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Developing an Electrical Engineering Program

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Abstract

The Department of Engineering and Design (E&D) within the School of Computing and Engineering Sciences at Eastern Washington University (EWU) is developing a new Electrical Engineering (EE) degree program that will prepare professional engineers to adapt quickly to new technologies and knowledge. Coursework, faculty, community, and industry partners will engage students in the fundamentals of critical thinking, communication, and teamwork. The program emphasizes the best of engineering theory, professional practice, cutting-edge software, design, and manufacturing processes while utilizing instructional methods in the way people learn best. The result will be highly capable engineering professionals with both theoretical and active knowledge of engineering.

The EE program is organized around an "experience-based learning" approach that gives equal importance and attention to service learning as well as industrial collaboration. Providing students with the necessary fundamentals to be able to solve technical problems both in industry and society will drive the curriculum.

A recruiting and retention plan is also being developed as part of the new curriculum design. The development of this plan is considered to be a crucial and fundamental component of the overall EE program. One of the biggest concerns is the recruitment and retention of underrepresented groups in the engineering field.

This paper describes the planning and development of the new Electrical Engineering program at EWU including the significance, infrastructure, goals, objectives, laboratory needs, program requirements, and curriculum.

Introduction

The EE program was conceived on the basis of three factors: industrial demand within the region and state, the small number of qualified graduates available to enter the workforce, and the increasing pool of potential students. Currently there is no additional capacity in the existing EE programs offered by The University of Washington and Washington State University. As a result, the 2003 Washington State Legislature approved and Governor Locke signed into law

EHB 1808, which provides the opportunity for all state universities to offer Electrical Engineering programs. Eastern is the first regional comprehensive university in the State to pursue and develop an EE degree program.

Graduates will earn a Bachelor of Science in EE, and will enter the workforce as electrical engineers, systems engineers, project engineers, digital engineers and computer engineers. Graduates will also be prepared for positions in management through courses in engineering management and economics principles. The EE program is designed in line with the Engineering Accreditation Commission of the Accreditation Board for Engineering and Technology (EAC of ABET) program guidelines. Graduates of this type of program are currently in great demand and obtain jobs with industry, engineering firms, consulting agencies, governmental agencies, and manufacturing facilities where they work to design, develop, and implement military, industrial and consumer products.

Background and Infrastructure

The instruction offered at large research institutions is suited to many students who are recruited from national and international venues. However, such programs are often not compatible with those served by schools like Eastern Washington University. As a regional comprehensive institution, Eastern has a mission to reach local and regional populations often low-income, first-generation college students. They respond best to individualized instruction, experiential opportunities, service learning, and additional support services for review of important math and science courses. Often, large research institutions lack the time and capacity to offer the individualized attention and integrated learning that smaller programs, like Eastern's, can.

Current research suggests that a program like Eastern's is a logical approach to teaching engineering, both in fostering qualities professionals need and in recruiting and retaining students into the field. Professionals need to learn new engineering knowledge quickly, work in teams, solve problems creatively, communicate, and respect diversity [1]. Keys to recruiting and retaining engineering students include: engaging them early through courses that articulate and integrate the relevance of engineering to early requirements such as math, physics, design, communication, humanities, and other requirements [2] using active learning so they can apply theory and practice [3, 4], and help foster a sense of community and communication with instructors [5].

In 2000, Eastern began the Technology Initiative for the New Economy, designed to help address current workforce needs, particularly as they applied to the regional technology sector, through excellent student learning, recruitment, and retention. To that end, faculty in the College of Science, Mathematics and Technology reorganized and redeveloped the Departments of Engineering and Design (E&D), Computer Science, and Physics. The faculty of these departments united within a new academic unit named the School of Computing and Engineering Sciences (SCES) where interdependent programs can focus on student learning within the context of the ever-increasing demand for technology connected degrees. Realizing the benefit of a new academic unit at Eastern, the Washington State legislature funded the design and construction of a new state-of-the-art building to house the School and its programs. In light of the changes in the State law, the building has been designed to include laboratories that support curriculum for an EE degree.

The SCES facility is now under construction, with anticipated completion in late spring 2005. The facility will include 15 classrooms (three of which will be wired for distance education) and 21 laboratories, more than doubling the usable space now available for students in high-technology disciplines. With more space (93,000 gross square feet and 60,000 assignable square feet), Eastern can serve 51% more students in the E&D Department, while relieving space to increase enrollment in foundation programs (computer science and physics) in other buildings. The new facility was designed to accommodate students and faculty based on projections for enrollment at least eight years into the future. Laboratories will be furnished with the latest equipment and software, thanks in part to industry partners, helping students understand how to use these technologies as professionals. Specialized labs and equipment will also aid faculty in their research and foster further industrial partnerships, with the goal of developing new technologies and new applications for both current and new applications.

The SCES facility itself is a living laboratory for engineering students and faculty, designed with monitors and controls throughout. HVAC, refrigeration equipment, building network equipment, building structural steel, atmospheric conditions in and out of the building, and system controls such as temperature and security monitoring will be instrumented to provide readings on stress and strain, power factor, heat loads, equipment efficiency, network statistics, and electrical load.

Significance of the Electrical Engineering Program

The significance of the Eastern E&D Department's EE Program derives from three interrelated elements:

- A special niche (in Washington State a high industrial demand for graduates, a small number of EE graduates, and an increasing pool of potential students) exists for employment of EE graduates in Washington State.
- A best-practices approach integrating "experience-based learning," defined as both service learning and industry collaboration, throughout the curriculum will be used and will serve as the cornerstone of the program.
- The program will invite participation from a broad cross section of the communities Eastern serves, creating an opportunity to improve both workforce diversity and the number of individuals pursuing an education, and provides a model that can be replicated in other universities.

Experience-Based Learning as a Best Practices Approach

To retain and engage students, teachers must provide an avenue for innovation and creativity. Traditional lectures in science and engineering education results in a passive form of learning and may not be the most efficient for student education [3, 4]. Constructivists, however, assert that learning is "constructed" in the learner's mind through experiences [6]. Practical/industrial projects elevate student interest. Thus, focusing less on lectures and more on increasing active student involvement through teamwork, cooperative learning, and use of current practical projects should be an engineering education priority. These concepts encouraged Eastern's E&D

Department to focus on experienced-based learning not only in introductory courses, but throughout the curriculum.

The EE program is organized around an "experience-based learning" approach that gives equal importance and attention to service learning as well as industrial collaboration. This approach provides students with the necessary fundamentals to be able to solve technical problems both in industry and society will drive the curriculum. Current pedagogical evidence shows that community involvement is important both in the technical and civic aspects of the curriculum.

While service-learning programs are in place throughout the country, the vast majority are related to non-technical disciplines. However, the few active technical service-learning activities tend to focus on only one course [7, 8, 9] and one project in the engineering or engineering technology curriculum. Typically this design experience occurs only during the freshman year, leaving the remaining three years of study without any service-learning activities. One exception is the long-term, large-scale, team-based, multidisciplinary undergraduate engineering design program at Purdue University [10] called EPIC (Engineering Projects In Community Service). Thus, Eastern's EE Program is unique by incorporating service-learning projects into a majority of the required courses, not just one or two. As a result, students will be exposed to and become active participants in community service during their entire course of study. In addition, Eastern's plan limits activities to projects that can be successfully completed during a one or two quarter course sequence. In addition, they could be effectively handed off to other students in a subsequent related course, thus allowing students to encounter and complete multiple service-learning experiences, resulting in a richer education.

In this program, service learning will involve designing and implementing projects and solutions for a given community and for the public good. Students will be expected to address both the technical and the human aspects of the problem. Public costs versus benefits must be determined and weighed requiring students to think critically about the community and their professional philosophies. Students will also critique and evaluate what aspects of the project were difficult and why, what aspects of the project they were unprepared for, and how the project related to their coursework and career goals.

The trend in engineering education is converging technological education and liberal arts education [1]. This article further states that students need to "be prepared for a life in a world where technological, scientific, humanistic, and social issues are all mixed together." Eastern's Vision 2010 calls for "convergence" of scientific and liberal arts education. Placing the EE program in this type of educational environment, coupled with wide use of service learning and industrial collaboration, will greatly enhance student learning.

Development

The curriculum developed for the new EE program is based on a series of existing lower division prerequisite courses in mathematics, English, physics, chemistry, and general education requirements. At the upper division, the curriculum includes both new courses designed and existing courses revised to incorporate experience-based learning.

During the development phase of the EE program, there are four major objectives:

Objective 1. Create and implement an experience-based learning model.
Objective 2. Establish a recruitment/retention infrastructure.
Objective 3. Develop and implement the EE program curriculum.
Objective 4. Upgrade existing laboratories and provide new laboratory instrumentation.

Objective 1. Create and Implement an Experience-Based Learning Model
The E&D Department surveyed current programs offering a service learning or and industrial experience in the curriculum. The evaluation and synthesis of survey information validated Eastern's proposed EE coursework and is guiding the development of curriculum and laboratories. New and updated learning strategies and problem-solving techniques are integrated into the curriculum. Brief descriptions of these include the following.

Direct involvement of industry. Industrial representatives will be given the opportunity to provide input into curriculum and laboratory refinements and identify current skill sets required in the EE work environment through the advisory broad. These relationships have helped identify a series of industry related problems that exemplify current and cutting-edge trends and related workforce preparation needs that can be addressed in the classroom.

Team-based learning. Current trends in the field of technology indicate that team based projects are increasingly more beneficial to the learning experience than individual ones. Because electrical engineers often work as a member of a team in their profession, especially when engineering processes interface with hardware and software processes, the department will pilot multi-disciplinary, problem-oriented team projects. This approach will allow students from different programs and departments to work together on projects that simulate real working environment scenarios. Group projects and assignments will be stressed throughout the program, which will culminate with a team senior project and a capstone design class.

Assign industry/service problems to students. Industry and community partners can request that EE classes (faculty and students) tackle real problems on their behalf. Regional technology companies, non-profit organizations, government agencies, and start up non-technical businesses can propose projects or assignments with an expected outcome to the E&D Department. Faculty will evaluate the proposal for compatibility with the curriculum, ensuring it provides problem-solving approach to learning, and for its potential for a favorable outcome within a reasonable timeframe for students. If a proposal is accepted, a representative from the company or organization must commit time to the project at the university, serve as a mentor, member of the advisory board, or guest lecturer, oversee an internship, or participate in some other role that contributes to the EE program. These assignments are expected to encompass a wide variety of industry-related theoretical and practical problems. A sample project is a card reader system for student access to information-sensitive university offices, classes and laboratories. A team of students, either from one class or from a variety of classes and backgrounds, would work together to design, implement, and test the system. After testing, a small quantity "mass-production" system would be implemented. The end product would be donated to the community partner.

Table 1 lists a sample of the courses that will incorporate experience-based learning projects.

Table 1. Courses that will incorporate experience-based learning

Class Name	New Experience-based Projects
Digital Circuits I (ENGR 160)	• Score board design for school district in Cheney, WA. • Message display board design for public buildings.
Freshman Design (ENGR 197)	• Design of parking lot layout for new construction. • Website development for non-profit organizations and local communities (i.e. recycling centers, childcare centers, museums).
Circuits I/II (ENGR 209/210)	• Design of intrusion detection and alarm systems for university buildings. • Expansion of traffic light system for City of Cheney.
Digital Circuits II (ENGR 250)	• Improvement and implementation of systems designed in Digital Circuits I.
Microprocessors (ENGR 260)	• Design a microprocessor-based router switching system. • Card reader access security system for campus and public buildings. • Card reader system for parking meter payment.
Programming Principles I/II (CSCD 225/205/226)	• Source code security analysis, to eliminate potential security vulnerabilities at source code levels, as used in industry.
Signals and Systems I/II (ENGR 320/321)	• CO_2 meter and decibel meter design for public buildings. • Improvement and design of automatic door with motion sensor for public buildings.
Electronics I/II (ENGR 330/331)	• Improvement and implementation of systems designed in Circuits I and II. • Signal amplifier (or repeater) design for networks in Cheney.
Energy Systems and Electromagnetism (ENGR 350/PHYS 401)	• DC/AC motor driver design for wheelchairs. • Variable voltage transformer design for labs in the Cheney school district.
Control Systems (Senior EE elective)	• Automatic air purification system design for campus laboratory. • Automatic water recirculation system for public swimming pools.
Signal Processing (Senior EE elective)	• Voice-activated system design for public buildings. • Design of camera activated traffic light system for the city of Cheney.
Communication Systems (Senior EE elective)	• Improvement and design of wireless communication in public buildings. • Design of campus guide system for visually impaired students.
VLSI Design (Senior EE elective)	• Chip design to read student I.D. number for local bus lines. • Chip design for audio and/or lighting control in auditorium.

Freshman design experience. All EE students will enroll in Freshman Design. The course is project-based with the projects selected to target the level of the students' technical knowledge. Example projects include working with the facilities engineering department to layout the parking spaces for the parking lot for new buildings, web page design for special pages of the E&D Department website, programmable robots projects, competitions such bridge/tower building and egg dropping, and very basic computer projects.

Laboratory-oriented experience-based learning. Students will participate in a laboratory-intensive curriculum. The EE program will stress laboratory-oriented learning, while not straying from the theoretical background critical to understand the systems at hand. Laboratory experiences will be thorough and comprehensive. New and existing labs will be created in the new SCES facility. Use of industry-supplied problems will be implemented in all EE laboratories. A recent project involved helping a local company with a software/hardware problem. A device was designed to measure fetus heartbeat with a specialized detection technique utilized for twins. The company provided the heartbeat data files, and students in the laboratory built filter systems to detect and measure the separate heartbeats. They tested the system, documented their findings, and reported the results back to the company.

Mentoring. Appropriate local representatives will be identified (with the assistance of the advisory board) to serve as mentors to EE students with regard to career opportunities and senior projects. A list of mentors with professional background descriptions will be created and expanded during the development phase. Once the EE curriculum is implemented, students will be provided the opportunity to work with mentors on special projects subject to the approval of a faculty member to ensure that the scope and the level of difficulty of the project are commensurate to the class needs. Mentors will be matched with students with attention given to the backgrounds and compatibility of both the student and mentor along with the career goals of the student. This mentoring approach is similar to what is currently in place with other programs in the E&D Department at Eastern.

Internships. Working closely with local and regional industry in the development of the EE program, the planning team has identified some internship positions and will identify more for EE students. Students completing internships through these businesses will obtain practical experience and credit toward their academic degree, while opening the door for future permanent employment. Internships will be determined paying close attention to the background and compatibility of the student along with the internship supervisor, the location of the internship and the ability of the placement to meet the needs of the student (promoting workforce diversity, maintains flexible hours, employment potential, etc.).

Objective 2. Establish a Recruitment/Retention Infrastructure
This objective consists of establishing a solid recruitment and retention program for underrepresented students in the EE program and is an outgrowth of initial efforts conducted by the E&D Department. It is aimed at the successful completion of the EE program by all students considered underrepresented in science and engineering. The goal is to have at least 50% of the student body coming from this community.

The inclusion of underrepresented individuals is a high priority for Eastern, as it builds the enrollment capacity within the SCES and the new EE program. It is in direct response to a comprehensive campus diversity initiative focused on developing an institution-wide plan to enhance and increase the level of support and services provided to underrepresented faculty and students at the University. The successful implementation will be a crucial and fundamental component of the overall EE program's development, drawing on the concept that it is still a growing area, which invites participation from a broad cross section of the communities Eastern serves.

Current demographic data from the Washington State Office of the Superintendent for Public Instruction also indicates that Washington has an increasingly broad pool of potential non-traditional students. The challenge is to develop effective contact, communication strategies and programming that meet the needs and desires of these students.

The principal rationales for creating a recruitment and retention component are threefold:

1. It is an opportunity to address what has been in the past a significant limitation to the improvement of workforce diversity and to the number of individuals pursuing an education in the engineering sciences;
2. It has the potential to provide a successful model that can be replicated in other engineering programs and at other institutions; and
3. It aligns appropriately with the core curriculum objectives of the EE program.

The activities required to support the recruitment and retention infrastructure are divided into University wide as well as E&D Department responsibilities. All of these are described below:

The University wide activities with support and involvement of the E&D faculty include:

- Develop an in-depth and holistic admissions review criteria including, but not limited to, community service activities, leadership records, and interviews that may be considered with grade point average and standardized test scores (with the goal of determining the student's potential to be successful at Eastern given their background and the services available to them once on campus);
- Expand the performance-based transfer competency program being piloted with Spokane Community Colleges to community colleges within the state with high enrollments of underrepresented students;
- Obtain institutional approval to create faculty development plans (required for tenure and promotion) in which faculty get credit for mentoring and retaining underrepresented students in their departments; and
- Expand outreach to K-12 schools and organizations supporting the educational development of nontraditional students.

The Engineering and Design Departmental level activities include:

- Traditional recruitment activities such as site visits, advertisements and circulation of Internet, multi-media CDs, and hardcopy information on the EE program in conjunction with Eastern's recruitment team in Student Affairs;
- Work with high school guidance counselors in ethnically and culturally diverse areas to develop a formal school to university relations and transitions program for EE;
- Develop or expand working relationships with the region's Gear-up, Upward Bound, Talent Search, MESA (Math, Engineering, Science Achievement) and HAAP (Hispanic Academic Achievers Program) programs to develop initiatives that pique student interest and participation in EE;
- Work with Washington State Achiever's Program (funded by Washington Education Foundation) advisors/mentors to recruit and retain scholarship recipients to the EE

program;
- Develop courses designed to interest college students in the field of engineering, especially targeting those who exhibit desirable qualities but have not yet committed to a major;
- Work with industries to assist in developing specialized educational programs such as those provided by Micron, Inc. [15] that lead to better academic preparation in science and engineering at all levels and to better workforce skills;
- Identify industry mentors and establish culturally relevant internships for underrepresented students (i.e., minority owned businesses, businesses located in the student's home community, etc.);
- Identify potential employers sensitive to the needs of underrepresented students (i.e., flexible hours, daycare center on site, diverse workforce) and expand opportunities for part-time and full-time employment; and
- Train and support upper classmen and women to be effective mentors and counselors.

In order to be successful, an infrastructure was created that utilizes the cooperative effort of the faculty along with other areas of the University. These units include the: Admissions Office, Academic Advising, African American Studies, American Indian Studies, Chicano Education and the College Assistance Migrant Programs, Women's Studies, and the campus TRIO programs (Student Support Services and McNair Scholars).

Objective 3. Develop and Implement the EE program curriculum
The EE program curriculum is based on a series of existing lower division prerequisite courses in the humanities, mathematics, physics, and general education requirements. The upper division core includes both existing courses and new courses along with laboratory revisions in the E&D Department.

The program was designed to meet the EAC of ABET criteria that provides a set of program standards that must be met including a minimum number of credits (180 for quarter hour programs), certain curriculum elements, assessment criteria (i.e. the student must be able to design experiments, communicate effectively, etc.), advisory board formation, administration criteria, etc. All curriculum planning, including the identification of program objectives and outcomes were conducted with this final goal in mind.

For students who need additional foundational courses and support in math and science or other requirements, university wide programs are currently in place to assist them. Students will have the opportunity to take additional academic year and intensive summer programs designed to help them feel part of a coherent learning community (again, supported by literature); tutoring; contextual learning in early courses to emphasize the importance of math, science, communication, and the humanities to their chosen field; and opportunities for interaction and support from fellow students, faculty, and peers through liaisons with student groups, industry contacts, and support services.

The 4-year Electrical Engineering program curriculum has been developed and is presented in Table 2. Engineering and other related courses (with prefixes of ENGR and TECH) are taught by faculty from the E&D Department.

Table 2. Electrical Engineering Program 4-Year Plan

	Fall		**Winter**		**Spring**	
	Freshman Year					
	Calculus I (MATH 161)	5	Calculus II (MATH 162)	5	Calculus III (MATH 163)	5
	General Education Core Requirement (GECR)	5	GECR	5	Physics I (PHYS 151)	4
	College Composition (ENGL 201)	5	Programming Prin. I (CSCD 225)	5	Physics I Lab (PHYS 161)	1
	Freshman Design (ENGR 197)	2	Programming Prin. I Lab (CSCD205)	1	GECR	5
48	Total	17	Total	16	Total	15
	Sophomore Year					
	Programming Principles II (CSCD 226)	5	*Circuits II (ENGR 210)*	5	GECR	5
	GECR	5	Physics II (PHYS 152)	4	Physics III (PHYS 153)	4
	Differential Equations (MATH 347)	4	Physics II Lab (PHYS 162)	1	Physics III Lab (PHYS 163)	1
	Circuits I (ENGR 209)	4	Linear Algebra (MATH 231)	5	Calculus IV (MATH 241)	5
48	Total	18	Total	15	Total	15
	Junior Year					
	Digital Circuits I (ENGR 160)	4	*Signals and Systems I (ENGR 320)*	5	GECR	5
	Electronics I (ENGR 330)	5	*Electronics II (ENGR 331)*	5	*Signals and Systems II (ENGR 321)*	5
	Physics IV (PHYS 221)	4	General Chemistry (CHEM 151)	5	*Microprocessors I (ENGR 260)*	4
	Physics IV Lab (PHYS 164)	1	Digital Circuits II (ENGR250)	2		
45	Total	14	Total	17	Total	14
	Senior Year					
	Prob. and Intro. to Statistics (MATH385 4cr)		*EE Elective*	5	EE Electives	10
	or Elem. Prob. and Statistics (MATH 380)	5	*Energy Systems (ENGR 350)*	5	Tech. and World Civil.(TECH393)	4
	Technical Writing (ENGL 205)	5	Cultural/Gender Diversity	4	*Capstone (ENGR 490)*	4
	Electromagnetism (PHYS 401)	4				
46	Total	14	Total	14	Total	18
187	Electrical Engineering Program Total					

A number of these courses have been revised or newly developed specifically for the EE program. Extensive research was conducted to insure that the EE coursework reflects both the leading edge of technology and the requirements of industry. The revised or newly created courses include:

Freshman Design (ENGR 197). A course with introductory projects to introduce students to engineering in general, with part of the class dedicated specifically to EE. In previous years, ENGR 197 was TECH 197 and consisted of introductory topics in Engineering Technology, invited speakers, and a final project. Under the new structure, it will keep its previous content, while including a biweekly service learning project designed to intrigue, motivate, and challenge students.

Digital Circuits (ENGR 160). Digital Circuits is the first of a two-course sequence. Traditionally this class has included lecture only as the preferred pedagogical method. ENGR 250 provides the laboratory component of the sequence. While this structure will be maintained, an experience-based project design will be implemented throughout the class, with a formal project report due at the end of class being heavily weighed in the final grade.

Circuits I/II (ENGR 209/210). These courses will retain their traditional lecture approach, however the laboratory component will include an experience-based project.

Digital Hardware (ENGR 250). This class currently offers the laboratory component of Digital Circuits (ENGR 160). The revised version will include the hardware implementation of the project designed in the precedent class with the traditional lecture and laboratory experiments.

Microprocessors (ENGR 260). ENGR 260 is a traditional lecture/laboratory based course focusing on the hardware design and assembly language programming of microprocessor systems. The basics of the course will not be modified; however, an experience-based final project will be included.

Signals and Systems I/II (ENGR 320/321). A two-course sequence that studies basic and intermediate signal and control systems theory. The first course will develop a computer simulation of an experience-based project, while the second course will do the laboratory implementation of the previously simulated project.

Electronics I/II (ENGR 330/331). These courses provide traditional lecture on electronic devices. The laboratories will build upon and improve on the projects completed in Circuits I/II (ENGR 209/210).

Energy Systems and Electromagnetism (ENGR 350/PHYS 401). These theory-based classes will be culminated with an experience-based project such as those described in Table 1.

Senior Electives. Each senior elective will combine theory and practice by utilizing both lectures and experience-based projects including computer simulation. Students will select their area of concentration according to their interests. The initial concentrations will include signal processing, control systems, communications systems, and microelectronics.

Senior Capstone (ENGR 490). The senior capstone class models a team-based industrial environment, where students with a variety of academic and skill backgrounds unite to design and implement a given project. Due to recent revisions, this course needs no further revisions.

Objective 4. Upgrade Existing Laboratories and Provide New Laboratory Instrumentation
The E&D Department will develop four new laboratories and renovate three additional laboratories to better meet the curriculum objectives of the EE program. The four new laboratories are the Microelectronics/VLSI Lab, the Controls Lab, the Communication Systems/Signal processing Lab, and the Power Lab. The three laboratories that will undergo renovations are the Networking Lab, the Circuit Analysis/Digital Lab, and the PC Lab. Each will provide the necessary hardware and software resources to incorporate and support the experience-based learning methodology. The EE laboratories include:

Networking Laboratory. The current networking lab containing routers, switches, and PCs, will be renovated to increase the number of routers and switches. Servers, firewalls, and a network core will be installed so that students are able to work with various computer configurations. In addition, network security products such as hardware encryption tools and antivirus will be included as well. This lab will cover several elective courses related to networking including Data Communications (ENGR 416), Network Communications (ENGR 417), Introduction to Computer Networks (CSCD 333), Advanced Network Programming (CSCD 433), and Network Security (CSCD 434). Students will learn about setting up network environments, analyzing network speed and performance, investigating security problems, and numerous other computer networking aspects. This lab will support experience-based learning projects such as “Design of a microprocessor-based router switching system,” or “Signal amplifier (or repeater) design for network in Cheney, WA” both mentioned in Table 1.

Circuit Analysis/Digital Laboratory. The current Circuit Analysis/Digital lab will be renovated and/or replaced by new equipment. The new equipment includes logic analyzers, digital oscilloscopes, network analyzers, and frequency counters. In addition Multisim and Xilinx software will be added to the current Digital lab PCs. The existing microprocessor boards, function generators, digital multimeters, power supplies, and pulse generators will be replaced. Courses including Microprocessors (ENGR 260), Digital Circuits I/II (ENGR 160/250), Senior Capstone (ENGR 490), Circuits I/II (ENGR 209/210), Electronics I/II (ENGR 330/331), and others will utilize this lab. In this lab students will learn about microprocessors and their applications, as well as digital and analog design. This lab will provide hardware resources to perform projects such as “Score board design for school district in Cheney,” or “Design of intrusion detection and alarm system for university buildings” (refer to Table 1).

PC Laboratory. The current PC Lab will be renovated with the latest PCs and software resources. Also, it will be used as an open lab for all students in the EE program. This lab will service a number of courses including Programming Principles I/II (CSCD 225/226), Senior Capstone (ENGR 490), and Signal Systems I/II (ENGR 320/321) just to list a few .

Microelectronics/VLSI Laboratory. The lab will contain HP Servers and HP workstations with software including PSPICE, Xilinx, Cadence, and Synopsys, which will be used for elective courses such as VLSI Design, ASIC Design, and RF Microelectronics. Students will have hands-on experience in designing hardware based on the utilization of software schematic capture and simulation packages. This lab can be used for Electronics I/II (ENGR 330/331), Circuits I/II (ENGR 209/210), and Digital Circuits I/II (ENGR 160/250). Students requiring flexible lab time will be allowed to access the network remotely. This lab will support experience-based learning projects such as "Chip design to read student identification number for local bus line," or "Chip design for audio and/or lighting control in auditorium" (refer to Table 1).

Controls Laboratory. This lab will include small robots, an inverted pendulum, data acquisition boards, sensors, and PCs with software such as MATLAB and Labview. In this lab, students will get hands-on experience in designing sensor conditioning circuits, interface circuits, and in implementing various control algorithms. Several courses such as Microprocessors (ENGR 260), Signal and Systems I/II (ENGR 320/321), Electronics I/II (ENGR 330/331), and elective courses in Control Systems are supported by this lab. In addition, intensive simulations for control systems are performed by students using equipment in this lab. This lab will support experience-based learning projects such as "Automatic air purification system design for campus labs" or "Improvement and design automatic door with motion sensor for public buildings" (refer to Table 1).

Communication Systems/Signal Processing Laboratory. This lab will provide students with hands-on experience in analog communication systems, digital communications, fiber optic communications, and wireless communications using Lab-Volt (or similar) equipment. In addition, sensors, audio, camera, and DSP (Digital Signal Processing) boards will be will be used for signal processing experimentation. Simulation software such as MATLAB will also be available for the students to use. Several courses will utilize this lab including Signals and Systems I/II (ENGR 320/321), and electives Communication systems and Digital Signal Processing. Utilizing this lab a number of experience-based learning projects such as "Design of campus guide system for visually impaired students" or "Voice activated system design for public buildings" can be implemented (refer to Table 1).

Power Laboratory. AC/DC motors, generators, and transformers of various powers will be available for students to utilize with electromechanical training systems. Various speed control equipment for AC/DC motors will be installed. Experimental kits for power electronics such as power transistors, thyristors, inverters, SCRs (silicon-controlled rectifiers), and others will be utilized. Several classes will be supported including Energy Systems (ENGR 350), Electromagnetism (PHYS 401), and Electronics I/II (ENGR 330/331). In addition, the lab will offer partial support for experience-based learning projects such as "AC/DC motor driver design or repair of a mechanized wheel chair for the handicapped" and "Expansion of traffic light system for city of Cheney, WA" (refer to Table 1).

Conclusions, Reflections and the Future

Eastern Washington University's new EE program has a well-stated long-term plan leading from the development phase to the implementation phase. Development work has included the curriculum both for the program and new courses, piloting of courses, new learning strategies and problem-solving techniques, the purchase of laboratory equipment, and implementation of student recruitment and retention activities. While the existing complement of engineering faculty are capable of both developing and offering the new program in its initial stages, a steady increase in the number of students is expected. As the student population rises and the program expands and is institutionalized in the new facility, it is planned that at least two new faculty members will be added to the E&D Department.

An additional future component is the increase in collaboration with industry by exploring partnerships with businesses to allow experienced engineers to spend a sabbatical year at Eastern. This partnership could include reciprocal exchanges, where the faculty at Eastern would spend time in industry to promote technology transfer and other collaborative research between academia and industry. To this and other ends, the new program in EE at Eastern will have a cutting-edge culture, thriving towards advancement in engineering practice and education.

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