam covers the following 15 topics:

| | | |
|---|---|---|
| Circuits | Electromagnetics | Power |
| Computers | Electronics | Probability |
| Controls | Ethics | Properties |
| Digital | Mathematics | Signals |
| Economics | Mechanics | Software |

The exam consists of six questions for each topic for a total of 90 questions. To avoid giving a single long exam, we split the exam into two equal parts by giving students 45 questions in ECE 4010 Senior Project I and 45 questions in ECE 4020 Senior Project II. The exam was administered to students for the first time during the 2017-2018 academic year. Table 4-10 is a summary of the mean scores.

Now that we have one year of exam data, the plan for fall 2018 is to devote a faculty meeting to a discussion of the efficacy of the exam and the interpretation of the results.

Table 4-10. Senior assessment exam results (mean scores in percent)

| Topic | Fall 2017 | | Spring 2018 | |
|---|---|---|---|---|
| | ECE 4010 | ECE 4020 | ECE 4010 | ECE 4020 |
| 1. Circuits | 51.5 | 35.3 | 43.8 | 26.2 |
| 2. Computers | 57.6 | 64.7 | 54.2 | 66.7 |
| 3. Controls | 66.7 | 43.1 | 22.9 | 54.8 |
| 4. Digital | 63.6 | 51.0 | 56.3 | 66.7 |
| 5. Economics | 45.5 | 60.8 | 45.8 | 42.9 |
| 6. Electromagnetics | 60.6 | 54.9 | 50.0 | 59.5 |
| 7. Electronics | 39.4 | 45.1 | 54.2 | 52.4 |
| 8. Ethics | 54.6 | 66.7 | 45.8 | 61.9 |
| 9. Mathematics | 100.0 | 70.6 | 89.6 | 76.2 |
| 10. Mechanics | 45.5 | 39.2 | 29.2 | 28.6 |
| 11. Power | 39.4 | 35.3 | 37.5 | 26.2 |
| 12. Probability | 60.6 | 39.2 | 56.3 | 28.6 |
| 13. Properties | 57.6 | 31.4 | 58.3 | 38.1 |
| 14. Signals | 27.3 | 23.5 | 37.5 | 16.7 |
| 15. Software | 63.6 | 58.8 | 72.9 | 42.9 |

# CRITERION 5. CURRICULUM

## A. Program Curriculum

1. Curriculum description

Table 5-1 describes the plan of study for students. This table includes course offerings in the required curriculum in the form of a recommended schedule by year and semester. The table also includes maximum section enrollments for all courses in the program over the two years immediately preceding the on-site visit. Weber State University is on the semester system. The Electrical Engineering Program has no special curricular options.

**Table 5-1. Curriculum: Electrical Engineering**

| Course (Department, Number, Title) | Required (R) Elective (E) Selected Elective (SE) | Subject Area (Credit Hours) | | | | Last two semesters course was offered (year and semester) | Maximum enrollment for last two semesters offered |
|---|---|---|---|---|---|---|---|
| | | Math and Basic Sciences | Engineering Topics. (✓) if contains design | General Education | Other | | |
| **Freshman Year: Fall Semester** | | | | | | | |
| ENGR 1000 Introduction to Engineering | R | | 2(✓) | | | 2017 Fall<br>2018 Spring | 85<br>48 |
| Math 1210 Calculus I | R | 4 | | | | 2017 Fall<br>2018 Spring | 261<br>253 |
| Physics 2210 Physics for Scientists & Engineers I [(4)] | R | 5 | | | | 2017 Fall<br>2018 Spring | 163<br>98 |
| Library Information Literacy | R | | | 0.5 - 1 | | 2017 Fall<br>2018 Spring | ------<br>------ |
| **Freshman Year: Spring Semester** | | | | | | | |
| ECE 2700 Digital Circuits | R | | 4 | | | 2017 Fall<br>2018 Spring | 22<br>24 |
| Math 1220 Calculus II | R | 4 | | | | 2017 Fall<br>2018 Spring | 105<br>174 |
| Physics 2220 Physics for Scientists & Engineers II | R | 5 | | | | 2017 Fall<br>2018 Spring | 45<br>70 |
| CS 2250 Structured Computing in a Selected Lang. | R | | 4 | | | 2016 Spring<br>2017 Spring | 17<br>25 |

**Table 5-1. (cont.) Curriculum: Electrical Engineering**

| Course (Department, Number, Title) | Required (R) Elective (E) Selected Elective (SE) | Subject Area (Credit Hours) | | | | Last two semesters course was offered (year and semester) | Maximum enrollment for last two semesters offered |
|---|---|---|---|---|---|---|---|
| | | Math and Basic Sciences | Engineering Topics. (√) if contains design | General Education | Other | | |
| **Sophomore Year: Fall Semester** | | | | | | | |
| ECE 1270 Introduction to Electrical Circuits | R | | 4 | | | 2017 Fall<br>2018 Spring | 36<br>12 |
| Math 2210 Calculus III | R | 4 | | | | 2017 Fall<br>2018 Spring | 53<br>53 |
| Chem 1210 Principles of Chemistry I [(4)] | R | 5 | | | | 2017 Fall<br>2018 Spring | 200<br>137 |
| Engl 2010 Intermediate College Writing | R | | | 3 | | 2017 Fall<br>2018 Spring | 1321<br>1367 |
| **Sophomore Year: Spring Semester** | | | | | | | |
| ECE 2260 Fundamentals of Electrical Circuits | R | | 4 | | | 2017 Fall<br>2018 Spring | 17<br>22 |
| Math 2250 Linear Algebra and Differential Equations [(1)] | R | 4 | | | | 2017 Spring<br>2018 Spring | 25<br>29 |
| Engl 3100 Professional & Technical Writing | R | | | | 3 | 2017 Fall<br>2018 Spring | 126<br>96 |
| General Education (AI,CA, HU or SS/DV) | SE | | | 3 | | 2017 Fall<br>2018 Spring | -----<br>----- |

**Table 5-1. (cont.) Curriculum: Electrical Engineering**

| Course (Department, Number, Title) | Required (R) Elective (E) Selected Elective (SE) | Subject Area (Credit Hours) | | | | Last two semesters course was offered (year and semester) | Maximum enrollment for last two semesters offered |
|---|---|---|---|---|---|---|---|
| | | Math and Basic Sciences | Engineering Topics. (√) if contains design | General Education | Other | | |
| **Junior Year: Fall Semester** | | | | | | | |
| ECE 3110 Microelectronics I | R | | 4 | | | 2016 Fall<br>2017 Fall | 2<br>24 |
| ECE 3210 Signals and Systems | R | | 4 | | | 2016 Fall<br>2017 Fall | 30<br>27 |
| ECE 3610 Digital Systems | R | | 4 | | | 2016 Fall<br>2017 Fall | 31<br>33 |
| ECE 3000 Engineering Seminar | R | | 1 | | | 2016 Fall<br>2017 Fall | 28<br>25 |
| Math 3410 Probability and Statistics | R | 3 | | | | 2017 Fall<br>2018 Spring | 60<br>28 |
| **Junior Year: Spring Semester** | | | | | | | |
| ECE 3120 Microelectronics II | R | | 4 | | | 2016 Spring<br>2017 Spring | 29<br>29 |
| ECE 3310 Electromagnetics I | R | | 4 | | | 2016 Spring<br>2017 Spring | 34<br>26 |
| ECE 3710 Embedded Systems | R | | 4 | | | 2016 Spring<br>2017 Spring | 30<br>21 |

**Table 5-1. (cont.) Curriculum: Electrical Engineering**

| Course (Department, Number, Title) | Required (R) Elective (E) Selected Elective (SE) | Subject Area (Credit Hours) | | | | Last two semesters course was offered (year and semester) | Maximum enrollment for last two semesters offered |
|---|---|---|---|---|---|---|---|
| | | Math and Basic Sciences | Engineering Topics. (✓) if contains design | General Education | Other | | |
| ECE 3890 Internship | R | | 2 | | | 2017 Fall<br>2018 Spring | 6<br>7 |
| Comm HU 2110 Interpersonal & Small Group Communication | R | | | 3 | | 2017 Fall<br>2018 Spring | 569<br>487 |
| **Senior Year: Fall Semester** | | | | | | | |
| ECE 4010 Senior Project I | R | | 2 (✓) | | | 2017 Fall<br>2018 Spring | 11<br>8 |
| ECE 4100 Control Systems | R | | 4 | | | 2016 Fall<br>2017 Fall | 29<br>25 |
| ECE 5xxx Electives [(2)] | SE | | 3 | | | 2017 Fall<br>2018 Spring | 24<br>26 |
| Econ SS2010 Principles of Microeconomics | R | | | 3 | | 2017 Fall<br>2018 Spring | 262<br>192 |
| General Education (AI,CA, HU or SS/DV) | SE | | | 3 | | 2011 Fall<br>2012 Spring | -----<br>----- |
| **Senior Year: Spring Semester** | | | | | | | |
| ECE 4020 Senior Project II | R | | 2 (✓) | | | 2017 Fall<br>2018 Spring | 18<br>5 |

**Table 5-1. (cont.) Curriculum: Electrical Engineering**

| Course (Department, Number, Title) | Required (R) Elective (E) Selected Elective (SE) | Subject Area (Credit Hours) | | | | Last two semesters course was offered (year and semester) | Maximum enrollment for last two semesters offered |
|---|---|---|---|---|---|---|---|
| | | Math and Basic Sciences | Engineering Topics. (✓) if contains design | General Education | Other | | |
| ECE 5xxx Electives [(2)] | SE | | 3 | | | 2017 Fall<br>2018 Spring | 24<br>26 |
| General Education (AI,CA, HU or SS/DV) | SE | | | 3 | | 2017 Fall<br>2018 Spring | |
| General Education (AI,CA, HU, LS or SS/DV) | SE | | | 3 | | 2017 Fall<br>2018 Spring | -----<br>----- |
| General Education Life Science (LS) [(3)] | SE | 3 | | | | 2017 Fall<br>2018 Spring | -----<br>----- |
| **TOTALS: ABET BASIC-LEVEL REQUIREMENTS** | | 37 | 59 | 21.5 - 22 | 3 | | |
| **OVERALL TOTAL CREDIT HOURS FOR COMPLETION OF THE PROGRAM** | 120.5 - 121 | | | | | | |
| **PERCENT OF TOTAL** | 100% | 30.58% | 48.76% | 18.18% | 2.48% | | |
| **MINIMUM SEMESTER CREDIT HOURS** | | 32 | 48 | | | | |
| **MINIMUM PERCENTAGE** | | 25% | 37.5% | | | | |

(1) In lieu of Math 2250 (4), the ECE student may also take Math 2270 Linear Algebra (3) *and* Math 2280 Differential Equations (3). These courses are both offered fall and spring semesters.

(2) ECE Electives: ECE 5110 Digital VLSI Design (3) was taught 2017 Fall. Enrollment: 5
ECE 5310 Electromagnetics II (3) was taught 2017 Fall. Enrollment: 11

ECE 5710 Real Time Embedded Systems (3) was taught 2017 Fall. Enrollment: 8

(3) Life Science (LS) is a General Education course, but it is categorized here as a basic science.

(4) Physics 2210 and Chemistry 1210 are general education physical science courses but are categorized here as basic sciences.

Note: The data in Table 5-1 reflect the 2017-2018 general catalog.

2. This section describes how the curriculum aligns with the program educational objectives.

   The program educational objectives are to produce graduates that are able to:

   - Design and develop electrical systems.
   - Effectively communicate technical information and participate in a team environment.
   - Engage in life-long learning through continuing education and industrial practice.
   - Demonstrate professional ethics and social awareness.

   The alignment of the curriculum with the program educational objectives can be determined from Figure 3-1 (Criterion 3) and Table 4-2 (Criterion 4) via the student outcomes. A more direct alignment is shown in Table 5-2 without the student outcomes "bridge."

**Table 5-2. Alignment of Curriculum with Program Educational Objectives**

| Program Educational Objective | Electrical Engineering Courses (1) |
|---|---|
| Design and develop electrical systems | ECE 1270 Introduction to Electrical Circuits<br>ECE 2260 Fundamentals of Electrical Circuits<br>ECE 2700 Digital Circuits<br>ECE 3110 Microelectronics I<br>ECE 3120 Microelectronics II<br>ECE 3210 Signals and Systems<br>ECE 3310 Electromagnetics I<br>ECE 3610 Digital Systems<br>ECE 3710 Embedded Systems<br>ECE 3890 Internship<br>ECE 4010 Senior Project I<br>ECE 4020 Senior Project II<br>ECE 4100 Control Systems<br>ECE 4210 Digital Signal Processing<br>ECE 4310 Electromagnetics II<br>ECE 4410 Communication Circuits and Systems |
| Effectively communicate technical information and participate in a team environment | ECE 3710 Embedded Systems<br>ECE 3890 Internship<br>ECE 4010 Senior Project I<br>ECE 4020 Senior Project II |
| Engage in life-long learning through continuing education and industrial practice | ECE 3000 Seminar<br>ECE 3890 Internship<br>ECE 4010 Senior Project I<br>ECE 4020 Senior Project II |
| Demonstrate professional ethics and social awareness | ECE 3000 Seminar<br>ECE 3710 Embedded Systems<br>ECE 3890 Internship<br>ECE 4010 Senior Project I<br>ECE 4020 Senior Project II |

(1) These courses are designated “highly applicable” (H) to the associated student outcomes in Table 4-2.

Because design is the heart of any engineering curriculum, the first program educational objective encompasses most of the courses in the program. The other three program educational objectives encompass the so-called “soft” skills and knowledge areas contained primarily in the seminar, internship and senior project courses.

3. This section describes how the curriculum and its associated prerequisite structure support the attainment of student outcomes.
   The curriculum supports the attainment of student outcomes delineated in Table 4-2 of Criterion 4. By carefully considering the curricular content of each Electrical Engineering

course, the faculty ascertained that specific student outcomes are supported by the courses designated “highly applicable” in Table 4-2. For example, ECE 1270 Introduction to Electrical Circuits supports student outcomes (a), (e) and (k). The prerequisite for ECE 1270 is Math 1210 Calculus I. ECE 2260 Fundamentals of Electrical Circuits also supports student outcomes (a), (e) and (k), and has ECE 1270 and Math 1220 Calculus II as prerequisites.

For every course that is highly applicable to one or more student outcomes, a course rubric is used to assess that course. For example, ECE 1270 Introduction to Electrical Circuits has a rubric that is used to measure the level of attainment of outcomes (a), (e) and (k). ECE 4010 Senior Project I has a rubric that is used to measure the level of attainment of outcomes (c), (d), (f), (g) and (j). Course rubrics are discussed in detail in Criterion 4, Section B.

4. Flow chart of the prerequisite structure of the program’s required courses

   The prerequisite structure of the Electrical Engineering Program is shown in Figure 5-1. This flow chart shows both required and elective courses as well as support courses in mathematics, physics, chemistry, computer science and writing.

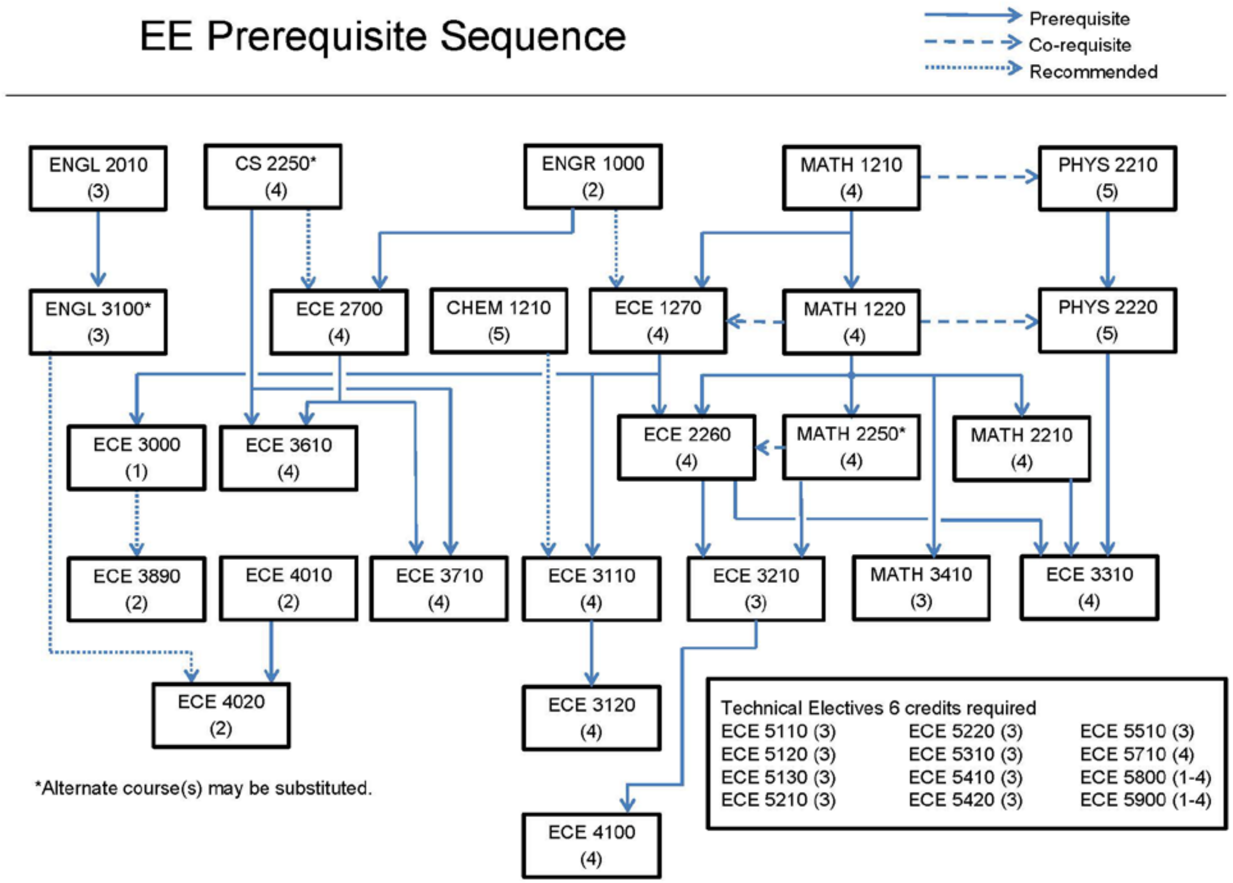



**Figure 5-1. Prerequisite Structure of the WSU Electrical Engineering Program**

5. This section addresses how the program meets the requirements in terms of hours and depth of study for each subject area (Math and Basic Sciences, Engineering Topics and General Education) specifically addressed by either the general criteria or the program criteria.

   As shown in Table 5-1, the program exceeds the requirements in terms of hours of study for each subject area. In math and basic sciences, the program contains 37 credit hours, 5 more than required. In engineering topics, the program contains 59 credit hours, 11 more than required. In general education, the program contains about 22 credit hours. (No minimum number of credit hours of general education is specified by ABET in Criterion 5).

   Table 5-3 summarizes how the program meets the requirements specifically addressed by the general and program criteria in each subject area.

**Table 5-3. How the program meets general and program criteria in terms of hours and depth of study in each subject area**

| Subject Area | General Criteria | Program Criteria | How requirements are met |
|---|---|---|---|
| Math and basic sciences | 1 year of a combination of college level math and basic sciences | • math through differential and integral calculus<br>• probability & statistics, including applications | • calculus I, II & III (12 hrs)<br>• linear algebra & differential equations (4 hrs)<br>• probability & statistics (3 hrs)<br>• physics (10 hrs)<br>• chemistry (5 hrs)<br>• life science (3 hrs) |
| Engineering topics | 1 ½ years of engineering topics (engineering sciences and engineering design) | • engineering topics, including computing science | • electrical engineering topics, including senior design (55 hrs)<br>• computing science (4 hrs) |
| General education | complements the technical content of and is consistent with program and institutional objectives | (not applicable) | • American institutions, information literacy, writing, humanities, creative arts, social sciences (25 hrs)<br>• meets WSU general education requirements for BS degrees |

6. This section describes the major design experience that prepares students for engineering practice and how this experience is based upon the knowledge and skills acquired in earlier course work and incorporates appropriate engineering standards and multiple design constraints. The primary design experience that prepares students for engineering practice is incorporated in ECE 4010 Senior Project I and ECE 4020 Senior Project II, a two-semester sequence consisting of two credit hours per semester. ECE 4010 and ECE 4020 constitute a required capstone course that not only prepares students for engineering practice but integrates as much of the curriculum as possible into a dedicated design experience. Each project, overseen by a faculty member, requires students to plan, budget, design, analyze,

build, test and document a device or system that performs an engineering or scientific function. The project typically originates from industry or a research project of the faculty.

Design projects typically require a great deal of circuit analysis, a topic that is extensively covered in several courses. Depending on the nature of the project, writing code may also be required. Because projects are carried out by two or more people working together, students learn how to function on teams, a critical skill for successful engineering practice. Communication, individual responsibility and professionalism are attributes that a team-based project begin to foster in students as they make the transition from the university to industry.

Engineering codes and standards are an integral part of engineering practice. Depending on the nature and scope of the senior project, students are introduced to some of the codes and standards used in the electrical and electronics industry. The Institute of Electrical and Electronics Engineers (IEEE) has developed standards for a variety of systems and processes. For example, IEEE 488 (Standard digital interface for programmable instrumentation) and IEEE 1076 (VHDL - VHSIC hardware description language) are two well-known IEEE standards to which students may be introduced.

Because engineering design is a decision making process in which resources are optimally converted to meet desired needs, design is inherently subject to constraints. Table 5-4 is a list of the primary types of engineering design constraints.

Generally speaking, the constraints that are emphasized the most in senior projects are the functional, economic, timing and safety constraints. These four constraints are emphasized because the students must obviously design and build devices and systems that work within limiting electrical and mechanical parameters. The projects must also be completed within budget and on schedule. Economic constraints are driven by the allocated budget for the project, and timing constraints are driven by project related schedules as well as academic calendar deadlines. Also, the device or system must not pose a safety hazard of any kind to the user or the public. The other constraints in Table 5-4 apply to some extent, depending on the nature and scope of the project, and are addressed in the design as deemed necessary.

The use of multiple design constraints is measured by a performance indicator in the rubrics for ECE 4010 and ECE 4020.

**Table 5-4. Engineering design constraints.**

| Constraint | Description |
|---|---|
| Functional | Power, frequency, geometry, materials, stresses, motion |
| Economic | Market size, production costs, supplier costs, overhead |
| Timing | Schedule, project planning, supply chains, testing |
| Health & Safety | Human, operational |
| Quality | Codes and standards, reliability, inspection, labeling |
| Manufacturing | Production limitations, assembly, supplier limits, installation |
| Life-cycle | Product life, wear, maintenance, repair, replacement cost |
| Ergonomic | Operation, human interaction, layout, clarity, warnings |
| Environmental | Environmental impact, social & political consequences |
| Aesthetic | Customer appeal, shape, color, cultural trends |
| Social | Trends, fashions, contemporary issues, cultural influences |
| Political | Political party influences, governmental control |
| Ethical | Public safety, health, welfare, integrity |
| Legal | Governmental regulations, intellectual property, codes |

7. This section addresses how cooperative education is addressed by either criteria general or program criteria and how it is evaluated by faculty.

   Cooperative education, referred to as "Internship" in the program, is addressed by the general criteria. As shown in Table 4-2 of Criterion 4, student outcomes (d), (f), (g), (h), (i), (j) and (k) are highly applicable to ECE 3890 Internship, a required two-credit hour course. ECE 3890 Internship is a course in which the student works part time for a local engineering company in order to receive industrial experience while attending school.

   Faculty evaluate internships using two assessment instruments. The first instrument is a rubric that faculty use to rate student performance for each of the applicable outcomes. Details of course rubric content and their use are discussed in Criterion 4, Section B. The second instrument is a survey for the employer of the intern. Faculty administer the survey to the employer at the conclusion of the internship. The employer internship survey asks ten questions relating to the responsibilities, timeliness, professionalism, communication, ethics and overall performance. Seven of the ten questions are assigned a numerical rating that is used to quantify results.

8. This section describes the materials that will be available for review during the visit to demonstrate achievement related to this criterion.

The following materials will be available for review during the on-site visit:

• samples of student work that pertain to the achievement of student outcomes (a) through (k)

- examinations and quizzes
- homework
- laboratory reports
- class reports
- senior project log books
- senior project reports
- other student work as required

• textbooks used in Electrical Engineering courses
• course syllabi

**B. Course Syllabi**

Given in Appendix A are syllabi for every course that satisfies requirements in the Electrical Engineering Program. Syllabi are included from the following curricular areas:

• Electrical Engineering
• Mathematics
• Physics
• Chemistry
• Computer Science

# CRITERION 6. FACULTY

## A. Faculty Qualifications

The combined years of industrial and teaching experience of the WSU Department of Engineering faculty exceeds 170. The department, which houses the Electrical Engineering, Computer Engineering and Pre-Engineering programs, has eight faculty members. Seven faculty members have a PhD in Electrical Engineering, whereas the eighth member (the chair) has a PhD in Mechanical Engineering. Their specific expertise, gained from graduate work, industrial practice, consulting and teaching provides an ample experience base for every curricular topic in the department. Table 6-1 summarizes faculty qualifications. Faculty vitae are given in Appendix B.

**Table 6-1. Faculty Qualifications: Electrical Engineering**

| Faculty Name | Highest degree earned. Field. Year. | Rank [1] | Type of academic appointment [2] T, TT, NTT | Full-time or Part-time [3] | Years of Experience | | | Professional Registration/Certification | Level of Activity [4] H, M or L | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Government/Industrial Practice | Teaching | This institution | | Professional Organizations | Professional Development | Consulting & Summer Work |
| Fon Brown | PhD<br>Electrical Engineering<br>1998 | ASC | T | FT | 26 | 11 | 8 | | L | M | H |
| Kirk Hagen<br>(Chair) | PhD<br>Mechanical Engineering<br>1989 | P | T | FT | 13 | 26 | 25 | | M | M | L |
| Christian Hearn | PhD<br>Electrical Engineering<br>2012 | ASC | T | FT | 8 | 10 | 7 | PE<br>(VA) | M | M | H |
| Justin Jackson | PhD<br>Electrical Engineering<br>2008 | ASC | T | FT | 3 | 11 | 11 | | M | M | L |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Suketu Naik | PhD<br>Electrical Engineering<br>2011 | AST | TT | FT | 4 | 4 | 4 | | M | M | M |
| Dhanya Nair | PhD<br>Electrical Engineering<br>2013 | AST | TT | FT | 2 | 4 | 2 | | M | M | L |
| Christopher Trampel | PhD<br>Electrical Engineering<br>2012 | AST | TT | FT | 2 | 10 | 4 | | L | M | M |
| Larry Zeng | PhD<br>Electrical Engineering<br>1988 | ASC | T | FT | 0 | 28 | 5 | | H | L | H |

1. Code: P = Professor ASC = Associate Professor AST = Assistant Professor I = Instructor A = Adjunct O = Other
2. Code: T = Tenured TT = Tenure Track NTT = Non Tenure Track
3. Code: FT = Full-time PT = Part-time appointment at the institution
4. The level of activity (High, Medium or Low) should reflect an average over the year prior to the visit plus the previous two years.

**B. Faculty Workload**

Table 6-2 summarizes the workload of the Engineering faculty. Weber State University full-time faculty are assigned a minimum teaching load of 24 credit hours per academic year, which means that faculty teach approximately 12 credit hours per semester. A program coordinator receives three credit hours per semester of equivalent load for that duty, and a department chair receives six credit hours per semester of equivalent load for that duty. The “Other” category in Table 6-2 includes time devoted to these advising and administrative responsibilities. As indicated in Table 6-2, the Engineering faculty teach some courses in the Pre-Engineering (ENGR) and Electronics Engineering Technology (EET) programs. Faculty workloads include credit hours in all programs.

**Table 6-2. Faculty workload summary: Electrical Engineering**

| Faculty Member | FT or PT [(1)] | Courses Taught: Semester & Year, Course Number, Title and Credit Hours [(2)] | Program Activity Distribution [(3)] | | | Percent of time Devoted to the Program [(5)] |
|---|---|---|---|---|---|---|
| | | | Teaching | Research or Scholarship | Other [(4)] | |
| Fon Brown | FT | **Fall 2017**<br>ECE 3610 Digital Systems (4)<br>ECE 5710/6710 Real-Time Embedded Systems (4)<br>Program Director, MSCE (3)<br><br>**Spring 2018**<br>On sabbatical leave | 80<br><br>0 | 10<br><br>0 | 10<br><br>100 | 100<br><br>100 |
| Kirk Hagen | FT | **Fall 2017**<br>ENGR 1000 Introduction to Engineering (2)<br>ENGR 2300 Thermodynamics I (3)<br>Department Chair (6)<br><br>**Spring 2018**<br>ENGR 1000 Introduction to Engineering (2)<br>ENGR 2080 Dynamics (4)<br>Department Chair (6) | 40<br><br>40 | 10<br><br>10 | 50<br><br>50 | 100<br><br>100 |

| Faculty Member | FT or PT [1] | Courses Taught: Semester & Year, Course Number, Title and Credit Hours [2] | Program Activity Distribution [3] | | | Percent of Time Devoted to the Program [5] |
|---|---|---|---|---|---|---|
| | | | Teaching | Research or Scholarship | Other [4] | |
| Christian Hearn | FT | **Fall 2017**<br>ECE 2260 Fundamentals of Electrical Circuits (4)<br>ECE 5310 Electromagnetics II (3)<br>EET 4010 Senior Project I (2)<br>EET 4030 Controls and Systems (4) | 90 | 10 | 0 | 100 |
| | | **Spring 2018**<br>ECE 1270 Introduction to Electrical Circuits (4)<br>ECE 3310 Electromagnetics I (4)<br>ECE 5210/6210 Digital Signal Processing (3)<br>ECE 6010 Graduate Design Project (1.5)<br>EET 4040 Signals and Systems (4) | 90 | 10 | 0 | 100 |
| Justin Jackson | FT | **Fall 2017**<br>ECE 3890 Internship (2)<br>ECE 4010 Senior Project I (2)<br>ECE 4020 Senior Project II (2)<br>ECE 5110/6110 Digital VLSI Design (3)<br>ECE Program Coordinator (3) | 65 | 10 | 25 | 100 |
| | | **Spring 2018**<br>ECE 3890 Internship (2)<br>ECE 4010 Senior Project I (2)<br>ECE 4020 Senior Project II (2)<br>ECE 5130 Advanced Semiconductors (3)<br>ECE 6010 Graduate Design Project (1.5)<br>ECE Program Coordinator (3) | 65 | 10 | 25 | 100 |
| Suketu Naik | FT | **Fall 2017**<br>ECE 1270 Introduction to Electrical Circuits (4)<br>ECE 1270 Introduction to Electrical Circuits (4)<br>ECE 4010 Senior Project I (2)<br>ECE 6010 Graduate Design Project (1.5) | 90 | 10 | 0 | 100 |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | **Spring 2018**<br>ECE 3120 Microelectronics II 2 x (4)<br>ECE 4020 Senior Project II (2)<br>ECE 6010 Graduate Design Project (0) | 90 | 10 | 0 | 100 |
| Dhanya Nair | FT | **Fall 2017**<br>ENGR 1000 Introduction to Engineering (2)<br>ECE 3000 Engineering Seminar (1)<br>ECE 3110 Microelectronics I 2 x (4)<br><br>**Spring 2018**<br>ENGR 1000 Introduction to Engineering (2)<br>ECE 3710 Embedded Systems 2 x (4)<br>ECE 6010 Graduate Design Project (1.5) | 90<br><br>90 | 10<br><br>10 | 0<br><br>0 | 100<br><br>100 |
| Christopher Trampel | FT | **Fall 2017**<br>ECE 3000 Engineering Seminar (1)<br>ECE 3210 Signals and Systems 2 x (4)<br>ECE 4020 Senior Project II (2)<br><br>**Spring 2018**<br>ECE 2260 Fundamentals of Electrical Circuits (4)<br>ECE 3310 Electromagnetics I (4)<br>ECE 5410/6410 Communications Systems (3)<br>ECE 6010 Graduate Design Project (1.5) | 90<br><br>90 | 10<br><br>10 | 0<br><br>0 | 100<br><br>100 |
| Larry Zeng | FT | **Fall 2017**<br>ECE 2700 Digital Systems (4)<br>ECE 4100 Control Systems (4)<br>ECE 6010 Graduate Design Project (2)<br><br>**Spring 2018**<br>ECE 2700 Digital Circuits 2 x (4)<br>ECE 6010 Graduate Design Project (3) | 90<br><br>90 | 10<br><br>10 | 0<br><br>0 | 100<br><br>100 |

(1) FT = Full-time, PT = Part-time faculty at the institution
(2) For the academic year for which the self-study is being prepared.
(3) Program activity distribution should be in percent of effort in the program and should total 100 percent.
(4) Indicate sabbatical leave, etc., under “Other”
(5) Out of the total time employed at the institution
ENGR = Pre-Engineering, EET = Electronics Engineering Technology

## CRITERION 7. FACILITIES

### A. Offices, Classrooms and Laboratories

This section summarizes the program's facilities in terms of the ability to support the attainment of the program educational objectives and student outcomes and to provide an atmosphere conducive to learning.

1. Offices

   The Department of Engineering occupies the south end of the Engineering Technology (ET) Building, a two-story building located in the north-central part of the WSU Ogden campus. This area of the ET Building houses faculty offices and the department reception area, class rooms, teaching and research laboratories, project rooms, restrooms, storage areas, and a student lounge. The faculty offices contain a desk and chairs, book shelves, file cabinets and a desk top or laptop computer.

   The department administrative assistant works in the reception area. She has a large work surface and raised counter, file cabinets, computer, a networked black and white/color copier/scanner, and a fax machine. Just off the reception area is a secure room with faculty mail boxes, office supplies, storage, microwave oven and two small refrigerators. Department meetings and other gatherings are held in the Dean's conference room on the first floor of the ET Building.

2. Classrooms

   Rooms that are dedicated to lectures only, i.e., rooms that have no laboratory equipment, are described in this section. Laboratories are described in the next section. Lecture rooms are described in Table 7-1. With the exceptions of ET 128 and ET 133D, the classrooms listed in Table 7-1 are shared with the Engineering Technology Department.

**Table 7-1. Classrooms (dedicated lecture rooms)**

| Room | Description |
| --- | --- |
| ET 101 | Seating capacity: 28<br>White board and projector screen<br>Computer/overhead projection system |
| ET 128 | Seating capacity: 77<br>White boards and projector screen<br>Computer/overhead projection system |
| ET 133D | Seating capacity: 22<br>White boards and projector screen<br>Computer/overhead projection system |
| ET 204 | Seating capacity: 32<br>White boards and projector screen<br>Computer/overhead projection system |
| ET 210 | Seating capacity: 30<br>White boards and projector screen<br>Computer/overhead projection system |
| ET 224 | Seating capacity: 32<br>White boards and projector screen<br>Computer/overhead projection system |
| ET 228 | Seating capacity: 40<br>White boards and projector screen<br>Computer/overhead projection system |
| ET 238 | Seating capacity: 24<br>White boards and projector screen<br>Computer/overhead projection system |
| M2 100<br>(Module 2) | Seating capacity: 28<br>White boards and projector screen<br>Computer/overhead projection system |

3. Laboratories

   Table 7-2 lists the basic laboratory equipment and engineering related software packages installed on the laboratory computers. A detailed list of equipment is given in Appendix C.

   Laboratories are available to the students from about 8:30 am to 10:00 pm, Monday through Friday, during the fall and spring semesters, including final examination periods.

**Table 7-2. Laboratories**

| Room | Description | Equipment or Contents | Software |
|---|---|---|---|
| ET 101A | Combined lecture/lab<br>12 work stations<br>White boards | 12 computers, power supplies, o-scopes, digital multi-meters, function generators | Xilinx ISE Design Suite, NI Multisim and Utilboard, MATLAB, Labview, MS Office |
| ET 101B | Combined lecture/lab<br>12 work stations<br>White boards | 12 computers, power supplies, o-scopes, digital multi-meters, function generators | Xilinx ISE Design Suite, NI Multisim and Utilboard, MATLAB, Labview, MS Office |
| ET 127 | Combined lecture/lab<br>12 work stations<br>White boards<br>Computer/projector system | 12 computers, power supplies, o-scopes, digital multi-meters, function generators | Xilinx ISE Design Suite, NI Multisim and Utilboard, MATLAB, Labview, MS Office |
| ET 133C | Combined lecture/lab<br>12 work stations<br>White boards<br>Computer/projector system | 12 computers, power supplies, o-scopes, digital multi-meters, function generators | Xilinx ISE Design Suite, NI Multisim and Utilboard, MATLAB, Labview, MS Office |
| M4 101<br>(Module) | Combined lecture/lab<br>12 work stations<br>White boards<br>Computer/projector system | 12 computers, power supplies, o-scopes, digital multi-meters, function generators | Ubuntu Linux, Cadence Design Suite, MATLAB, VPN off campus access |

4. Other rooms

In addition to classrooms and laboratories, there are other rooms in the Engineering Technology Building that support the program. These rooms are described in Table 7-3.

**Table 7-3. Other Rooms**

| Room | Description | Equipment or Contents |
|---|---|---|
| 133 | Common area | 3 desks with chairs, 2 small couches, small technical library, white board |
| 133H | IEEE lounge | Table and chairs, refrigerator, sink, microwave oven, overhead cabinets, 1 computer, white board |
| 133J | Storage | 2 computers, tables and chairs, storage cabinets, small parts, hand tools |
| 133K | Senior projects | 2 computers, pick and place machine, microscopes, solder oven |
| 133L | Research (faculty and graduate students) | 2 computers, miscellaneous parts and equipment storage |

**B. Computing Resources**

Weber State University has a well-developed computing and IT infrastructure at both the Ogden and Davis campuses. Central computing facilities for students, faculty and staff are closely monitored to ensure that capacity planning meets expected bandwidth needs. Decentralized computing facilities have continued to grow in recent years to the point where over 90 percent of the university's classrooms and laboratories are equipped with a computer connection to the network and various instructional hardware.

Due to the growing use of laptops with mobile devices, the demand for open student computer laboratories has decreased recently, but WSU still maintains over hundreds of desktop computers in nine locations with a mix of Windows and Apple computers. The Stewart Library provides additional computers in a reference laboratory, a commons area and circulation desk with laptops for checkout. A virtual laboratory environment allows students to access software from anywhere at any time. This virtual laboratory, consisting of over 70 software applications, is available to all enrolled students and employees at WSU.

Professional technical support staff provide instruction to faculty on the use of technology in the classroom. This instruction often involves the use of software applications that students will learn in their course work. Training Tracker is an online training program developed to schedule and approve training for faculty and staff in a variety of personal, financial and professional development topics as well as computing related subjects.

A laboratory is available to faculty and staff to scan photos and slides and to prepare multimedia materials for their courses, publications and department web sites. This laboratory is supported by designers and development experts that can assist faculty and staff in the use of high-end software applications to efficiently complete their projects.

## C. Guidance

Students in the program are guided in the use of laboratory equipment and computer software by the engineering faculty, who have many years of experience in the use of electrical test equipment and engineering software applications. The majority of Electrical Engineering courses are combined lecture/laboratory courses in which basic test equipment is used. As indicated in Table 7-2, the primary equipment in the laboratories are power supplies, oscilloscopes, multi-meters and signal generators.

Faculty guide students in the use of engineering and computing software as it is introduced in the curriculum. As majors progress in the program, they use this equipment on a more frequent basis and progressively learn how to use more functions. By the time students are taking upper division courses, particularly senior project, they have become proficient in using all the basic test equipment. Faculty teach students how to operate the equipment properly such that their measurements are meaningful. Faculty also teach students how to handle the equipment so that they do not harm themselves or others or damage the equipment or surroundings.

## D. Maintenance and Upgrading of Facilities

The program has a course fee system for the periodic replacement of expendable and non-expendable items. Expendable items include electrical parts and supplies that require replacement on a relatively short time line due to continuous consumption by students. Non-expendable items include test equipment such as oscilloscopes, multi-meters, power supplies and signal generators. Course fees are assessed to students when they register for courses, and the funds generated go into an account that the program uses to replace the equipment. The cost structure of the system accommodates a one-year replacement time line for expendable items and a five-year replacement time line for non-expendable items. Course fees also include costs for the maintenance of annual software licenses.

Computers in faculty offices and student laboratories are typically replaced/upgraded every three to four years by the college IT staff. These computers are normally funded by a combination of internal and external grants. Each summer when our facilities experience little or no utilization by students, our IT staff conducts an assessment of the software requirements of faculty and laboratory computers. If upgrades are needed, the IT staff installs them at this time. Summers are also an opportune time to organize and clean laboratories and other areas in the department in preparation for a new academic year. Depending on staffing, this duty may fall on work-study students under the direction of the EE or ET faculty. Equipment, supplies and office furniture that have outlived their usefulness are sent to Property Control where they are offered to other departments on campus or sold to the public.

**E. Library Services**

The Stewart Library at WSU provides students and faculty with the full range of services expected of any university library, including expert reference assistance and information literacy instruction. Library services are provided at both the Ogden and Davis campuses. Collections include print, electronic, and audio-visual resources as well as access to an increasingly large number of electronic databases, books and journals. The library contains 459,585 bound volumes, 323 databases, 141,788 print and electronic periodicals and 24,153 audio-visual works. The library has online access to IEEE transactions through the IEEE Package, and many of the print periodicals and bound volumes are electrical engineering or technology related.

An equivalent full-time faculty of 10.7 plus 32.8 FTE staff provide library services to the WSU community. The library is open 105 hours per week during fall and spring semesters; reduced hours are in effect during the summer semester and semester breaks. Computers are located throughout the library to facilitate access to resources, and a wireless system affords connectivity for patrons with laptops. Off-campus access to resources and services is available 24/7 through the library's web site. During the 2016-2017 academic year, over 12,000 in-person circulation transactions occurred.

The Department of Engineering is supported by a subject librarian that provides expert assistance to students and faculty. The subject librarian is responsible for periodically consulting with faculty to assess instructional and research needs and to develop the collection. The library allocates an annual budget to the department for the purchase of these items.

The electronic catalog is the main tool for finding materials held by the library. Academic Search Premier is the library's primary search tool for finding materials that are not held by the library. The Inter-Library Loan (ILL) system can then be utilized to obtain the materials in a timely manner. Numerous databases are available through the Stewart Library, including technical databases such as IEEE All-Society Periodical Package and NASA Technical Reports Server. An Electronic Reserve system permits faculty to place course materials and other documents on reserve such that students can access them online at any time.

## F. Overall Comments on Facilities

Even though Engineering Technology Building is one of the oldest buildings on campus, it is a safe learning and working environment for students, faculty and staff. The building has five main exits. The building has a central fire alarm system and several strategically located fire extinguishers in the hallways. The building complies with ADA regulations and has backup power and emergency lighting systems. Evacuation plans are posted in every room to facilitate removal of personnel in case of fire or other emergencies. Facilities Management conducts periodic inspections of the building to assure that mechanical, electrical and fire systems are operational. The electrical equipment used in the program complies with applicable codes and standards. As discussed in Section 7.C., engineering faculty practice and teach equipment safety in classrooms, laboratories and project rooms.

## CRITERION 8. INSTITUTIONAL SUPPORT

### A. Leadership

The WSU Electrical Engineering Program is led by the chair of the Department of Engineering, Dr. Kirk Hagen, and the Electrical Engineering program coordinator, Dr. Justin Jackson. (Note: Dr. Hagen is stepping down as chair July 1, 2018, and Dr. Jackson will be the new chair. Dr. Christian Hearn will assume the role of EE program coordinator). The leadership responsibilities of the chair include, but are not limited to, the following:

- Manage and oversee the programs in the Department of Engineering
- Represent the department to outside entities
- Guide the accreditation efforts of the Electrical and Computer Engineering Programs
- Manage personnel issues in the department
- Oversee the recruitment, hiring and evaluation of faculty, adjunct faculty and staff
- Manage and approve department budgets and expenditures
- Schedule and run regular department meetings
- Schedule regular Industrial Advisory Board meetings
- Attend department chair meetings in the college
- Oversee and approve teaching assignments
- Oversee the curricula in the department
- Consult with and report to the dean of the college on matters pertaining to the department
- Sit on the department promotion and tenure committee
- Foster excellent teaching, scholarship and service among faculty
- Approve faculty leaves of absence
- Supervise the department administrative assistant
- Oversee scholarships offered by the department

The leadership responsibilities of the program coordinator include, but are not limited to, the following:

- Advise new and current students in Electrical Engineering
- Guide the EE curriculum
- Schedule EE courses
- Assign instructors for EE courses
- Assist the chair in accreditation activities of the EE Program
- Assist the chair with various duties as required

The department chair and EE program coordinator receive six credit hours and three credit hours, respectively, of equivalent teaching load per semester for their leadership duties.

The Dean of the College of Engineering, Applied Science & Technology, Dr. David Ferro, has upper level administrative oversight of the program. The department chair and program coordinator have direct leadership responsibility and decision making authority for the Electrical Engineering program, but all faculty participate to some extent in program leadership. Faculty opinions and suggestions are freely and openly discussed in department meetings. Faculty have input to department curriculum, policies and practices and are responsible for and participate in the continuous improvement of the program. Faculty fulfill their teaching, scholarship and service obligations as part of their academic appointments at the university.

**B. Program Budget and Financial Support**

1. Process used to establish the program's budget and evidence for continuity of institutional support

   The program budget consists of two main components---salaries and benefits of faculty and staff and operations. Salaries are determined at the time of hire and are allocated by the institution to the various academic divisions. Depending upon state and institutional economic conditions, salaries increase over time with across-the-board cost of living increases, promotions, special bonuses allocated by the administration, performance-based pay raises and equity adjustments. Benefits include retirement, medical and dental insurance, life insurance, unemployment insurance, workers compensation insurance and long-term disability.

   Operations include the maintenance and upgrading of equipment and supplies, faculty development, disbursement of financial aid and routine office functions and materials. Maintenance and upgrading of equipment and supplies is funded by course fees as well as grants and special allocations. Faculty development is funded by the department, college or outside entities. The department typically funds registration fees for conferences, seminars and professional courses, whereas the college funds travel expenses for these activities. Faculty may pursue external funding for research or projects through the WSU Office of Sponsored Projects. Internal funding is available for faculty development through the Research, Scholarship and Professional Growth (RS&PG) and Hemingway committees. Routine office functions and materials such as telephones, copy machine, printers, office supplies, advising literature, etc. are covered by the operating budget of the department.

2. How teaching is supported by the institution in terms of graders, teaching assistants, teaching workshops, etc.

   Weber State University is primarily an undergraduate institution. Until the end of the 2017-2018 academic year, Electrical Engineering was a four-year program only and therefore did not have graduate students who can serve as graders or teaching assistants. Thus, grading and teaching have been done by the program faculty. However, now that WSU has a MS EE program, the BS EE program may use graduate students on an as-needed basis, particularly as graders and lab assistants.

Faculty are encouraged to participate in the Teaching & Learning Forum, an organization founded by a group of WSU faculty in 1992. The Forum offers retreats, book groups, workshops, collaborative projects, and other initiatives in support of faculty teaching and development. Activities are directed by the Teaching, Learning, and Assessment (TLA) Committee, a standing committee of the WSU Faculty Senate. The Teaching and Learning Forum office is staffed year round and has a library of books and other materials on teaching and learning. The Forum consists of several learning groups, two of which are particularly applicable to the program: "Technology and Education" and "Issues in Science Education." Program faculty are also encouraged to attend and participate in conferences sponsored by national societies and groups such as the American Society for Engineering Education (ASEE) and The Teaching Professor.

3. To the extent not described above, how resources are provided to acquire, maintain and upgrade the infrastructures, facilities and equipment used in the program

   Resources for maintaining and upgrading laboratory equipment are described in Criterion 7, Section D. WSU Facilities Management provides the resources for the broader infrastructures and facilities such as building safety, lighting, power, heating and air-conditioning, water, furnishings and cleaning.

4. Adequacy of the resources described in this section with respect to the students in the program being able to attain the student outcomes

   The budgets of the institution, college and department are adequate to facilitate the achievement of student outcomes. The qualifications and number of faculty as well as faculty development in support of teaching are likewise sufficient for the attainment of student outcomes. Finally, student outcomes are appropriately and adequately supported by the infrastructure, facilities and equipment used by the program.

## C. Staffing

The Electrical Engineering Program is supported by administrative, instructional and technical staff. Administrative personnel who have control of the program are the dean of the college and the provost and president, the chief academic officers of the institution. The dean has academic and budgetary oversight of six academic units in the college, including the Department of Engineering. As discussed in Criterion 6, Sections A and C, the qualifications and number of the instructional staff are adequate to meet the needs of the program.

The IT manager for the college contributes approximately 10 percent of his total work load to the Electrical Engineering Program (See Table D-2, Appendix D). He is responsible for upgrading and maintaining faculty, staff, and laboratory computers in the program. He is assisted by IT staff and hourly student employees. His responsibilities do not include the setup, maintenance and monitoring of laboratory equipment, supplies and parts.

## D. Faculty Hiring and Retention

1. Process for hiring new faculty

Hiring new faculty at WSU is a three-step process:

Position approval and advertisement

- Identify a significant instructional need in the program
- Obtain the verbal approval of the dean and provost to hire a new faculty member
- Hiring/screening committee is organized
- Committee prepares the selection criteria and prepares an advertisement
- Requisition, advertisement and other forms are submitted to Human Resources (HR)
- HR submits the forms to the dean and provost for signatures
- Position is advertised for the appropriate time period
- Committee receives applications and resumes from HR

Screening and interviewing applicants (1)

- Preferences (veteran, diversity and/or internal) are applied
- Committee makes first cut, eliminating applicants who do not meet minimum qualifications
- First cut is approved by the AA/EO Director
- Committee narrows applicant list using numerical ratings of their selection criteria
- Committee conducts telephone interviews of remaining applicants (around 6 to 8)
- Based on telephone interviews, committee narrows list to 3 or 4 final applicants
- Committee notifies HR of foreign nationals among final applicants
- Final applicants are invited for campus interviews
- Interviews are completed
- Reference checks are completed
- Finalist is selected by the committee with the dean’s approval

Selection Approval and Offer

- Name of finalist and ARS rating sheets are submitted to HR
- Finalist is approved by HR and the AA/EO Director
- Background check is conducted
- Employment offer is extended to the finalist by HR or the dean
- HR sends letters to the finalists not selected

(1) WSU uses an online Applicant Rating System (ARS) that quantifies the screening process. The starting salary of a new faculty member is open to negotiation between the finalist and the Dean, who considers such factors as the ratings of the screening committee, academic credentials and industrial experience of the finalist, salaries of current faculty in the program and the college budget.

2. Strategies to retain current qualified faculty

Strategies to retain current qualified faculty are, to a great extent, woven into the fabric of the university working environment. The direct and indirect benefits of working at a university are difficult, if not impossible, to match elsewhere. Engineering courses are not typically offered during the summer, so faculty may consult or work in their disciplines on a full-time basis if they wish. Furthermore, WSU has a liberal sabbatical leave policy that provides faculty opportunities to conduct research or pursue other professional endeavors.

The program strives to assign faculty courses that are within their areas of technical expertise. This strategy is not only more satisfying to the faculty member, but students likewise benefit by learning from professors with in-depth knowledge and experience in the subject matter of the course.

Another strategy for retaining current qualified faculty is to abide by institutional policies with respect to academic freedom. From the WSU Policies and Procedures Manual (PPM) 9-1: "Weber State University seeks to provide and sustain an environment conducive to sharing, extending and critically examining knowledge and values and to furthering the search for wisdom. Effective performance of these central functions requires that faculty members be free to pursue and teach the truth in accord with appropriate standards of scholarly inquiry."

Also from PPM 9-1: "Academic freedom in the pursuit and dissemination of knowledge through all media shall be maintained at Weber State University. Such freedom shall be recognized as a right of all members of the faculty whether of tenure or non-tenure status, of all administrative officers and of all students."

Other strategies are reflected in the employment benefits and working environment of WSU. Full time faculty enjoy a wide range of benefits and privileges including a generous employer retirement contribution, tuition waivers for themselves, spouses and children, on-campus services and activities such as recreation, sporting events and performing arts. Nestled against the western slope of the Rocky Mountains, the WSU community enjoys numerous outdoor recreational activities such as hiking, biking, skiing, fishing and hunting.

To incentivize tenured professors who hold the rank of full professor, a program called Performance Compensation Plan (PCP) provides a monetary award for maintaining a level of accomplishment in teaching, scholarship and service equivalent to promotion to full professor. Tenured faculty are eligible to apply for the PCP every five years after being promoted to full professor up to two times.

## E. Support of Faculty Professional Development

Support of faculty professional development is integral to the support of faculty scholarship, one of the key expectations of faculty academic duties and responsibilities. Thus, professional development of faculty is supported at the department, college and university levels. The department funds registration fees for seminars, conferences and short courses, while the college funds travel expenses. If the faculty member is awarded a grant or contract in support of professional development, funding is provided centrally through the university from the funding agency.

As discussed in Criterion 6, Section D, the institution provides a liberal sabbatical leave program in which faculty can engage in professional development for an extended period of time without having regular teaching and other faculty responsibilities. After achieving tenure, faculty are eligible for a two-semester sabbatical leave at 75 percent of their base salary. After taking that sabbatical leave, faculty accrue a one-semester sabbatical leave after three years of service and a two-semester sabbatical leave after six years of service. For the one-semester and two-semester leaves, faculty are paid 100 percent and 75 percent, respectively, of their base salary. Granting of a sabbatical leave is contingent on the approval of the chair and dean and is subject to existing instructional needs and funding constraints.

**PROGRAM CRITERIA**

ABET specifies program criteria for Electrical, Computer, and similarly named Engineering programs. The program criteria state

These program criteria apply to engineering programs that include “electrical,” “electronic(s),” “computer,” “communication(s),” “telecommunication(s),” or similar modifiers in their titles.

1. Curriculum

   The structure of the curriculum must provide both breadth and depth across the range of engineering topics implied by the title of the program.

   The curriculum must include probability and statistics, including applications appropriate to the program name; mathematics through differential and integral calculus; sciences (defined as biological, chemical, or physical science); and engineering topics (including computing science) necessary to analyze and design complex electrical and electronic devices, software, and systems containing hardware and software components.

There are four primary elements of the program criteria defined above:

(1) probability and statistics, including applications
(2) mathematics through differential and integral calculus
(3) sciences
(4) engineering topics, including computing science

Probability and statistics

Probability and statistics are two separate but related branches of mathematics that deal with random phenomena and the analysis and interpretation of data. A required course in the Electrical Engineering curriculum is Math 3410 Probability and Statistics. This course is three credit hours and is typically taken in the fall semester of the junior year.

The program was cited for a *program criteria* weakness during our 2012 on-site visit. Even though Math 3410 was a required course in the EE curriculum, there was not a required EE course that used probability and statistics applications. This weakness was corrected by an agreement with the Department of Mathematics in which applications were added to Math 3410. Refer to the Background Information section for specific language of the citation.

Mathematics through differential and integral calculus

The Electrical Engineering curriculum contains a three-semester calculus sequence–Math 1210 Calculus I, Math 1220 Calculus II and Math 2210 Calculus III. Each of these courses is four credit hours. This sequence is normally taken during the first three semesters of the program and is immediately followed by Math 2250 Linear Algebra and Differential Equations. In lieu of Math 2250 the student may take Math 2270 Elementary Linear Algebra and Math 2280 Ordinary Differential Equations.

<u>Sciences</u>

Four science courses are required in the program. A two-semester physics sequence consisting of Phys 2210 Physics for Scientists and Engineers I and Phys 2220 Physics for Scientists and Engineers II is typically taken in the freshman year. Each physics course is five credit hours and includes a three-hour laboratory each week. Chem 1210 Principles of Chemistry I is a five-credit hour course that likewise includes a three-hour laboratory each week. As part of the general education component of the program, a Life Science (LS) course is required. Any course that has an LS prefix is acceptable. The Life Science groups from which students may select a course are Anthropology, Botany, Health Sciences, Honors, Microbiology, Nutrition and Zoology.

<u>Engineering topics</u>

Engineering courses are the backbone of the curriculum. The primary engineering topical areas are

- analog circuits
- digital circuits
- microelectronics
- electromagnetics
- embedded systems
- signal processing
- seminar
- internship
- senior project

To complement the hardware related engineering topics in the curriculum, CS 2250 Structured Computing in a Selected Language is also required.

Course descriptions of all required engineering, mathematics, science and computing science courses in the curriculum are given in Appendix A.

# APPENDIX A – COURSE SYLLABI

## A-1 Electrical Engineering

1. Course number and name: **ENGR 1000 Introduction to Engineering**

2. Credit hours: 2
   Contact hours: 2

3. Instructors: Kirk Hagen, Randall Kent, Dhanya Nair

4. Textbooks

   Title: Design Concepts for Engineers, 5th Ed.
   Author: Mark Horenstein
   Publisher: Pearson
   Year: 2016

   Title: Introduction to Engineering Analysis, 4th Ed.
   Author: Kirk Hagen
   Publisher: Pearson
   Year: 2014

5. Specific course information

   a. Catalog description

      An introductory course for engineering students. Engineering as a profession and career opportunities. Fundamentals of design and analysis. Team design and build project.

   b. Co-requisite: MATH 1060 or MATH 1080 or equivalent

   c. Required (R), Elective (E), or Selected Elective (SE): R

6. Specific goals for the course

   a. Learning outcomes

   - Be familiar with the engineering curriculum
   - Be familiar with the engineering disciplines and functions
   - Understand the basic engineering design process
   - Be able to perform a basic engineering analysis
   - Know how to work effectively on an engineering design team

b. Applicable student outcomes: d, f (Low/Medium applicability)

7. List of topics covered

a. The industrial team
b. Engineering fields and functions
c. Basic engineering design
d. The engineering design cycle
e. Introduction to engineering analysis
f. Dimensions and units
g. General analysis methodology
h. Engineering mechanics
i. Electrical circuits
j. Thermodynamics
k. Renewable energy
l. Team design project

1. Course number and name: **ECE 1270 Introduction to Electrical Circuits**

2. Credit hours: 4
   Contact hours: 6

3. Instructors: Christian Hearn, Suketu Naik

4. Textbook

   Title: Electric Circuits
   Author: James W. Nilsson and Susan A. Riedel
   Publisher: Prentice Hall
   Year: 2014

5. Specific course information

   a. Catalog description

   The basics of analog circuits as an introduction to Electronics Engineering. Concepts of voltage, current, power, resistance capacitance and inductance. Circuit analysis techniques such as Kirchhoff's Laws, node voltages, and mesh currents. Thevenin's and Norton's equivalent circuits, sinusoidal steady state and phasors.

   b. Pre-requisite: MATH 1210

   c. Required (R), Elective (E), or Selected Elective (SE): R

6. Specific goals for the course

   a. Performance Indicators

   - Analyze a basic circuit using node and mesh techniques.
   - Derive Thevenin and Norton equivalent circuits.
   - Explain the function of passive circuit elements.
   - Utilize phasors to determine sinusoidal steady-state waveforms response.
   - Conduct tests on basic circuits.

   b. Applicable student outcomes: a, e, k

7. List of topics covered

   a. Circuit variables
   b. Kirchhoff's Laws
   c. Resister combinations

d. Measuring techniques
e. Node analysis
f. Mesh analysis
g. Thevenin and Norton equivalents
h. Operational amplifiers
i. Capacitors
j. Inductors
k. Sinusoidal steady-state
l. Phasors
m. Transformers
n. Complex power calculations
o. Three phase circuits

1. Course number and name: **ECE 2260 Fundamentals of Electrical Circuits**

2. Credit hours: 4
   Contact hours: 6

3. Instructors: Christian Hearn, Dhanya Nair, Christopher Trampel

4. Textbook

   Title: Electric Circuits
   Author: James W. Nilsson and Susan A. Riedel
   Publisher: Prentice Hall
   Year: 2014

5. Specific course information

   a. Catalog description

   Fundamental electric-circuit techniques including: time domain transient responses for 1st and 2nd order circuits, Laplace transforms, Fourier series, and filters. Lecture and lab combination.

   b. Pre-requisite: ECE 1270 and MATH 1220

   c. Required (R), Elective (E), or Selected Elective (SE): R

6. Specific goals for the course

   a. Performance Indicators

      - Analyze transient responses for 1st and 2nd order circuits.
      - Apply Laplace transforms to circuits.
      - Apply Fourier transforms to signals.
      - Construct simple passive filters.

   b. Applicable student outcomes: a, e, k

7. List of topics covered

   a. 1st order circuit response
   b. 2nd order circuit response
   c. Review phasors
   d. Laplace transforms
   e. Inverse Laplace transform

f. S-domain circuit analysis
g. Fourier series
h. Fourier transform
i. Passive filters

1. Course Number and Name: **ECE 2700 Digital Circuits**

2. Credit hours: 4
   Contact hours: 6

3. Instructors: Larry Zeng

4. Textbook

   Title: Introduction to Digital Circuits with VHDL
   Author: Fon Brown
   Publisher: Linus Learning
   Year: 2014

   Other supplemental materials

   ISE Webpack software

5. Specific course information

   a. Catalog description

   Introduction to digital electronics, integrated circuits, numbering systems, Boolean algebra, gates, flip-flops, multiplexers, sequential circuits, combinational circuits, and computer architecture. Introduction to hardware description language and programmable logic devices. Lecture and lab combination. Laboratory activities to include the design, construction, analysis and measurement of basic digital circuits.

   b. Pre-requisite: ENGR 1000

   c. Required (R), Elective (E) or Selected Elective (SE): R

6. Specific goals for the course

   a. Performance Indicators

   - Design and build combinational circuits using gates and inverters.
   - Design and build sequential circuits using gates, inverters and flip-flops.
   - Compute propagation delays and maximum clock frequency.
   - Analyze circuits that use medium scale integrated devices.
   - Convert numbers from/to binary, decimal, and hexadecimal.
   - Design logic circuits that use binary numbers.

   b. Applicable student outcomes: a, e, k

7. List of topics covered

a. Digital signals
b. Numbering systems and arithmetic
c. Boolean algebra
d. Combinational logic design
e. Karnaugh maps and VEMs
f. Modeling and simulation
g. Integrated logic circuits
h. Introduction to VHDL
i. Synthesis, programmable devices
j. Sequential logic design
k. Memory devices
l. State machine design
m. Microprocessor architecture

1. Course number and name: **ECE 3000 Engineering Seminar**

2. Credit hours: 1
   Contact hours: 1

3. Instructors: Dhanya Nair, Christopher Trampel

4. Textbook

   None

   Supplemental materials

   Handouts on class website

5. Specific course information

   a. Catalog description

   An engineering seminar course designed to prepare the student for professional engineering employment. Topics to include resumes, hiring criteria, interviewing techniques, engineering ethics, professional and societal responsibilities, lifelong learning, diversity, creative problem solving, goals, quality, timeliness, and continuous improvement. The students will research related topics and write a paper.

   b. Pre-requisite: Permission of instructor

   c. Required (R), Elective (E), or Selected Elective (SE): R

6. Specific goals for the course

   a. Performance Indicators

   - Explain ethical responsibilities in engineering
   - Define engineering professionalism
   - Write a resume and cover letter
   - Understand interviewing techniques
   - Summarize a major engineering failure
   - Explain the role of their general education as it pertains to engineering
   - Attend technical presentations, short courses, or seminars
   - Understand the role of professional societies and publications

b. Applicable student outcomes: f, g, h, i, j

7. List of topics covered

a. Resumes and cover pages
b. Hiring criteria
c. Finding a professional position
d. Interviewing techniques
e. Honesty, ethics, and integrity
f. Engineering ethics
g. Professional and societal responsibilities
h. Lifelong learning
i. Diversity
j. Assertiveness and motivation
k. Creative problem solving
l. Goals
m. Quality
n. Timeliness
o. Continuous improvement

1. Course number and name: **ECE 3110 Microelectronics I**

2. Credit hours: 4
   Contact hours: 6

3. Instructor: Dhanya Nair

4. Textbook

   Title: Microelectronic Circuits
   Author: Adel S. Sedra and Kenneth C. Smith
   Publisher: Oxford University Press
   Year: 2009

5. Specific course information

   a. Catalog description

   Fundamental semiconductor device characteristics including diodes, MOSFETs and bipolar transistors; small and large signal characteristics and design of linear circuits. Lecture and lab combination. Laboratory activities to include the design construction, computer simulation, and analysis of semiconductor circuits, amplifiers and power supplies.

   b. Pre-requisite: CHEM PS1210 and ECE 2260

   c. Required (R), Elective (E), or Selected Elective (SE): R

6. Specific goals for the course

   a. Performance Indicators

   - Model semiconductor devices such as diodes, BJT transistors, and field effect devices.
   - Design and model semiconductor circuits.
   - Explain the difference between the BJT and MOSFET amplifier configurations.
   - Design, build, and evaluate BJT and MOSFET amplifiers.

   b. Applicable student outcomes: a, e, k

7. List of topics covered

   a. Signals and amplifiers
   b. Semiconductors
   c. Diodes
   d. MOS field effect transistors

e. Bipolar junction transistors
f. Operational amplifiers

1. Course number and name: **ECE 3120 Microelectronics II**

2. Credit hours: 4
   Contact hours: 6

3. Instructor: Suketu Naik

4. Textbook

   Title: Microelectronic Circuits
   Author: Adel S. Sedra and Kenneth C. Smith
   Publisher: Oxford University Press
   Year: 2009

5. Specific course information

   a. Catalog description

   Intermediate topics related to microelectronics including differential and multistage amplifiers, frequency response, feedback systems, power amplifiers, filters, and signal generation. Lecture and lab combination. Laboratory activities to include the design, construction, computer simulation, and analysis of filters and advanced circuits.

   b. Pre-requisite: ECE 3110

   c. Required (R), Elective (E), or Selected Elective (SE): R

6. Specific goals for the course

   a. Performance Indicators

   - Transform physical circuits into mathematical models.
   - Describe the frequency response of MOSFET and BJT amplifiers.
   - Design amplifiers for integrated circuits utilizing cascading, cascoding, and current mirroring techniques.
   - Analyze, design, and build transistor circuits, multistage amplifiers, differential amplifiers, operational amplifiers, current dividers, and interface circuits.
   - Analyze circuit models using ideal components, computer simulations and physical prototypes.

   b. Applicable student outcomes: a, e, k

7. List of topics covered

a. Building blocks of integrated circuit amplifiers
b. Differential and multistage amplifiers
c. Frequency response
d. Feedback
e. Output stages and power amplifiers

1. Course number and name: **ECE 3210 Signals and Systems**

2. Credit hours: 4
   Contact hours: 6

3. Instructor: Christopher Trampel

4. Textbook

   Title: Signal Processing and Linear Systems
   Author: B.P. Lathi
   Publisher: Oxford University Press
   Year: 1998

5. Specific course information

   a. Catalog description

   Topics related to the analysis of linear time invariant continuous and discrete systems and signal transformations, convolution, frequency spectra, Laplace transforms, Z transforms, and fast Fourier transforms. Lecture and lab combination. Laboratory activities to include the computer simulation, analysis, and numerical modeling of signals and systems.

   b. Pre-requisite: ECE 2260, MATH 2250 or MATH 2270 and MATH 2280

   c. Required (R), Elective (E), or Selected Elective (SE): R

6. Specific goals for the course

   a. Performance Indicators

   - Represent signals in time, frequency, Laplace and Z domains
   - Perform discrete and continuous time convolution
   - Design, build and analyze linear time-invariant systems.
   - Program simple scripts and functions in MATLAB.

   b. Applicable student outcomes: a, e, k

7. List of topics covered

   a. Continuous-time and discrete-time signals
   b. Linear time invariant systems
   c. Time domain analysis

d. Convolution (continuous)
e. Stability
f. Fourier series
g. Fourier transformation
h. Sampling
i. Discrete (and fast) Fourier transforms
j. Circular convolution (discrete)
k. Laplace transform
l. Analog filters
m. Z transform

1. Course number and name: **ECE 3310 Electromagnetics I**

2. Credit hours: 4
   Contact hours: 6

3. Instructor: Christian Hearn

4. Textbook

   Title: Fundamentals of Applied Electromagnetics 6th Ed.
   Author: Fawwaz T. Ullaby, Eric Michielssen, and Umberto Ravaioli
   Publisher: Prentice Hall
   Year: 2010

   Supplemental materials

   Handouts on class website

5. Specific course information

   a. Catalog description

   An introduction to electrostatics, magnetostatics and Maxwell's equations with specific applications to wave propagation and transmission line theory. Lecture and lab combination. Laboratory activities to include the design, construction, and analysis of RF radar subsystems.

   b. Pre-requisite: MATH 2210, PHYS 2220 and ECE 2260

   c. Required (R), Elective (E), or Selected Elective (SE): R

6. Specific goals for the course

   a. Performance Indicators

   - Apply Coulomb's and Gauss's equations to electrostatics problems
   - Apply Biot-Savart's and Ampere's equations to magnetostatics problems
   - Apply Maxwell's equations to time-varying fields
   - Describe wave propagation in free space
   - Describe transmission line theory

   b. Applicable student outcomes: a, e, k

7. List of topics covered

a. Coulombs’s equation
b. Gauss’s equation
c.  Capacitance
d.  Biot-Savart’s equations
e. Ampere’s equation
f. Inductance
g. Maxwell’s equations
h. Wave equation
i. Plane-wave propagation
j. Transmission line theory
k. Smith Chart
l. Impedance matching
m. Radiation

1. Course number and name: **ECE 3610 Digital Systems**

2. Credit hours: 4
   Contact hours: 6

3. Instructor: Fon Brown

4. Textbook

   Title: Digital Systems Design Using VHDL, 2nd Ed.
   Author: Charles H. Roth, Jr. And Lizy Kurian John
   Publisher: Cengage
   Year: 2008

   Supplemental materials

   ISE Webpack software

5. Specific course information

   a. Catalog description

   Introduction to microprocessor architecture, arithmetic logic units, memory systems, input/output interfaces, peripheral devices, and communication. Lecture and lab combination. Laboratory activities to include the programming and operation of microprocessor circuits.

   b. Pre-requisite: ECE 2700 and CS 2250 or CS 1410

   c. Required (R), Elective (E), or Selected Elective (SE): R

6. Specific goals for the course

   a. Performance Indicators

   - Analyze microprocessor architecture
   - Design a digital system using a hardware description language
   - Write a test bench using a hardware description language
   - Simulate and debug a digital system using software design tools

   b. Applicable student outcomes: a, e, k

7. List of topics covered

a. Review of digital circuit design

b. Introduction to hardware description language

c. Designing with programmable logic devices

d. Design of networks for arithmetic operations

e. Digital design with SM charts

f. Designing with programmable gate arrays

g. Floating point arithmetic

h. VHDL models for memories and busses

i. Hardware testing and design for testability

1. Course number and name: **ECE 3710 Embedded Systems**
2. Credit hours: 4

   Contact hours: 6

3. Instructor: Dhanya Nair
4. Textbook

| | |
|---|---|
| Title: | The 8051 Microcontroller and Embedded Systems |
| Author: | Muhammad A. Mazidi, Janice G. Mazidi, Rolin D. McKinlay |
| Publisher: | Prentice Hall |
| Year: | 2006 |

Supplemental materials

a. ISE Webpack software

b. Silicon Labs IDE software

5. Specific course information

a. Catalog description

Design and implementation of a microcontroller or microprocessor embedded system including assembly language programming, interfacing to peripherals, interrupt handling and debugging techniques. Lecture and Lab. Laboratory exercises build toward a final embedded systems project.

b. Pre-requisite: ECE 2700 and CS 2250 or CS 1410

c. Required (R), Elective (E) or Selected Elective (SE): R

6. Specific goals for the course

a. Performance Indicators

- Write a computer program in assembly language
- Write code to handle interrupts
- Debug a computer program using both hardware and software tools
- Interface peripherals to a microcontroller or microprocessor using a bus
- Document the hardware and software of an embedded system design

b. Applicable student outcomes: a, c, e, g, k

7. List of topics covered

a. Microprocessor/microcontroller architecture

b. Machine and assembly language

c. Instruction set architecture

d. I/O ports

e. Timers

f. Serial communications

g. Interrupts

h. Busses

i. Semiconductor memory

j. A/D and D/A conversions

k. Miscellaneous peripherals

1. Course number and name: **ECE 3890 Internship**

2. Credit hours: 2

   Contact hours: 0.5

3. Instructor: Justin Jackson

4. Textbook

   None

   Supplemental materials

   Handouts on class website

5. Specific course information

Catalog description:

This is a core course that is required for the BS Engineering degree. ECE 3890 can be taken a maximum of three times for a for a total of six credits, but only two credits count toward the major. The student will need department approval before being allowed to register.

Pre-requisite: Permission from the department

Required (R), Elective (E), or Selected Elective (SE): R

6. Specific goals for the course

   a. Performance Indicators

   - Participate in team problem-solving activities
   - Demonstrate ethics in the workplace
   - Demonstrate professionalism in the workplace
   - Communicate (presentations, memos, meetings, reports, etc.) in the workplace
   - Discuss how the company provides engineering solutions in a global, economic, environmental and social context
   - Learn industrial procedures and practices of the company
   - Explain how the company stays abreast of contemporary issues
   - Demonstrate techniques, skills and modern engineering tools used within the industry

   b. Applicable student outcomes: d, f, g, h, i, j, k

7. List of topics covered

a. Career objectives

b. Technical skills

c. Human relations skills

d. Communication (oral and writing) skills

e. Personal skills

f. Dependability

g. Productivity

h. Appropriate attire

i. Team building skills

j. Attention to detail

k. Attitude

1. Course number and name: **ECE 4010 Senior Project I**

2. Credit hours: 2
   Contact hours: 2

3. Instructors: Christian Hearn, Justin Jackson

4. Textbook

   Title: ECE 4010/4020 Senior Project Workbook
   Author: Fon Brown
   Publisher: Weber State University
   Year: 2011

5. Specific course information

   a. Catalog description

   Students will be required to complete a 200-hour engineering project in a team environment. Project management and problem solving techniques will be emphasized. Topics to include goal setting, developing milestone charts, writing contracts, conducting research, project design and construction, testing and analysis, project documentation and design review presentations.

   b. Pre-requisite: Department permission

   c. Required (R), Elective (E), or Selected Elective (SE): R

6. Specific goals for the course

   a. Performance Indicators

      - Define the requirements of a design
      - Develop a project plan
      - Conduct a design review
      - Share the workload
      - Fulfill assigned duties as a team member
      - Contribute individual expertise to the group
      - Demonstrate collegiality and congeniality with teammates
      - Maintain an engineering logbook
      - Manage a budget
      - Write a project proposal

- Describe the concepts and knowledge areas required for a senior project that are not covered in other engineering courses

- Describe how the student's senior project addresses contemporary issues

b. Applicable student outcomes: c, d, f, g, i, j

7. List of topics covered

a. Project plan and milestone chart

b. Goal setting

c. Conducting research

d. Project design and construction

e. Testing and analysis

f. Design review presentation

1. Course number and name: **ECE 4020 Senior Project II**
2. Credit hours: 2

   Contact hours: 2

3. Instructors: Justin Jackson, Suketu Naik
4. Textbook

   Title: ECE 4010/4020 Senior Project Workbook

   Author: Fon Brown

   Publisher: Weber State University

   Year: 2011

5. Specific course information

   a. Catalog description

   A continuation of Senior Project I. Students will be required to complete a significant engineering project in a team environment. Project management and problem solving techniques will be emphasized. Topics to include goal setting, developing milestone charts, writing contracts, conducting research, project design and construction, testing and analysis, project documentation, and design review presentations.

   b. Pre-requisite: ECE 4010

   c. Required (R), Elective (E), or Selected Elective (SE): R

6. Specific goals for the course

   a. Performance Indicators

   - Define the requirements of a design
   - Develop a project plan
   - Conduct a design review
   - Share the workload
   - Fulfill assigned duties as a team member
   - Contribute individual expertise to the group
   - Demonstrate collegiality and congeniality with teammates
   - Maintain an engineering logbook
   - Manage a budget

- Write a project proposal

- Describe the concepts and knowledge areas required for a senior project that are not covered in other engineering courses

- Describe how the student's senior project addresses contemporary issues

b. Applicable student outcomes: c, d, f, g, i, j

7. List of topics covered

a. Project plan and milestone chart

b. Goal setting

c. Conducting research

d. Project design and construction

e. Testing and analysis

f. Design documentation

g. Design review presentation

1. Course number and name: **ECE 4100 Control Systems**
2. Credit hours: 4

   Contact hours: 6

3. Instructor: Larry Zeng

4. Textbook

   Title: Control Systems Engineering 6$^{th}$ Ed.

   Author: Norman S. Nise

   Publisher: John Wiley & Sons

   Year: 2010

5. Specific course information

   a. Catalog description

      Topics related to control theory, analysis, and testing of systems in the time domain, frequency domain and state space. Lecture and lab combination.

   b. Pre-requisite: ECE 3120 and ECE 3210

   c. Required (R), Elective (E), or Selected Elective (SE): R

6. Specific goals for the course

   a. Performance Indicators

   - Model a control system in the time and frequency domains
   - Explain state space
   - Construct a signal flow diagram
   - Explain a Nyquist diagram
   - Construct a Bode plot

   b. Applicable student outcomes: a, b, e, k

7. List of topics covered

   a. Modeling in the frequency domain

   b. Modeling in the time domain

c. State space

d. Signal flow diagrams

e. Mason’s Rule

f. Stability/Routh-Hurwitz criterion

g. Steady-state errors

h. Root locus

i. Nyquist diagram

j. Bode plots

k. Controllability

l. Observability

1. Course number and name: **ECE 4210 Digital Signal Processing**
2. Credit hours: 4

   Contact hours: 6

3. Instructor: Christian Hearn

4. Textbook

   Title: Discrete-Time Signal Processing 3rd Ed.

   Author: Allan V. Oppenheim and Ronald W. Shafer

   Publisher: Prentice Hall

   Year: 2009

5. Specific course information

   a. Catalog description

   Theory, application and implementation of digital signal processing (DSP) concepts from the design and implementation perspective. Topics include: Fast Fourier transforms, adaptive filters, state-space algorithms, random signals and spectral estimation.

   b. Pre-requisite: ECE 3210

   c. Required (R), Elective (E) or Selected Elective (SE): E

6. Specific goals for the course

   a. Performance Indicators

   - Describe discrete-time signals and systems
   - Explain sampling
   - Perform transforms: Z, discrete Fourier, fast Fourier and Hilbert
   - Explain functions of IIR and FIR filters

   b. Applicable student outcomes: a, e, k

7. List of topics covered

   a. Discrete-time signals and systems
   b. Sampling
   c. Z-transforms
   d. Transform analysis of LTI systems
   e. Structures for discrete-time systems
   f. IIR filters

g. FIR filters
h. Discrete Fourier transform
i. Fast Fourier transform
j. Hilbert transform

1. Course number and name**: ECE 4310 Electromagnetics II**

2. Credit hours: 3
   Contact hours: 3

3. Instructor: Christian Hearn

4. Textbook

   Title: Introduction to Electromagnetic Compatibility
   Author: Clayton R. Paul
   Publisher: Wiley-Interscience
   Year: 2006

   Supplemental materials

   Handouts on class website

5. Specific course information

   a. Catalog description

   A study of intermediate electromagnetic issues common to circuits, systems, and communication networks.

   b. Pre-requisite: ECE 3310 Electromagnetics I

   c. Required (R), Elective (E), or Selected Elective (SE): E

6. Specific goals for the course

   a. Performance Indicators

   - Explain the difference between ideal and physical components
   - Describe intrinsic, conductance and radiated noise sources
   - Explain electromagnetic compatibility (EMC)
   - Utilize advanced circuit simulation tools

   b. Applicable student outcomes: a, e, k

7. List of topics covered

   a. Ideal elements

b. Physical resistors
c. Physical capacitors
d. Physical inductors
e. Physical transmission lines
f. Intrinsic noise
g. Conductance noise
h. Radiated noise
i. Cross talk
j. Grounding
k. Shielding
l. Electromagnetic compatibility

1. Course number and name: **ECE 4410 Communication Circuits and Systems**

2. Credit hours: 3
   Contact hours: 3

3. Instructor: Christopher Trampel

4. Textbook

   Title: Digital and Analog Communication Systems 6th edition
   Author: Leon W. Couch
   Publisher: Prentice Hall
   Year: 2001

   Supplemental materials

   Handouts on class website

5. Specific course information

   a. Catalog description

   A study of communication circuits, modulation and decoding theory, spectrum usage, networks, and protocols.

   b. Pre-requisite: ECE 3210 and MATH 3410

   c. Required (R), Elective (E), or Selected Elective (SE): E

6. Specific goals for the course

   a. Performance Indicators

   - Describe digital and analog modulation techniques
   - Describe signal to noise effects and error correction techniques
   - Utilize circuit building blocks such as oscillators, mixers, amplifiers and filters
   - Analyze basic communication circuits

   b. Applicable student outcomes: a, e, k

7. List of topics covered

   a. Signal representation
   b. Sampling theorem

c. Energy/power spectral density
d. Correlation functions
e. Modulation (amplitude, frequency, phase, pulse amplitude, pulse-code)
f. Signal noise performance
g. Spectrum usage
h. Communication protocols

1. Course number and name: **ECE 4800 Individual Studies**

2. Credit hours: 1-4
   Contact hours: variable

3. Instructor: (Any ECE faculty member assigned by the chair or program coordinator)

4. Textbook

   None

5. Specific course information

   a. Catalog description

   The students will receive credit for approved studies in the Electronics Engineering program. A maximum of four credits can count as an elective course in the Electronics Engineering program.

   b. Pre-requisite: permission of instructor

   c. Required (R), Elective (E), or Selected Elective (SE): E

6. Specific goals for the course

   a. To be determined by instructor

   b. Applicable student outcomes: none

7. List of topics covered

   a. To be determined by instructor

1. Course number and name: **ECE 4900 Special Topics**

2. Credit hours: 1-4
   Contact hours: variable

3. Instructor: (Any ECE faculty member assigned by the chair or program coordinator)

4. Textbook

   None

5. Specific course information

   a. Catalog description

   A one-time special study course designed to introduce a new relevant topic that is not covered in the EE program. Lecture and lab combination. Laboratory activities support the selected course topic. A maximum of four credits can be counted for EE program.

   b. Pre-requisite: permission of instructor

   c. Required (R), Elective (E), or Selected Elective (SE): E

6. Specific goals for the course

   a. To be determined by instructor

   b. Applicable student outcomes: none

7. List of topics covered

   a. To be determined by instructor

## A-2 Mathematics

**Course Title:** **Calculus I**

**Course Number:** MATH 1210

**Credit Hours:** 4

**Prerequisite:** MATH 1050 and 1060 or MATH 1080 or placement exam
**Corequisite:** MATH 1100 or ability to use computer algebra system

**Catalog Description:** Limits, continuity, differentiation, integration.

**Objectives:** To give students a solid understanding of the fundamental notions of calculus. Conceptual understanding as well as a mathematically rigorous treatment of the subject are central to the course.

**Suggested Text:** James Stewart, *Calculus*, 7th Ed., Brooks Cole, 2011.

**Course Coverage:** Limits and continuity, derivatives, Mean Value Theorem, applications of derivatives, integration, applications of integration.

**Course Title:** **Calculus II**

**Course Number:** MATH 1220

**Credit Hours:** 4

**Prerequisite:** MATH 1210
**Corequisite:** MATH 1100 or ability to use computer algebra system

**Catalog Description:** Transcendental functions, techniques of integration, analytic geometry, infinite series.

**Objectives:** To give students a solid understanding of the fundamental notions of calculus. Conceptual understanding as well as a mathematically rigorous treatment of the subject are central to the course.

**Suggested Text:** James Stewart, *Calculus*, 7th Ed., Brooks Cole, 2011.

**Course Coverage:** Transcendental functions, techniques of integration, applications of integration, conic sections, polar coordinates, sequences and series.

**Course Title:** **Calculus III**

**Course Number:** MATH 2210

**Credit Hours:** 4

**Prerequisite:** MATH 1220

**Catalog Description:** Vector algebra, vector-valued functions, multivariable functions, partial derivatives, multiple integrals, line integrals, integration in vector fields.

**Objectives:** To give students a solid understanding of the fundamental notions of calculus. Conceptual understanding as well as a mathematically rigorous treatment of the subject are central to the course.

**Suggested Text:** James Stewart, *Calculus*, $7^{th}$ Ed., Brooks Cole, 2011.

**Course Coverage:** Vectors and analytic geometry, vector-valued functions and motion in space, multivariable functions and partial derivatives, multiple integrals, integration in vector fields.

**Course Title:** **Linear Algebra & Differential Equations**

**Course Number:** MATH 2250

**Credit Hours:** 4

**Prerequisite:** MATH 1220

**Catalog Description:** Introduction to Linear Algebra and Differential Equations. Systems of linear equations, matrices, vector spaces, eigenvalues. First and second order differential equations and models, higher order linear equations, linear systems.

**Objectives:** To introduce the ideas of vector spaces, linear transformations, Eigen-values and eigen-vectors. To learn how differential equations are used to model the physical world and how linear algebra is useful in differential equations. To learn theory and methods for solving differential equations.

**Suggested Texts:** Paul Bugl, *Differential Equations, Matrices and Models*, Prentice Hall, 1994.
Stephen Goode, *Differential Equations and Linear Algebra*, 3rd Ed., Prentice Hall, 2007.
Albert Rabenstein, *Elementary Differential Equations with Linear Algebra*, 4th Ed., Brooks Cole, 1992.

**Course Coverage:** Systems of linear equations, matrix equations, determinants, vector spaces, linear transformations, eigenvalues and eigenvectors, intro to differential equations, first and second order differential equations, higher-order differential equations, systems of differential equations.

**Course Title:** **Elementary Linear Algebra**

**Course Number:** MATH 2270

**Credit Hours:** 3

**Prerequisite:** MATH 1220

**Catalog Description:** Systems of linear equations, matrices, vector spaces, eigenvalues linear transformations, orthogonality.

**Objectives:** To study the fundamental topics of linear algebra. To familiarize students with matrix theory, vector spaces and orthogonality.

**Suggested Texts:** David Lay, *Linear Algebra and its Applications*, 4th Ed., Addison Wesley, 2011.

**Course Coverage:** Systems of linear equations, matrix equations, determinants, vector spaces, linear transformations, eigenvalues and eigenvectors, orthogonality.

**Course Title:** **Ordinary Differential Equations**

**Course Number:** MATH 2280

**Credit Hours:** 3

**Prerequisite:** MATH 1220

**Catalog Description:** Methods of solution for ordinary differential equations. Exact equations, linear equations Laplace Transforms, series solutions.

**Objectives:** To learn the most fundamental aspects of differential equations. To familiarize students with the meaning, methods and applications of ordinary differential equations.

**Suggested Texts:** Boyce and DiPrima, *Elementary Differential Equations* 9th Ed., Wiley, 2008.

Nagel, Saff and Snider, *Fundamentals of Differential Equations* 8th Ed., Addison Wesley, 2011.

**Course Coverage:** Classification of differential equations, first order equations, linear and second order equations, higher order equations, Laplace transforms, series solutions.

**Course Title:** **Probability and Statistics**

**Course Number:** MATH 3410

**Credit Hours:** 3

**Prerequisite:** MATH 1220

**Catalog Description:** Introductory probability theory and mathematical statistics, including applications.

**Objectives:** To learn the mathematical content of probability and statistics at the undergraduate post-calculus level. An understanding of the applications of probability and statistics is also stressed.

**Suggested Texts:** Wackerly, Mendenhall and Scheaffer, *Mathematical Statistics with Applications* 7$^{th}$ Ed., Duxbury Press, 2007.

Jay Devore, *Probability and Staticstics for Engineering and the Sciences* 8$^{th}$ Ed., Duxbury Press, 2011.

Hogg and Tanis, *Probability and Statistical Inference* 8$^{th}$ Ed., Prentice Hall, 2009.

Larsen and Marx, *An Introduction to Mathematical Statistics and its Applications* 5$^{th}$ Ed., Prentice Hall, 2011.

Milton and Arnold, *Introduction to Probability and Statistics– Principles and Applications for Engineering and the Computing Sciences* 4$^{th}$ Ed., McGraw-Hill, 2002.

**Course Coverage:** Statistical theory, data analysis, combinatorial mathematics, discrete distributions, continuous distributions, functions of random variables, statistical theorems, estimation, confidence intervals, hypothesis testing, (optional) statistical computer software applications.

## A-3 Physics

**Course Title:** **Physics for Scientists and Engineers I**

**Course Number:** Phys 2210

**Credit Hours:** 5

**Co-requisite:** MATH 1210

**Catalog Description:** First semester of a two-semester sequence in calculus-based physics, primarily for students in science, math, computer science, and pre-engineering. This semester covers topics in mechanics, including kinematics, Newton's laws, and the conservation laws of energy, linear momentum, and angular momentum. Also covered are topics in gravity, fluid mechanics, waves, and thermodynamics. Class meets five hours per week in lecture/discussion format. One 3-hour lab per week (PHYS 2219).

**Objectives:** This course is meant to serve as the second half of a first rigorous course in physics using calculus. We will cover a variety of topics including optics, electricity and magnetism, and modern (20th century) physics.

**Text:** Randall Knight, *Physics for Scientists and Engineers: A Strategic Approach with Modern Physics* 2nd Ed., Addison Wesley, 2007.

**Course Coverage:** Motion in one and two dimensions, velocity and acceleration, Newton's laws of motion, momentum, collisions, energy, gravity, orbits, rotating and rolling, oscillations, fluids, nature of matter, thermodynamics, waves, sound.

**Course Title:** **Physics for Scientists and Engineers II**

**Course Number:** Phys 2220

**Credit Hours:** 5

**Prerequisite:** PHYS 2210
**Co-requisite:** MATH 1220

**Catalog Description:** Second semester of a two-semester sequence in calculus-based physics. This semester covers topics in electricity and magnetism, electromagnetic waves, light and optics, relativity, and quantum, atomic, and nuclear physics. Class meets five hours per week in lecture/discussion format. One 3-hour lab per week (PHYS 2229).

**Objectives:** This course is meant to serve as the second half of first rigorous course in physics using calculus. We will cover a variety of topics including optics, electricity and magnetism, and modern ($20^{th}$ century) physics.

**Text:** Randall Knight, *Physics for Scientists and Engineers: A Strategic Approach with Modern Physics* $2^{nd}$ Ed., Addison Wesley, 2007.

**Course Coverage:** Electricity and magnetism, DC circuits, alternating current, Gauss's Law, Maxwell's equations, electromagnetic waves, light and optics. Fundamentals of several topics from modern physics including: relativity, quantum, and nuclear physics.

## A-4 Chemistry

**Course Title:** **Principles of Chemistry I**

**Course Number:** CHEM 1210

**Credit Hours:** 5

**Prerequisites:** MATH 1010 or equivalent and CHEM 1200 or departmental approval.

**Catalog Description:** The first course in a series designed primarily for science majors and others who will take more than one year of chemistry such as pre-medical students, clinical/medical laboratory scientists and some engineering students. The fundamental principles of chemistry with laboratory emphasis upon qualitative and quantitative methods of analysis. Four hours of lecture and one 3-hour lab a week.

**Objectives:** To present the fundamental concepts of chemistry with laboratory emphasis upon qualitative and quantitative methods of analysis.

**Text:** Theodore Brown, Eugene Lemay, Bruce Bursten, Catherine Murphy, *Chemistry–The Central Science* $11^{th}$ Ed., Prentice Hall, 2008.

**Course Coverage:** Measurement and significant figures, chemical balances, identification of compounds, simple stoichiometry, changes and reactions, calorimetry, acid base stoichiometry, acid rain reactions, gas laws, coligative properties of solutions.

**Course Title:** **Fundamentals of Programming**

**Course Number:** CS 1400

**Credit Hours:** 4

**Co-requisite:** CS 1030 (1)

**Catalog Description:**

This course covers basic operating system navigation and components of the program development process. The majority of the course covers basic problem solving and program design of a software application using a selected language. Topics presented and discussed depending on selected language include: thinking logically to solve problems, working with input/output devices, compilation and library use, structured programming and modularity concepts, conditional and iterative structures including recursion, object oriented design, data types and structures and pointers.

**Objectives:** The purpose of this course is to teach the crucial skills of problem solving. The tool used to solve problems is the Java programming language. In order to use Java effectively, students will learn the fundamentals of programming using the syntax of Java. Students will then use those skills to write programs to solve problems.

**Text:** J. Dean and R. Dean, *Introduction to Programming with Java: A Problem-Solving Approach*, McGraw-Hill, 2008.

**Course Coverage:** Introduction to computers and programming, algorithms and design, Java basics, control statements, using pre-built models, game maker, object-oriented programming, robocode, arrays and lists, exception handling, files, GUI programming basics.

(1) This co-requisite is waived for Electrical Engineering majors.

**Course Title:** **Object-Oriented Programming using C++**

**Course Number:** CS 1410

**Credit Hours:** 4

**Prerequisite:** CS 1400

**Catalog Description** An introduction to the C++ language. Topics will include data types, control structures, functions, pointers, arrays, I/O streams, classes, objects, encapsulation, overloading, inheritance and use of these concepts in problem solving.

**Objectives:** Understand and program the basic constructs, data types and components of the C++ language and use the language to solve a wide range of problems.
Understand the object-oriented paradigm and how C++ supports and implements the specific features using the class construct.
Understand and operate a typical C++ Integrated Development Environment (IDE) and how to create, compile, execute and debug programs in that environment.
Understand and use the basic data structures such as arrays, matrices and lists.
Understand the general purpose of the templates, exceptions and the STL including some of the common algorithms and containers.

**Text:** Robert Lafore, *Object-Oriented Programming in C++* 4th Ed., Sams, 2001.

**Course Coverage:** Variables, expressions, statements, flow of control statements, structures and unions, pointers, operators, syntax, I/O streams, the STL, classes and objects, attributes and functions, member access, virtual or abstract classes, polymorphism, organization of C++ programs, writing C++ programs to solve specific problems.

**Course Title:** **Structured Computing in a Selected Language**

**Course Number:** CS 2250

**Credit Hours:** 4

**Prerequisite:** Basic skills in fundamental algebra.

**Catalog Description** Introduction to structured problem solving using objects, data enumeration and encapsulation in a selected language. The language for a particular instance of this course will be based upon demand.

**Objectives:** To learn the features of the C programming language and the main standard libraries.

**Text:** Gary Bronson, *A First Book of ANSI C* 4$^{th}$ Ed., Course Technology, 2006.

**Course Coverage:** Programs and files, expressions and statements, data and data types, operators, type conversions, macros, flow and control statements, functions, console file input and output, arrays, strings, structures and unions, pointers and dynamic memory.

## APPENDIX B – FACULTY VITAE

1. Name **Kirk D. Hagen**

2. Education

| | | | |
|---|---|---|---|
| PhD | Mechanical Engineering | University of Utah | 1989 |
| MS | Mechanical Engineering | Utah State University | 1980 |
| BS | Physics | Weber State College | 1977 |

3. Academic Experience

| | | | |
|---|---|---|---|
| Weber State University | Professor & Chair, Engineering | 2011 - 2018 | FT |
| Weber State University | Asc. Prof. Coordinator, Pre-eng | 1996 - 2001 | FT |
| Weber State University | Asst. Prof. Coordinator, Pre-eng | 1993 - 1996 | FT |
| Bucknell University | Visiting Asc. Prof. | 2000 - 2001 | FT |
| Salt Lake Com. College | Adjunct Instructor | 1992 - 1993 | PT |
| University of Utah | Adjunct Instructor | 1983, 2000 | PT |

4. Non Academic Experience

| | | |
|---|---|---|
| - GXX Corporation<br>Consulting Engineer/Designer | 2011 | PT |
| - JBT Aerospace Ogden, Utah<br>Consulting Engineer Thermal Analyst | 2009 | PT |
| - Ogwa, Pleasant Grove, Utah<br>Consulting Engineer/Designer | 2009 | PT |
| - Kahuna Creations Ogden, Utah<br>Consulting Engineer/Designer | 2008 | PT |
| - Unisys Corporation, Salt Lake City, Utah<br>Consulting Engineer, Thermal Designer/Analyst | 1993, 1994 | PT |
| - Unisys Corporation, Salt Lake City, Utah<br>Principal Engineer, Thermal Designer/Analyst | 1986 - 1992 | FT |
| - Hercules Aerospace, Salt Lake City, Utah<br>Principal Engineer, Thermal Analyst | 1980 - 1986 | FT |

5. Certifications or Professional Registrations None

6. Current Membership in Professional Organizations

| | |
|---|---|
| American Society of Mechanical Engineers (ASME) | 1986 - present |
| American Society for Engineering Education (ASEE) | 1993 – present |

7. Honors and Awards

| | |
|---|---|
| WSU Brady Presidential Distinguished Professor | 2014 |
| Hemingway Collaborative Award | 2011 |

| | |
|---|---|
| Hemingway Faculty Vitality Award | 1996 |

8. Service Activities (within and outside the institution)

Within WSU

| | |
|---|---|
| Faculty Board of Review (chair) | 2015 – 2017 |
| APAFT Committee | 2012 - 2015 |
| Research, Scholarship & Professional Growth Committee | 2009 - 2012 |
| University Planning Council | 2009 - 2011 |
| University Curriculum Committee | 2007 - 2010 |
| College Promotion & Tenure Committee | 2002, 2004, 2010, 2011 |
| University Committee on Assessment | 2001 - 2003 |
| Faculty Senate | 1996 - 1999 |

Outside WSU

| | |
|---|---|
| Subject Matter Expert, McGraw-Hill Higher Education | 2017 - present |
| Journal of Engineering Technology Reviewer | 1998 - present |

9. Publications and Presentations in the Last Five Years

Kirk D. Hagen, *Introduction to Renewable Energy for Engineers*, Pearson, 2016.

Kirk D. Hagen, *Introduction to Engineering Analysis 4th Edition*, Pearson Prentice Hall, 2015.

Hagen, K.D., “Senior Projects as a Means of Building Engineering Laboratories”, Joint International Conference on Engineering Education and Information Technology, Capetown, South Africa, 2013.

Hagen, K.D., “A Contextual Engineering Laboratory: Heat Transfer via Thermal Behavior of Electronics”, International Conference on Engineering Education and Research, Marrakesh, Morocco, July 2013.

Kirk D. Hagen, *The First Engineering Program at Weber State University: Expectations and Challenges*, ASEE Rocky Mountain Region presentation, March 2012.

Kirk D. Hagen, *Thermal-Fluid Science Laboratory Development at Weber State University*, ASEE Rocky Mountain Region paper, March 2012.

10. Recent Professional Development Activities

| | | |
|---|---|---|
| ABET Annual Conference and Workshop | Baltimore,MD | 2011 |
| The Teaching Professor | Kissimmee, FL | 2011 |

1. Name **Justin B. Jackson**

2. Education

| | | | |
|---|---|---|---|
| PhD | Electrical Engineering | University of Utah | 2008 |
| ME | Electrical Engineering | University of Utah | 2004 |
| MBA | Business Administration | Weber State University | 2003 |
| BS | Electronics Engineering Tech | Weber State University | 2000 |

3. Academic Experience

| | | | |
|---|---|---|---|
| Associate Professor | Weber State University | 2013 – Present | FT |
| Assistant Professor | Weber State University | 2007 – 2013 | FT |
| Teaching Assistant | University of Utah | 2003 – 2007 | PT |
| Adjunct Professor | Stevens-Henager College | 2003 – 2003 | PT |

4. Non-Academic Experience

| | | | |
|---|---|---|---|
| Lockheed Martin | Consultant | 2014 – 2015 | FT |
| University of Utah | Post-Doctoral Research Associate | 2007 – 2008 | FT |
| University of Utah | Research Assistant | 2003 – 2007 | FT |
| Primewave Communications | ASIC Design Engineer | 2001 – 2002 | FT |
| Linux NetworX | Hardware Design Engineer | 2000 – 2001 | FT |
| Smart Solutions | Electrical/Computer Design Engineer | 1999 – 2000 | FT |

5. Certifications or Professional Registrations

6. Current Membership in Professional Organizations

Institute of Electrical and Electronics Engineers

American Society for Engineering Education

Order of the Engineer

7. Honors and Awards

Nominated for the 2015 Utah Engineering Educator of the year.

8. Service Activities

<u>Within WSU</u>

2016-Present Weber State University Faculty Senate

| | |
|---|---|
| 2017-2018 | Chair, Jordan Olive MSCE committee |
| 2016-2017 | Jordan Bohne MSCE committee |
| 2016 | WSU Prep Talk |
| 2016 | MSCE graduate admissions committee |
| 2016 | Department Review committee for Dr. Suketu Naik |
| 2016 | Department Review committee for Dr. Christian Hearn |
| 2015-2016 | Constitution Review and Apportionment Committee |
| 2015 | MSCE graduate admissions committee |
| 2015 | Member of EE Faculty search committee. |
| 2015 | Department Review committee for Dr. Christopher Trampel |
| 2015 | Chair of Peer Review committee Dr. Christopher Trampel |
| 2012-2014 | Research, Scholarship, and Professional Growth Committee |
| 2013 | Peer Review committee for Dr. Larry Zeng |
| 2013 | Chair of Peer Review committee for Dr. Fon Brown |
| 2013 | EAST Tenure Document Review Committee |
| 2012 | Weber State University Davis Campus Projection Committee |
| 2012 | Member of EE Faculty search committee. |

<u>Outside WSU</u>

| | | |
|---|---|---|
| 2010-Present | Salt Lake Community College Engineering Department Program Advisory Committee | SLCC |
| 2008-Present | Campus Representative | ASEE |
| 2017-Present | Developing, with admissions, a transfer agreement between Snow College and WSU including suggested course schedules | Snow/WSU |
| 2016 | Developed, with admissions, a transfer agreement between SLCC and WSU including suggested course schedules | SLCC/WSU |
| 2015 | Session Chair, Aircraft Airworthiness and Sustainment Conference, Baltimore, MD | AA&S |

| | | |
|---|---|---|
| 2014 | Reviewed textbook Microelectronic Circuits 7th Edition by Sedra and Smith | Oxford Press |

9. Publications and Presentations in the last five years

2015 Mohammad A. U. Usman, Brady J. Smith, Justin B. Jackson, Matthew C. DeLong, Mark S. Miller, Titanium-Catalyzed Silicon Nanostructures Grown by APCVD, Journal of Electronic Materials, Vol. 44 No. 1, January 2015

2013 Mohammad A. U. Usman, Brady J. Smith, Justin B. Jackson, Matthew C. DeLong, Mark S. Miller, Titanium-Catalyzed Silicon Nanowires and Nanoplatelets, American Institute of Physics (AIP) Advances, 3, 032112, March 2013

2016 Evan Chief, Ross Frazier, and Justin B. Jackson, Remote Operating Sensor System, WSU Undergraduate Research Symposium, Ogden, Utah (2016)

2016 Jay Atkinson, Ben Oborn, and Justin B. Jackson, Compact, High Efficiency Power Supply, WSU Undergraduate Research Symposium, Ogden, Utah (2016)

2015 IEEE Tech Talk, WSU IEEE Student Chapter, Ogden, UT

2013 Justin B. Jackson, Electronics Engineering Technology Student Recruitment Design Project, 2013 ASEE Rocky Mountain Section Meeting, Pueblo, Colorado

10. Recent Professional Development Activities

2015 Aircraft Airworthiness & Sustainment Conference, Baltimore, MD

2014 DOD Maintenance Symposium, Birmingham, AL

2014 USTAR Conference Salt Lake City, UT

2013 American Society for Engineering Education (ASEE) Regional Conference, Pueblo, CO

2012 American Society for Engineering Education (ASEE) National Conference, San Antonio, TX

2012 American Society for Engineering Education (ASEE) Regional Conference, Ogden, UT

2012 American Society for Engineering Education (ASEE) Conference for Industry and Education Collaboration (CIEC), Orlando, FL

1. Name **Fon R. Brown**

2. Education

| | | | |
|---|---|---|---|
| PhD | Electrical Engineering | Utah State University | 1998 |
| MS | Computer Science | Brigham Young University | 1989 |
| BS | Electrical Engineering/Math | Utah State University | 1984 |

3. Academic Experience

| | | | |
|---|---|---|---|
| Associate Professor | Weber State University | 2010 – Present | FT |
| Adjunct Professor | Utah State University | 2015 – Present | PT |
| Lecturer | Utah State University | 2007 – 2010 | FT |
| Adjunct Professor | Utah State University | 2006 – 2007 | PT |

4. Non-Academic Experience

| | | | |
|---|---|---|---|
| Lead SW Engineer | GE Healthcare | 2005 – 2007 | FT |
| Senior SW Engineer | Evans and Sutherland | 1992 – 2001 | FT |
| Software Engineer | Signetics | 1984 – 1992 | FT |

5. Certifications or Professional Registrations

6. Current Membership in Professional Organizations

Institute of Electrical and Electronics Engineers

7. Honors and Awards

Outstanding Teacher of the Year 2009-2010, ECE Department, USU

8. Service Activities

Director, MSCE program (2016-present)

University Curriculum Committee (2016-present)

Undergraduate Research Committee (2016-present)

EE Department Honors Coordinator (2011-2016)

College of Applied Science & Technology Curriculum Committee (2011-2014)

Constitutional Review & Oversight Committee (2013-2016)

IEEE Branch Advisor (2011 – 2016)

9. Publications and Presentations in the last five years

*Application of Orthogonal Frequency Division Multiplexing Techniques to Photographic Media*, Journal of the Utah Academy of Sciences, Arts and Letters, 2017. (Also presented in conference April 2017)

Introduction to Digital Circuits, Linus Learning, 2e, 2014

10. Recent Professional Development Activities

2017 Great Teacher's Summit, Heber City, UT

2017 Registrar's Workshop, 2017

1. Name **Christopher P. Trampel**

2. Education

| | | |
|---|---|---|
| PhD | Electrical Engineering | Iowa State University 2012 |
| MS | Electrical Engineering | Michigan State University 2004 |
| BS | Electrical Engineering | Iowa State University 2002 |

3. Academic Experience

| | | | |
|---|---|---|---|
| Weber State University | Assistant Professor, Engineering | 2013 - present | FT |
| Des Moines Area Community College | Adjunct prof., Math | 2007-2013 | PT |

4. Non Academic Experience

| | | |
|---|---|---|
| PowerFilm Solar, Inc., Ames, IA<br>Engineer | 2010 | FT |
| GE Aviation, Cincinnati, OH<br>Engineer | 2008 | FT |

5. Certifications or Professional Registrations None

6. Current Membership in Professional Organizations

| | |
|---|---|
| Institute of Electrical and Electronics Engineers (IEEE) Member | 2014 - present |
| Council on Undergraduate Research Councilor | June 2016 - present |

7. Honors and Awards

American Society for Nondestructive Testing (ASNT)
Outstanding Paper Award 2015

8. Service Activities (within and outside the institution)

Within WSU

Chair of peer review committee for Dr. Justin Jackson Fall 2017.
Chair of peer review committee for Dr. Suketu Naik and Dr. Christian Hearn, Fall 2016
Faculty Testing Advisory Committee Fall 2015-present
EAST diversity committee Fall 2016-present
EAST technology committee Spring 2014-present
EAST curriculum committee Spring 2014-present
Peer review committee member for Dr. Larry Zeng Fall 2013

Outside WSU

Heritage Elementary Science Fair Judge Feb. 12, 2016

9. Publications and Presentations in the Last Five Years

C. Trampel,“The role of hybrid modes in extraordinary optical transmission through a plasmonic nanohole array.” Progress In Electromagnetics Research C, Vol. 78, 145-158, 2017.

C. Trampel, University of Utah, Salt Lake City, UT. Utah RF and Wireless Day, September 13, 2017. Topic: “The Lens-into-the-body.”

C. Trampel, Weber State University, WSU Prep Program, June 12, 2017. Topic: “The Revolution in Life Sciences and Engineering.”

C. Trampel, Utah State University, Logan, UT. Utah RF and Wireless Day, September 16, 2015. Topic: “A Flexible Hyperlens for Microwave Tomography.”

C.P. Trampel and J. R. Bowler, “Eddy current coil interaction with a perfectly conducting wedge of arbitrary angle.” Research in Nondestructive Evaluation, Vol. 25, 186-202, 2014.

C. Trampel, University of Utah, Salt Lake City, UT. Utah RF and Wireless Day, September 16, 2014. Topic: “Theory and Applications of Metasurfaces.”

10. Recent Professional Development Activities

University of Utah, Teaching Flipped (Canvas course) Fall 2014

**Christian Hearn**

**Education:**

| | | | |
|---|---|---|---|
| Ph.D. | Electrical Engineering | Virginia Tech | 2012 |
| M.S. | Electrical Engineering | Virginia Tech | 2001 |
| B.S. | E.E. Technology | Old Dominion University | 1997 |
| B.S. | Mechanical Engineering | Virginia Tech | 1989 |

**Academic experience:**

- Weber State University, *Associate Professor* 2017-present
- Weber State University, *Assistant Professor* 2012-present
- Old Dominion University, *Instructor*, EET 2004-2007
- Virginia Tech, Graduate Teaching Assistant 1997-1999

**Non-Academic experience**:

- Applied EM, Incorporated 2006-2012 PT/FT
  Research Engineer, Antenna Design and Integration
- Nanosonic Ltd – 2003-2004 PT
  Electrical Engineer, Prototype design and development
- Naval Surface Warfare Center – U.E.R.D. 1989-1997 FT
  Mechanical Engineer, ship survivability

**Certifications and professional registration:**

- Professional Engineer – Mechanical, Virginia

**Current Membership in Professional Organization**

- IEEE

**Honors & Awards:**

**Publications & Presentations:**

- Hearn, C.W. and Chiou, F.Y. *IEEE-SME Exam*, *WSU-EET Program Adjustments and Lessons Learned*, ASEE conference for Industry and Education Collaboration (ASEE-CIEC) February 8-10 2017
- Hearn et al, *Data Acquisition in Wireless Router Link Testbed using GNU Radio Companion* GRCON Technical Proceedings Paper 2016
- Hearn, C.W. and Chiou, F.Y., *Collaborating Solar Education with Solar Industry* ASEE conference for Industry and Education Collaboration (ASEE-CIEC) February 3-5 2016
- Hearn, C.W. and Davis, W.A., *FEKO Simulation of a Multi-Resonant Low-Profile PIFA* Applied Computational Electromagnetics Society – Sep/Oct 2015
- Marojevic, Goff, Dietrich, Yang, Hearn, *Wireless Communications Testbed & Tools for Authentic STEM Learning*, 122$^{nd}$ ASEE Conference and Expo, June 14-17, 2015 (paper ID#13504)

- Hearn, C.W. and Davis, W.A. *FEKO Simulation of Multi-Resonant Low-Profile PIFA*, 31st Int'l Review of Progress in Applied Computational Electromagnetics, March 22-26, 2015 Williamsburg, VA
- Hearn, C.W. and Davis, W.A., *Impedance Bandwidth and Q as a Function of Electrical Height for a Planar Inverted-F Antenna*, 29th Int'l Review of Progress in Applied Computational Electromagnetics, March 24-28th, 2013 Monterey, CA
- Hearn, C.W. and Davis, W.A., *Post-Processing FEKO 3-D Pattern Data for Spherical Mode Coefficients*, 28th Int'l Review of Progress in Applied Computational Electromagnetics, April 10-14, 2012 Columbus, OH
- Hearn, C.W. and Davis, W.A., *Post-Processing FEKO 3-D Pattern Data for Coverage Level Comparisons*, 28th Int'l Review of Progress in Applied Computational Electromagnetics, April 10-14, 2012 Columbus, OH
- Hearn, C.W. and Davis, W. A., *CADFEKO Curve Primitive Geometry Functions to Create a Reduced-Drag, Low-Profile Wideband Antenna*, 27th Int'l Review of Progress in Applied Computational Electromagnetics, Mar 27-31, 2011 Williamsburg, VA
- Hearn, C.W. and Davis, W.A., *Near-Field Detuning Characterization for Portable Small Antennas*, URSI/URSI National Radio Science Meeting, Jan 6-8, 2011 Boulder, CO

**Service Activities (within WSU)**

| | |
|---|---|
| • ARCC Committee | 2017-present |
| • WSU- Course Fees Committee | 2017-present |
| • OUR-Office of Undergraduate Research Committee – | 2014-2016 |
| • Science Olympiad | 2014-2017 |
| • Tenure and Faculty Search Committees (EE, EET) | 2013, 2014 |
| • CoAST Technology Committee | 2013-present |
| • Hosted SEI Micro-Hydroelectric Course at WSU | 2013 |

**Professional development:**

- Canvas Training for Instructors – Spring 2014
- Solar Training & Renewable Energy Education – Solar Energy International Course Sequence
    - PV101O: Solar electric Design and Installation (Grid-Direct)- June 2013
    - PV201L : Solar electric Lab-Week (Grid Direct)-July 2013
    - PV203O: Solar Electric Design (Battery-based)- April 2014
- New Faculty Retreat – WSU - August 2013

1. Name **Suketu Naik**

2. Education

| | | | |
|---|---|---|---|
| PhD | Electrical Engineering | Kyoto University | 2011 |
| MS | Electrical Engineering | University of Utah | 2004 |
| BS | Electrical Engineering | Utah State University | 2002 |

3. Academic Experience

Weber State University Asst. Prof., Electrical and Computer Engineering 2014-present

4. Non Academic Experience

| | | |
|---|---|---|
| SPAWAR Systems Center-Pacific, San Diego | 2011-2014 | FT |
| SPAWAR Systems Center-Pacific, San Diego | 2005-2008 | FT |

5. Certifications or Professional Registrations None

6. Current Membership in Professional Organizations

| | |
|---|---|
| Institute of Electrical and Electronics Engineers (IEEE) | 2014 - present |
| American Society for Engineering Education (ASEE) | 2014 - present |

7. Honors and Awards

| | |
|---|---|
| Hemingway Faculty Vitality Award, WSU | 2015 |
| Title II Project Grant, U.S. Forest Service | 2016 |
| Dee Technology Grant, WSU | 2016, 2017 |

8. Service Activities (within and outside the institution)

<u>Within WSU</u>

| | |
|---|---|
| New Faculty Hire Committee | 2016 |
| Textbook Adhoc Committee | 2016-2017 |
| EAST Internationalization Committee | 2016-present |
| Admissions, Standards and Student Affairs (ASSA) Committee | 2016-present |
| ECE Honors Program | 2015-present |
| Integrating Undergraduate Research into the Curriculum (IURC) Committee | 2017-present |

Outside WSU

Council on Undergraduate Research (CUR): Councilor 2016 – present

9. Publications and Presentations in the Last Five Years

S. Naik, V. In, A. Phipps, "Energy Harvesting with Coupled Magnetorestrictive Resonators," Technical Document 2024, Spawar Systems Center-Pacific, Sept. 2013.

A. Ryu, J. Rowland, S. Naik, "An Ultra-Low Power Edge Combining BPSK Transmitter," Technical Document 3271, Spawar Systems Center-Pacific, Sept. 2013.

S. Naik, A. Phipps, V. In, P. Cavaroc, A. Matus-Vargas, A. Palacios, H.G. Gonzalez-Hernandez, "Energy Harvesting with Coupled Magnetostrictive Resonators," Active and Passive Smart Structures and Integrated Systems, Proceedings of SPIE Vol. 9057, 90570W-1 to 90570W-11, March 2014.

A. Matus-Vargas, A. Palacios, H. Gonzalez, V. In, S. Naik, A. Phipps, P. Longhini, "Dynamics, Bifurcations and Normal Forms in Arrays of Magnetostrictive Energy Harvesters with All-to-All Coupling", International Journal of Bifurcation and Chaos, vol. 25, no. 02, 2015.

10. Recent Professional Development Activities

1. Name **Gengsheng Lawrence Zeng (Larry)**

2. Education

| | | | | |
|---|---|---|---|---|
| PhD | Electrical Engineering | University of New Mexico | 1988 |
| MS | Electrical Engineering | University of New Mexico | 1986 |
| BS | Physics | Xiandian University | 1982 |

3. Academic Experience

| | | | |
|---|---|---|---|
| Weber State University | Associate Professor | 2014 - present | FT |
| Weber State University | Assistant Professor | 2013 - 2014 | FT |
| University of Utah | Adjunct Professor | 2013 – 2014 | FT |
| University of Utah | Professor | 2005 - 2013 | FT |
| University of Utah | Associate Professor | 1999 - 2005 | FT |
| University of Utah | Assistant Professor | 1994 - 1999 | FT |
| University of Utah | Instructor | 1991 - 1992 | FT |
| University of Utah | Post Doc | 1989 - 1991 | FT |
| Xidian University | Instructor | 1982 - 1984 | FT |

4. Non Academic Experience None

5. Certifications or Professional Registrations None

6. Current Membership in Professional Organizations
   Fellow, The Institute of Electrical and Electronic Engineers (IEEE) 1988 - present

7. Honors and Awards none

8. Service Activities (within and outside the institution)

   WSU

   College of EAST Promotion and Tenure Committee 2015 — present
   College of EAST Hearing Committee 2013 – present

   University of Utah

   University of Utah Teaching Committee 2012 —2013
   University of Utah Policy Committee 2009 —2011
   University of Utah Technology Review Board 2005 — 2009
   niversity of Utah Credits and Admissions Committee 2004 — 2007
   University of Utah University Diversity Committee 2004 — 2006
   University of Utah School of Medicine Admissions Committee 1999 — 2004, 2012 —2013

   National and International

   ABET Program Evaluator (representing IEEE) 2015 – present
   IEEE Nuclear and Medical Imaging Sciences Council 2001–2003, 2012–2014, 2017 – present

IEEE Medical Imaging Conference Awards Committee 2003-2004
IEEE NMISC Awards committee 2010

## 9. Peer-Reviewed Publications in the Last Five Years

1. *Zeng GL, Li Y, and DiBella ERV: Non-iterative reconstruction with a prior for undersampled radial MRI data, Int. J. Imag. Sys. Tech., vol. 23, pp. 53-58, 2013, PMID:* 25520543, **PMCID: PMC4266489**
2. Zeng GL and Gullberg GT: On the bias of finite-view interior tomography using piecewise-constant and non-negativity constraints. *Phys. Med. Biol*., vol. 58, pp. L13-L16, 2013 [Featured Article], PMID: 23380877, **PMCID: PMC3584581**
3. Zeng GL and Zamyatin A: A filtered backprojection algorithm with ray-by-ray noise weighting, *Med. Phys.*, vol. 40, 031113; http://dx.doi.org/10.1118/1.4790696 (7 pages), Online Publication Date: 28 February 2013, PMID: 23464293, **PMCID: PMC5148087**
4. Zeng GL, Li Y and Zamyatin A: Iterative total-variation reconstruction vs. weighted filtered-backprojection reconstruction with edge-preserving filtering, *Phys. Med. Biol.,* vol. 58, pp. 3413-3431, 2013, PMID: 23618896, **PMCID: PMC4247166**
5. Mao Y and Zeng GL: Tailored ML-EM algorithm for reconstruction of truncated projection data using few view angles, *Phys. Med. Biol.,* vol. 58, pp. N157-N169, 2013, PMID: 23689102, **PMCID: PMC3745016**
6. Hernandez AM, Huber JS, Murphy ST, Janabi M, Zeng GL, Brennan1 KM, O'Neil JP, Seo Y, and Gullberg GT: Longitudinal evaluation of left ventricular substrate metabolism, perfusion and dysfunction in the SHR model of hypertrophy using microPET/CT imaging, *J. Nuc. Med*., vol. 54, no. 11, pp. 1938-1945, 2013, PMID: 24092939, PMCID: PMC4000452
7. Zeng GL: Comparison of a noise-weighted filtered backprojection algorithm with the standard MLEM algorithm for Poisson noise, *J. Nucl. Med. Tech*., vol. 41, no. 4, pp. 283-288, 2013, PMID: 24159012, **PMCID: PMC4243832**
8. Zeng GL: Revisit of combined parallel-beam/cone-beam or fan-beam/cone-beam imaging, *Med. Phys*., vol. 40, pp. 100701.1-100701.5, 2013, PMID: 24089888, **PMCID: PMC3785539**
9. Zeng GL: One-angle fluorescence tomography with in-and-out motion, *Journal of Electronic Imaging*, vol. 22(4), 043018, 2013, PMID: 25520544, **PMCID: PMC4266511**
10. Feng B and Zeng GL: Modeling of pixelated detector in SPECT pinhole reconstruction, *IEEE Trans. Nucl. Sci*., vol. 61, no. 2, pp. 888-893, 2014, PMID: 25574058, **PMCID: PMC4285383**
11. Zeng GL: Model-based filtered backprojection algorithm: A tutorial, *Biomedical Engineering Letters*, (http://link.springer.com/article/10.1007/s13534-014-0121-7), vol. 4, Issue 1, pp. 3-18, March 2014. PMID: 25574421, **PMCID: PMC4285391**
12. Zeng GL: Noise-weighted spatial domain FBP algorithm, *Med. Phys*. (http://scitation.aip.org/content/aapm/journal/medphys/41/5/10.1118/1.4870989), vol. 41, 051906, 2014, PMID: 24784385, **PMCID: PMC4000392**
13. Zeng GL: Comparison of FBP and iterative algorithms with non-uniform angular sampling, *IEEE Trans. Nucl. Sci*., vol. 62, no. 1, pp.120-130, 2015, PMID: 25678716, **PMCID: PMC4323100**
14. Zeng GL: Revisit of the ramp filter, *IEEE Trans. Nucl. Sci*., vol. 62, no. 1, pp.131-136, 2015, PMID: 25729091, **PMCID: PMC4341983**
13. Zeng GL: On few-view tomography and staircase artifacts, *IEEE Trans. Nucl. Sci*., vol. 62, no. 3, pp. 851-858, 2015.
15. Zeng GL: Fan-beam short-scan FBP algorithm is not exact, *Phys. Med. Biol*., vol. 60, N131-N139, 2015, PMID: 25802974, PMCID: PMC5297440
16. Mao Y, Yu Z and Zeng GL: Geometric calibration and image reconstruction for segmented-slant-hole stationary cardiac SPECT system, *J. Nucl. Med. Tech.*, vol. 43, pp. 103-112, 2015, PMID: 25956691, PMCID: PMC5297456
17. Zeng GL and Li Y: A discrete convolution kernel for no-DC MRI, *Inverse Problems*, vol. 31, 085006, 2015.
18. Mao Y, Yu Z and Zeng GL: Segmented slant hole collimator for stationary cardiac SPECT: Monte Carlo simulations, *Med. Phys.*, vol. 32, pp. 5426-5434, 2015, PMID: 26328991, PMCID: PMC4545103
142. Zeng GL: The ML-EM algorithm is not optimal for Poisson noise, *IEEE Trans. Nucl. Sci*., vol. 62, pp. 2096-2101, 2015.

19. Zeng GL and Divkovic Z: An extended Bayesian-FBP algorithm, *IEEE Trans. Nucl. Sci*., vol. 63, pp. 151-156, 2016, PMID: 27041768, **PMCID: PMC4813811**
20. Zeng GL: Noise-weighted FBP algorithm for uniformly attenuated SPECT projections, *IEEE Trans. Nucl. Sci.*, vol. 63, pp. 1435-1439, 2016, PMID:27840452, **PMCID: PMC5102335**
21. Zeng GL and Wang W: Noise weighting with an exponent for transmission CT, *Biomedical Physics & Engineering Express*, vol. 2, no. 045004, 2016
22. Zeng GL: Does Noise Weighting Matter? *IEEE Transactions on Radiation and Plasma Medical Sciences*, vol. 1, pp. 68-75, 2017.
23. Zeng GL: A fast method to emulate an iterative POCS image reconstruction algorithm, *Med. Phys*. (in press) 2017.
24. Zeng GL and Li Y: Fourier-domain analysis of the iterative Landweber algorithm, *IEEE Transactions on Radiation and Plasma Medical Sciences*. In press, 2017.

1. Name **Dhanya Nair**

2. Education

| | | |
|---|---|---|
| PhD | Electrical Engineering | Texas Tech University 2013 |
| MS | Electrical Engineering | Texas Tech University 2009 |
| BTech | Electronics and Communication | Cochin University of Science and Technology, India, 2006 |

3. Academic Experience

| | | | |
|---|---|---|---|
| Weber State University | Assistant Professor | 2016 - present | FT |
| Texas Tech University | Graduate Instructor | 2011 - 2013 | PT |

4. Non Academic Experience

| | | |
|---|---|---|
| Blast Motion Inc.<br>Consulting Engineer/ Fault Isolation Engineer | 2014-2015 | PT |
| Intel Corporation, Hillsboro, Oregon<br>Process Engineer/Yield Analysis Engineer | 2013 -2014 | FT |

5. Certifications or Professional Registrations

NI Certified LabVIEW Associate Developer (CLAD) 2011

6. Current Membership in Professional Organizations

Institute of Electrical and Electronics Engineers 2016 - present

7. Honors and Awards None

8. Service Activities (within and outside the institution)

<u>Within WSU</u>

| | |
|---|---|
| College Curriculum Committee | 2017 – present |
| SWE Advisor | 2016 – present |
| Faculty Peer Review Committee | 2016 |
| MS CE Review Committee | 2017 |
| SheTech Explorer Day Workshop Developer | 2017 |
| Parent-Daughter Engineering Day Committee | 2017 |

<u>Outside WSU</u>

| | |
|---|---|
| FIRST Lego League Judge | 2017– 2018 |
| Eurohaptics Conference Reviewer | 2018 |

| | |
|---|---|
| IEEE conference on Virtual Reality Reviewer | 2018 |
| IEEE conference on Human Robot Interaction Reviewer | 2018 |
| International Conference of the Learning Sciences Reviewer | 2018 |
| Information Processing in Computer Assisted Interventions Conference Reviewer | 2018 |

9. Publications and Presentations in the Last Five Years

S. Naik and D. Nair, "Coupled Piezoelectric Actuators for the Tactile Display", International Symposium on Nonlinear Theory and its Applications (NOLTA), Cancun, Mexico, Dec. 2017

D. Nair, R. Gale, T. Karp., "Total Ionizing Dose Effects on Data Retention Capabilities of Battery-Backed CMOS SRAM", IEEE Transactions on Nuclear Science, May 2013

10. Recent Professional Development Activities

| | | |
|---|---|---|
| CSUN Assistive Technology Conference | San Diego, CA | 2017 |
| IEEE Haptics Symposium | San Francisco, CA | 2018 |

**APPENDIX C – EQUIPMENT**

| Equipment | Qty. |
|---|---|
| Tektronix Oscilloscope | 45 |
| Tektronix Mixed Signal Oscilloscope | 1 |
| Tektronix Arbitrary Waveform Generator | 32 |
| BK Power Supply | 22 |
| Instek Function Generator | 11 |
| Fluke Digital Multimeter | 7 |
| Agilent Digital Multimeter | 10 |
| EZ Digital Multimeter | 2 |
| LG Digital Multimeter | 15 |
| Shexhen Mastech Power Supply | 12 |
| Rigol Power Supply | 12 |
| Rigol Digital Multimeter | 12 |
| National Instruments ELVIS Training Board | 8 |
| Hamden Power Station | 5 |
| Tektronix 64 Channel Logic Analyzer | 2 |
| GAL/PAL Device Programmer | 4 |
| Spectrum Analyzer | 4 |
| LC Bridge | 3 |
| Instrument Calibrator | 1 |
| Network/Spectrum/Impedence/Analyzer | 2 |
| TIMMS Telecommunications Station | 1 |
| Heat Flow Oven | 1 |
| Pick and Place Station | 1 |
| Video Enable Microscope Station | 1 |
| | |

## APPENDIX D – INSTITUTIONAL SUMMARY

### 1. The Institution

a. Name and address of the institution

Weber State University
3750 Harrison Blvd.
Ogden, Utah 84408

b. Name and title of the chief executive officer of the institution

Norm Tarbox, Interim President
Weber State University
Mail Code 1001
Ogden, Utah 84408-1001

c. Name and title of the person submitting the self-study report

David Ferro, Dean
College of Engineering, Applied Science & Technology
Weber State University
Mail Code 1801
Ogden, Utah 84408-1801

d. Name of the organization by which the institution is now accredited and the dates of the initial and most recent accreditation evaluations

Northwest Commission on Colleges and Universities (NCCU)

Date of initial accreditation: 1932
Date of last accreditation: 2015

### 2. Type of Control

Weber State University is controlled by the State of Utah through the Utah State Board of Regents, the higher education arm of the Utah Legislature.

### 3. Educational Unit

The Electrical Engineering Program is housed within the Department of Engineering, which offers five academic degrees:

1. BS Electrical Engineering
2. MS Electrical Engineering
3. BS Computer Engineering
4. MS Computer Engineering
5. Associates of Pre-Engineering

The Department of Engineering is one of six academic departments in the College of Engineering, Applied Science & Technology (EAST). The dean of the College reports to the Provost, who reports to the President of WSU. Figure D-1 is the organizational chart of the local educational unit. Figure D-2 is the organizational chart of Weber State University.

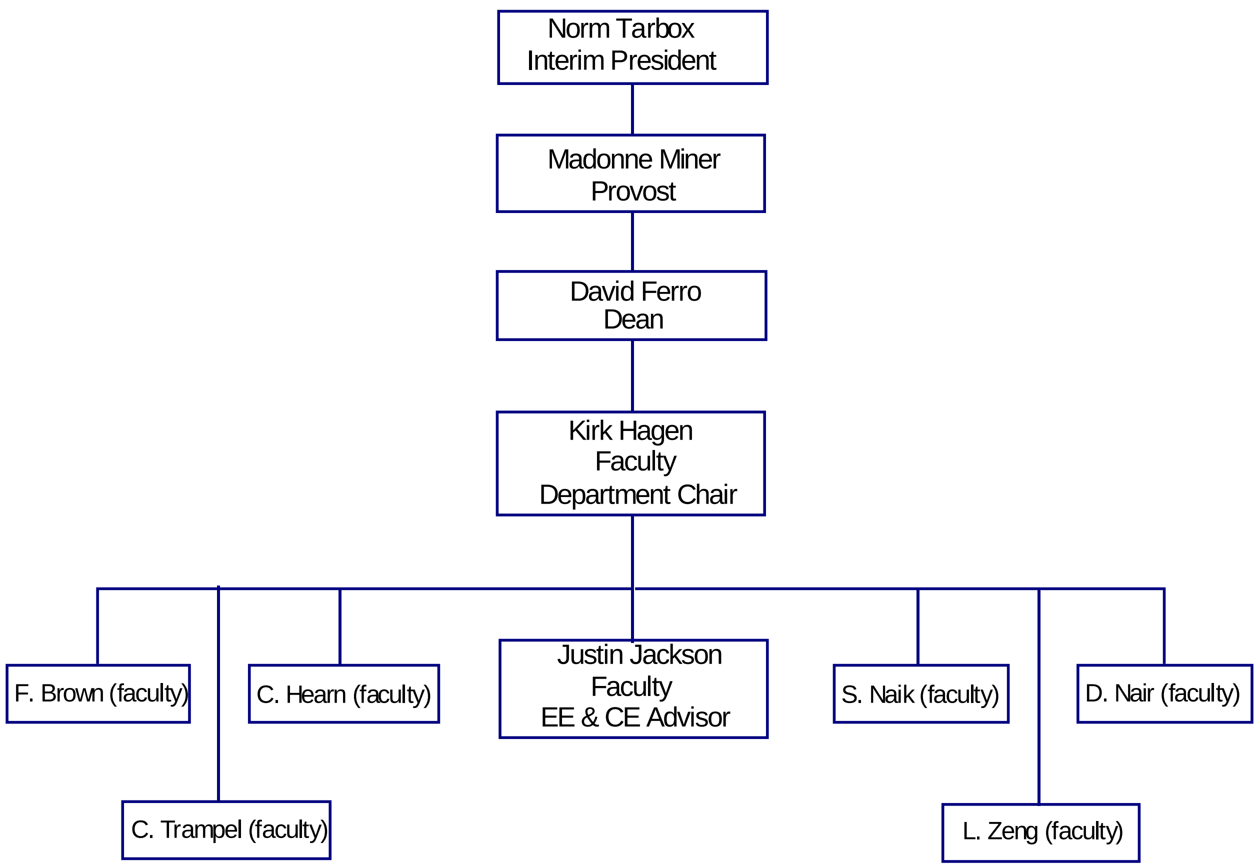



**Figure D-1. Local educational unit organizational chart.**

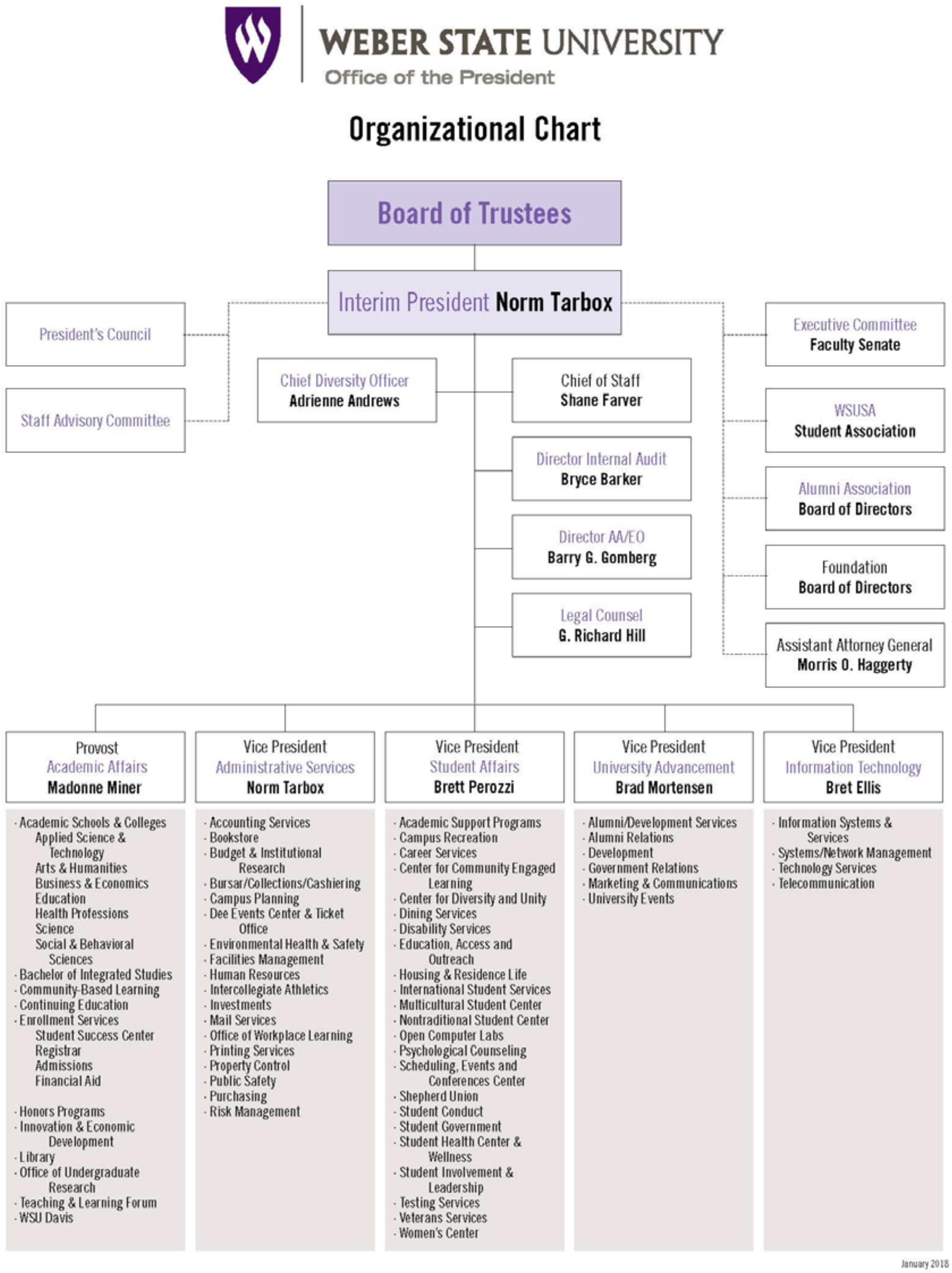



**Figure D-2. WSU Division of Academic Affairs organizational chart.**

## 4. Academic Support Units

Names and titles of individuals responsible for each of the units that teach courses required by the program.

Kirk Hagen, Professor, Chair, Department of Engineering
Paul Talaga, Professor, Chair, Department of Mathematics
Colin Inglefield, Professor, Chair, Department of Physics
Laine Berghout, Professor, Chair, Department of Chemistry
Brian Rague, Professor, Chair, School of Computing

## 5. Non-Academic Support Units

Names and titles of individuals responsible for each of the units that provide non-academic support to the program.

Inside EAST:

| | |
|---|---|
| Susan Foss | Department of Engineering Administrative Assistant |
| Gina Naisbitt | Executive Assistant to the Dean |
| Kimberly Ealy | Career Advisor |
| Rainie Ingram | General Ed. Advisor and Recruitment/STEM Director |
| Dana Dellinger | Outreach Director |
| Brad Naisbitt | IT Manager |
| Kelly Stackaruk | Development Director |

Outside EAST

| | |
|---|---|
| Wendy Holliday | Dean of the Library |
| Jeffrey Hurst | Dean of Students |
| Jed Spencer | Director, Financial Aid & Scholarships |
| Casey Bullock | University Registrar |

## 6. Credit Unit

Weber State University is on the semester system. One credit hour represents one class hour or three laboratory hours per week. Each semester consists of approximately 14 weeks of instruction plus three or four additional days for final examinations. The fall, spring and summer semesters are of equal duration.

## 7. Tables

Table D-1 contains program enrollment and degree data, and Table D-2 contains personnel data.

**Table D-1. Program enrollment and degree data: Electrical Engineering**

| | | Enrollment Year | | | | | Total Undergrad | Total grad | Degrees Awarded | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Academic Year | Full time/ Part time | 1st | 2nd | 3rd | 4th | 5th | | | Associates | Bachelors | Masters | Doctorates |
| 2017 – 2018 | FT | 41 | 23 | 22 | 60 | | 146 | 0 | 0 | 25 | 0 | 0 |
| | PT | 12 | 10 | 6 | 32 | | 60 | 0 | 0 | | | |
| 2016 – 2017 | FT | 32 | 23 | 30 | 58 | | 143 | 0 | 0 | 32 | 0 | 0 |
| | PT | 17 | 10 | 15 | 34 | | 76 | 0 | 0 | | | |
| 2015 – 2016 | FT | 30 | 16 | 25 | 61 | | 132 | 0 | 0 | 22 | 0 | 0 |
| | PT | 19 | 8 | 11 | 28 | | 66 | 0 | 0 | | | |
| 2014 – 2015 | FT | 27 | 13 | 24 | 55 | | 119 | 0 | 0 | 21 | 0 | 0 |
| | PT | 17 | 13 | 15 | 23 | | 68 | 0 | 0 | | | |
| 2013 – 2014 | FT | 20 | 19 | 24 | 39 | | 102 | 0 | 0 | 11 | 0 | 0 |
| | PT | 6 | 14 | 12 | 23 | | 55 | 0 | 0 | | | |

Give official fall term enrollment figures (head count) for the current and preceding four academic years and undergraduate and graduate degrees conferred during each of those years. The "current" year means the academic year preceding the fall visit.

FT = full time

PT = part time

## Table D-2. Personnel: Electrical Engineering

Semester/Year[1]: Fall/2017

| | Head Count | | FTE[2] |
|---|---|---|---|
| | Full Time | Part Time | |
| Administrative[2] | 0.5 | 0 | 0.5 |
| Faculty (tenure-track)[3] | 7.5 | 0 | 7.5 |
| Other Faculty (excluding student assistants) | 0 | 0.7 | 0.7[5] |
| Student Teaching Assistants[4] | 0 | 0 | 0 |
| Student Research Assistants | 0 | 0 | 0 |
| Technicians/Specialists | 0.1 | 0 | 0.1 |
| Office/Clerical Employees | 0.7 | 0 | 0.7 |
| Others[5] | 0 | 0 | 0 |

1. Data in this table should be for the fall term immediately preceding the visit. Updated tables for the fall term when the ABET team is visiting are to be prepared and presented to the team when they arrive.

2. Persons holding joint administrative/faculty positions or other combined assignments should be allocated to each category according to the fraction of the appointment assigned to that category.

3. For faculty members, 1 FTE equals what your institution defines as a full-time load.

4. For student teaching assistants, 1 FTE equals 20 hours per week of work (or service). For undergraduate and graduate students, 1 FTE equals 15 semester credit hours (or 24 quarter hours) per term of institutional course work, meaning all courses–science, humanities and social sciences, etc. For faculty members, 1 FTE equals what your institution defines as a full-time load.

5. Specify any other category considered appropriate, or leave blank. (Adjunct instructors)

# APPENDIX E.  GRADUATE SURVEY

WEBER STATE UNIVERSITY

**Electrical Engineering**

**Graduate Survey**

***This survey is to be administered to senior EE students just prior to graduation.***

***The information gathered by this survey is for ABET accreditation purposes only and will not be publicly disclosed.***

Today's Date _______________

Graduation Date _______________

The WSU Electrical Engineering program is accredited by the Engineering Accreditation Council (EAC) of ABET. ABET requires engineering programs to assess 11 student learning outcomes.

Please answer the following question for each outcome:

***The WSU Electrical Engineering program prepared you to achieve the following outcomes:***

**a. An ability to apply knowledge of mathematics, science and engineering.**

strongly agree ___ agree ___ neither agree nor disagree ___ disagree ___ strongly disagree ___

**b. An ability to design and conduct experiments, as well as to analyze and interpret data.**

strongly agree ___ agree ___ neither agree nor disagree ___ disagree ___ strongly disagree ___

**c. An ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability and sustainability.**

strongly agree ___ agree ___ neither agree nor disagree ___ disagree ___ strongly disagree ___

**d. An ability to function on multidisciplinary teams.**

strongly agree ___ agree ___ neither agree nor disagree ___ disagree ___ strongly disagree ___

**e. An ability to identify, formulate and solve engineering problems.**

strongly agree ___ agree ___ neither agree nor disagree ___ disagree ___ strongly disagree ___

**f. An understanding of professional and ethical responsibility.**

strongly agree ___ agree ___ neither agree nor disagree ___ disagree ___ strongly disagree ___

**g. An ability to communicate effectively.**

strongly agree ___ agree ___ neither agree nor disagree ___ disagree ___ strongly disagree ___

**h. The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental and social context.**

strongly agree ___ agree ___ neither agree nor disagree ___ disagree ___ strongly disagree ___

**i. A recognition of the need for, and an ability to engage in, life-long learning.**

strongly agree ___ agree ___ neither agree nor disagree ___ disagree ___ strongly disagree ___

**j. A knowledge of contemporary issues.**

strongly agree ___ agree ___ neither agree nor disagree ___ disagree ___ strongly disagree ___

**k. An ability to use the techniques, skills and modern engineering tools necessary for engineering practice.**

strongly agree ___ agree ___ neither agree nor disagree ___ disagree ___ strongly disagree ___

What are the strengths of the WSU Electrical Engineering program?

What are the weaknesses of the WSU Electrical Engineering Program?

What changes would you recommend for the WSU Electrical Engineering program?

Thank you!

Rev: Nov. 2015

## APPENDIX F. INTERNSHIP EMPLOYER SURVEY

**Confidential**

WEBER STATE UNIVERSITY

# Internship Employer Survey

**Electrical Engineering**

Instructions to employer

The purpose of this survey is to provide the Electrical Engineering faculty at Weber State University an employer's evaluation of student interns. **This survey is to be completed by the employer, not the intern.** Please answer the questions to the best of your knowledge. The results of this survey and the intern's self-assessment will be used to issue a grade to the student for ECE 3890 Internship. In addition, the results of the survey will be used as part of the assessment process of the WSU EE program for ABET accreditation.

Date ____________

Name of intern ____________________________________________

Intern's work period: Start date __________ End date __________

Approximate total number of hours worked by the intern __________

Supervisor or manager of intern:

Name __________________________________________ Phone ________________________

Email __________________________________________

1. Briefly describe the primary duties and responsibilities of the intern. Use additional sheets if needed.

A.

B.

C.

D.

2. The intern set goals at the beginning of the internship and reported them to the ECE 3890 instructor. To the best of your knowledge, did the intern accomplish these goals?

   Yes ___ No ___ Comments ________________________________________________

3. The intern performed his/her duties on schedule.

   Strongly agree Agree Neutral Disagree Strongly disagree

   Comments ________________________________________________

4. The intern reported to work on time.

   Strongly agree Agree Neutral Disagree Strongly disagree

   Comments ________________________________________________

5. The intern demonstrated professionalism and ethical behavior.

   Strongly agree Agree Neutral Disagree Strongly disagree

   Comments ________________________________________________

6. The intern demonstrated an ability to learn new concepts, skills, procedures, policies, etc. that are pertinent to the job.

   Strongly agree Agree Neutral Disagree Strongly disagree

   Comments ________________________________________________

7. The intern was an effective communicator.

   Strongly agree Agree Neutral Disagree Strongly disagree

   Comments ________________________________________________

8. Overall, I am satisfied with the performance of the intern.

   Strongly agree Agree Neutral Disagree Strongly disagree

   Comments ________________________________________________

9. If there was a full-time engineering position open at my company, I would hire this intern.

   Strongly agree Agree Neutral Disagree Strongly disagree

   Comments ________________________________________________

10. If you were to issue a letter grade to the intern for his/her work, what would it be?

    A A− B+ B B− C+ C Fail

Comments ________________________________________________________________

If you wish to provide further feedback or suggestions, please use additional sheets.

Thank you for completing this survey.

## APPENDIX G.  TPS FORMS

Weber State University Department of Engineering

# INSTRUCTOR-INITIATED COURSE IMPROVEMENT RECORD

This form is used to document instructor-initiated course improvements. It is required for all improvements triggered by performance indicator (PI) scores of 2 or less, but it may also be used to document course improvements regardless of motivation or PI score. Part I of the form should be submitted to the department chair when a course improvement plan has been adopted, and the completed form should be resubmitted after the plan has been implemented.

## PART I – ACTION PLAN

Course Number ________ Course Name______________________________________________________

Instructor_________________________________

What was the motivation for the improvement(s)? (If the improvement was motivated by an assessment instrument, name the instrument, semester of assessment, performance indicator, and/or score.)

Describe the improvement(s) planned or made to the course.

## PART II - IMPLEMENTATION

Year and semester course improvement(s) were implemented _________________

Comment on the efficacy of the improvement.

Weber State University Department of Engineering

# CURRICULUM IMPROVEMENT RECORD

This form is used to document program improvements initiated by the department faculty. It is required for addition of new courses, deletion of existing courses, or changes in program requirements, tracks, certificates or emphases. The form should be completed by the department chair or delegate after the improvement(s) are implemented.

## PART I – ACTION PLAN

Program(s) Affected ____________________________________

What was the motivation for the improvement(s)? (If an improvement was motivated by an assessment instrument, name the instrument, semester of assessment, performance indicator, and/or score.)
*General education changes. Benchmarking of competitor EE/CE programs.*

Describe the improvement(s) planned or made to the program(s).

## PART II - IMPLEMENTATION

Year and semester program improvement(s) were implemented _______________, _______________

Comment on the efficacy of the improvement.