2-19-2016

SR-15-16-34 APC

Marshall University

ACADEMIC PLANNING COMMITTEE
RECOMMENDATION

SR-15-16-34 APC

Recommends that the Intent to Plan for the Bachelor of Science in Electrical and Computer Engineering be approved.

RATIONALE:

The proposed degree program would be a valuable addition to the university program offerings.

FACULTY SENATE CHAIR:

APPROVED BY THE FACULTY SENATE: Larry Stickler DATE: 2/19/2016

DISAPPROVED BY THE FACULTY SENATE: _____ DATE: _____

UNIVERSITY PRESIDENT:

APPROVED: [signature] DATE: 3-2-16

DISAPPROVED: _____ DATE: _____

COMMENTS: _____

INTENT TO PLAN

BACHELOR OF SCIENCE IN ELECTRICAL AND COMPUTER ENGINEERING

MARSHALL UNIVERSITY ADMINISTRATIVE UNIT:

THE WEISBERG DIVISION OF ENGINEERING

COLLEGE OF INFORMATION TECHNOLOGY AND ENGINEERING

PROPOSED IMPLEMENTATION DATE: FALL 2016

Contact Person:

Asad Salem, Chair
Weisberg Division of Engineering
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September 21st, 2015

Intent to Plan
Degree: Bachelor of Science-Electrical and Computer Engineering
Major: Electrical and Computer Engineering (BSEE)

Marshall University Administrative Unit:
The Weisberg Division of Engineering, College of Information Technology and Engineering
Proposed Implementation Date: Fall 2016

Brief Summary Statement:

This is an Intent to Plan for a Bachelor of Science in Electrical and Computer Engineering (BSEE) by the Weisberg Division of Engineering of the College of Information Technology and Engineering (CITE) to graduate electrical and computer engineers for meeting West Virginia's increasing technological demands.

The proposed program will allow students to select one of two areas of emphasis: Electrical Engineering or Computer Engineering. Graduates of this Program will contribute to West Virginia's economic development, advance its competitive edge globally and contribute to improvement in the quality of life.

Electrical engineering is a field of engineering that generally deals with the study and application of electricity, electronics, and electromagnetism. The fields of electrical and computer engineering cover a wide range of subfields including electronics, power engineering, telecommunications, control systems, radio-frequency engineering, signal processing, instrumentation, microelectronics, digital systems including hardware, software, compliers and operating systems, coding, cryptography, network, mobile and distributed computing system, and cyber physical systems and security. As such, the BSEE program at Marshall University (MU) will prepare graduates with a BSEE with two areas of emphasis: general electrical engineering, and computer engineering. It will, also, emphasize service, systems-based knowledge, and sustainability with an eye toward the interface of traditional electrical and computer engineering with new and emerging fields. In accordance with the standards set forth by the Accreditation Board for Engineering and Technology (ABET) and MU's mission, the specific educational objectives of this program are to graduate students who will:

1. Practice the electrical and computer engineering discipline successfully within community-accepted standards
2. Possess teamwork and communications skills to develop a successful career in electrical and computer engineering
3. Fulfill professional and ethical responsibilities in the practice of electrical and computer engineering, including social, environmental and economic considerations,
4. Engage in professional service, such as participation in professional society and community service
5. Engage in life-long learning activities, such as graduate studies or professional workshops, and
6. Develop a professional career in the prevailing market that meets personal goals, objectives and desires

Accordingly, graduates will have the ability to work professionally and ethically, as individuals and in multi-disciplinary teams, in both the electrical and computer areas, including the design, manufacture, and control of such systems. Moreover, they will develop a deep understanding of the impact of engineering solutions from global, financial, environmental, societal, political, ethical, health and safety, and sustainability perspectives.

The University and the Weisberg Division of Engineering will actively recruit and train students from under-represented populations in the West Virginia and Tri-State region, beginning in middle school and continuing through high school. The BSEE degree program will be built on the foundation of the faculty members and facilities in MU's ABET-accredited B.S. degree program in General Engineering (BSE), degree program in Mechanical Engineering (BSME), and degree program in Computer Science (BSCS). To a substantial extent, the supporting coursework and infrastructure for a new BSEE program is in place as a result of our current programs in BSE, BSME and BSCS, most of the cost of the expanded program will be incremental and offset by the current programs. The proposed BSEE program, however, is geared toward the development of conceptual skills and the acquisition of specific knowledge regarding electrical and computer engineering systems, delivered in a sequence of engineering fundamentals and design courses that rely upon a foundation of advanced mathematics and science courses. Accordingly, the BSEE will differ from the existing programs, which is currently oriented toward Civil Engineering, and Mechanical engineering related applications. Therefore, five new faculty with doctoral degrees in electrical or computer engineering will be added in the first three years of the program.

From its inception, the BSEE program is designed to meet ABET accreditation standards. To be able to address the afore-mentioned "societal concerns," the BSEE program will incorporate a multi-disciplinary approach to the curriculum including a strong liberal arts component. The University's core curriculum with its emphasis on ethics provides the basis for such an approach. The curriculum will include courses that address MU's geographical location and the regional needs including energy, mining, materials, manufacturing, etc. Finally, an optional co-operative education component will be included that involves a full-time internship in industry, patterned after recent recommendations of the National Academy of Engineering and similar to other leading engineering programs.

ABET is the accreditation agency for engineering, and MU's BSE program is already accredited by ABET. Marshall will also seek ABET accreditation for the proposed undergraduate program in electrical and computer engineering. ABET does not consider, however, an institution for accreditation until the program produces its first graduate(s). It is anticipated that the first graduating class of BSEE engineering students will receive their BSEE degrees by the end of the Spring 2020 semester. Therefore, MU will make a Request for Evaluation (RFE) to ABET during the 2019-2020 academic year, which would require completing a self-study report in June 2020 and a comprehensive site visit during the Fall 2020 semester. The results of the accreditation visit shall be known during the Fall 2021, and would be considered retroactively for the graduating student class in May 2020. All components of the program will be designed to be consistent with ABET accreditation standards, and accreditation expenditures have been built into the budget for the program beginning in the first year. Designing the program to meet ABET standards from the start will facilitate the program's eventual accreditation.

The proposed program will require five additional faculty and one laboratory technician. The program will cost approximately $3.5 million during its first five years, of which about $655,000 will be used to develop the required undergraduate teaching laboratories. The program is expected to generate $3.35 million in revenues and reallocated funds during the first five years. The program is projected to become financially viable in its fourth year. The projected net revenues in the fourth and fifth years are $133,000 and $270,000 respectively. Enrollment is expected to increase over this period; it is expected that, after the first five years, 20 students will have graduated with a BSEE degree and approximately 102 students will be actively pursuing a BSEE degree at MU.

The primary tangible objective of the BSEE program will be to prepare students for the professional practice of engineering. Upon completion of an electrical and computer engineering degree, students will have completed the "education" component of the three requirements for licensure from the West Virginia Board of Professional Engineers (WVBPE). All individuals seeking licensure to practice engineering are required to take the Fundamentals of Engineering (FE) examination and the Principles and Practice of Engineering (PE) examination, prepared by the National Council of Examiners for Engineering and

Surveying (NCEES) and administered by state licensing boards, such as the West Virginia Board of Registration for Professional Engineers (WVPEBD). To qualify for licensure from the WVPEBD, candidates must hold a bachelor degree from an ABET-accredited engineering program. Accordingly, electrical and computer engineering students will be strongly advised to complete WVBPE's FE exam in their senior year to facilitate progress toward qualification for their PE licenses.

1. Program Description

After a decade's-long absence, undergraduate engineering education was re-established on the Marshall University campus in the fall of 2006 when the Marshall University Board of Governors approved the Bachelor of Science in General Engineering (BSE) degree. The BSE degree is a general engineering that also allows students to pursue areas of emphasis in particular engineering fields of study. Based on student interest and regional needs, the first area of emphasis offered was civil engineering (CEE). During this time, the BSE program has continued to grow and develop and provide additional resources to its students. A mechanical engineering discipline was created during 2014-15 academic year. Based on market demands and the available resources, we believe it is the right time to expand engineering programs to include an electrical and computer engineering discipline. After careful and in-depth analysis, the faculty of the Weisberg Division of Engineering along with the Engineering Advisory Board believe creating a Bachelor of Science in Electrical and Computer Engineering (BSEE) is the appropriate approach to address current and future demands for engineers within the discipline. The proposed BSEE program will enable the students to choose one of two areas of emphasis: Electrical Engineering or Computer Engineering.

1.1 Program Mission

The Program Objectives (POs') of the Bachelor of Science in Electrical and Computer Engineering (BSEE) program has several key components:

1. Practice the electrical and computer engineering discipline successfully within community accepted standards
2. Possess teamwork and communications skills to develop a successful career in electrical and computer engineering
3. Fulfill professional and ethical responsibilities in the practice of electrical and computer engineering, including social, environmental and economic considerations,
4. Engage in professional service, such as participation in professional society and community service
5. Engage in life-long learning activities, such as graduate studies or professional workshops
6. Develop a professional career in the prevailing market that meets personal goals, objectives and desires

These program objectives are consistent with the mission of the university; specifically with the following components contained in the *Marshall University Mission Statement* (http://www.marshall.edu/www/mission.asp):

> Marshall University will
> - provide affordable, high quality undergraduate and graduate education appropriate for the state and the region
> - foster faculty, staff, and student outreach through service activities
> - promote economic development through research, collaboration, and technological innovations

1.2 Program Features

The proposed BSEE program is designed to provide the core engineering courses and required electrical and computer engineering courses while allowing students to prescribed electives. The program allow the students to select an area of emphasis. Of the 132 total credits required to graduate from the BSEE program, over half are allocated to these three components ("broad engineering core", " core electrical and computer engineering", and " area of emphasis") to summarize, the BSEE program requirements are distributed among the various educational components as shown in the following table:

Table 1: BSEE Program Requirements

Category	Semester Credit Hours
General Education Core (I, II, add. Univ. Req., Math & Science) Curriculum	57
Required Core Courses	54
Area of Emphasis	18
Free Electives	3
Other *(Specify, e.g., internships, clinical work)*	Optional CO-OP
TOTAL	132

The proposed BSEE program will graduate students ready for successful careers as practicing engineers as well as for graduate work in advanced research degrees, and it will increase West Virginia's enrollment capacity to meet the needs of additional West Virginia, Tri-State region, and international high school graduates seeking careers in electrical and computer engineering. Additionally, these students will have attributes aligned with those of the Marshall University Engineering graduates, being socially conscious and innovative in addition to being technically excellent.

1.2.1 Program Learning Outcomes

Electrical engineering is a field of engineering that generally deals with the study and application of electricity, electronics, and electromagnetism. The fields of electrical and computer engineering cover a wide range of subfields including electronics, power engineering, telecommunications, control systems, radio-frequency engineering, signal processing, instrumentation, microelectronics, digital systems including hardware, software, compilers and operating systems, HDMI, coding, cryptography, network, mobile and distributed computing system, and cyber physical systems and security. As such, the BSEE program at Marshall University (MU) will prepare graduates with a BSEE with two areas of emphasis: general electrical engineering, and computer engineering. It will, also, emphasize service, systems-based knowledge, and sustainability with an eye toward the interface of traditional electrical and computer engineering with new and emerging fields

BSEE Program Students Outcomes (SOs'): Marshall University BSEE graduates shall 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 multidisciplinary 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.

1.2.2 Additional Program Outcomes:

In addition to above listed Outcomes the BSEE program will prepare students to become professional engineers after the required industrial experience. The electrical and computer students will be involved in research. The BSEE program will allow other engineering, computer science, science and biomedical students interested in high-tech devices to apply advanced computer based control system, and transport techniques to biotechnology and/or bioengineering problems. Moreover, the program will incorporate an optional five-year schedule involving a cooperative educational experience whereby the students in the latter part of their studies have periodic full-time work experiences in their area of interest with participating industries and businesses. Alternatively, a student may choose a fast-track approach and finish in four years (A Co-Op Plan is attached in Appendix B). In addition to the BSEE, a combined BS/MS degree program will also be available for exemplary BSEE students. This accelerated master's degree (program) will offer outstanding students an opportunity to earn both a bachelor's and a master's degree within approximately five years of entry to the BS program. The BS/MS program will have a strong research-oriented focus, and is primarily directed toward research oriented students or for those who ae planning on completing advanced degrees.

1.2.3 Admissions and Performance Standards

ABET is the accreditation agency for engineering. The proposed BSEE will seek accreditation from ABET. However, ABET does not consider an institution for accreditation until the program has produced its first graduates. It's anticipated that first graduate's from the BSEE will be by the end of Spring 2019. Therefore, MU's does not anticipate seeking accreditation until 2020-2021 and ABET visit is expected to take place during Fall 2020. All components of the proposed program will be designed to be consistent with ABET accreditation standards, and accreditation expenditures have been built into the budget for the program beginning in the first year. Designing the program to meet ABET standards from the start will facilitate the program's eventual accreditation. See Appendix E for ABET Standards.

1.2.4 Program Requirements

A. Admission Requirements

- Meet Marshall University admission requirements
- Admission to the BSEE Engineering program requires a minimum composite ACT score of 21 with a math score of 24, or a minimum SAT composite of 980 with a math SAT of 560.
- Transfer students must have completed MTH 127/130 College Algebra and MTH 132 Pre-Calculus.

For those needing to complete some requirements first, there is Pre-Engineering. Requirements for Pre-Engineering are a minimum composite ACT score of 19 with a math score of 19-23, or a minimum SAT composite of 900 with a math SAT of 460-550. Students who are admitted to the Pre-Engineering program generally will require an additional calendar year to complete the requirements for the BSEE degree. Transfer students must be eligible to take MTH127/130 College Algebra and MTH132 Pre-Calculus.

B. Graduation Requirements

The BSEC degree program requires a minimum of 132 credit hours of coursework. In addition to fulfilling the University's requirements for graduation, BSEE students must maintain a minimum GPA of 2.0 in all professional courses. These professional courses include mathematics (MTH 229 or above), required science courses, core engineering (ENGR) courses, EE courses, and courses used as technical electives. Entering students with a Math ACT of 24-26 are required to take MTH 132 Pre-Calculus. Such students will likely need an extra semester or summer term to satisfy BSEE requirements.

C. Curriculum

As the sample Curriculum Plan illustrates (Appendix A), the BSEE program has been designed to meet the POs' and the SOs' by providing an approximately equal mix of foundational mathematics and science courses, core engineering courses and electrical and computer engineering courses. Technical elective courses provide students an opportunity to get an area of emphasis and pursue individual interests.
The following tables identify the required courses and prescribed electives of the program.

Table 2: Program Required Courses

Prefix & Number	Required Courses	C.H.
ENGR 103	Freshman Seminar	1
ENGR 104	Engineering Profession	1
ENGR 201	Circuits I	4
ENGR 202	Circuits II	4
ENGR 204	Introduction to Digital Systems	4
ENGR 215	Engineering Materials	3
ENGR 217	Cooperative Education- CO-OP	1
ENGR 221	Engineering Economics	3
ENGR 451	Project Managements	3
ENGR 265	Engineering Analysis	4
CS 110	Computer Science I	3
EE210	Programming Lab	3
EE310	Electromagnetic Fields	3
EE 320	Analysis of Signals and Systems I	3
EE 330	Random Signals and Systems	3
EE 340	Computer Architecture & Design	3
EE350	Electric Properties of Materials	3
EE360	linear Systems & Control Theory	3
EE 370	Electric Machinery and Power Systems	3
EE380*	Microprocessor Design	3
EE 410	Electrical Engineering Design	3
EE 412*	Computer Engineering Design	3
EE 420	Capstone	3
ENGR 451	Project Management	3

MTH 229	Calculus I	5
MTH 230	Calculus II	4
MTH 231	Calculus III	4
MTH 220	Discrete Structures	3
MTH 345	Differential Equations	3
PHY 211	Physics I	4
PHY 213	Physics II	4
PHY 204	Physics II Lab.	1
CHM 211	General Chemistry I	3

Table 3: Program Prescribed Courses

Prefix & Number	Prescribed Elective Courses	SCH
EE 440*	Digital Control Systems	3
EE 445	Radio Frequency and Microwave Engineering	3
EE 447*	Real- time Digital Processing	3
EE 448	Power Electronics	3
EE 450	Electronic Motor Drives	3
EE 452	Control Engineering and Design Methodology	3
EE 454	Antenna Engineering	3
EE 455	Power System Fault Analysis and Protection	3
EE 456	Power System Operation and Control	3
EE 457	Wireless Communications	3
EE 459	VLSI Circuit Design	3
EE461*	Fundamentals of Data Transmission and Networking	3
EE 462*	Design of Embedded Systems	3
EE 463*	Computer-Human Interaction	3
EE 464*	Digital Integrated Circuit Design	3
EE465*	Digital Communications	3
ME465	Mechatronics	3
ME 475*	Programmable Logic Controls (PLC)	3
EE48X	Other Special Topic Courses	3

In addition to the courses marked with (*) in Table (5), EE students who wish to specialize in computer engineering (Computer area of emphasis), can take the following CS courses: CS 305, CS 310, CS 410, CS 430, CS 440, and others.

All EE engineering students must complete a senior-level senior project (Capstone) in EE 420. The capstone project will require students to work with practicing engineers to gain field experience. Electrical and computer engineering faculty may incorporate research projects from other colleges and departments of MU or industry in the capstone projects. The Engineering Advisory Board (drawn from local industries and community leaders) will assist with the process of identifying projects for students to implement.

The Engineering Advisory Board (EAB) will also facilitate the pursuit of less formal relationships earlier in the students' curriculum through field experiences, internships, and co-ops beginning in the sophomore year. Students will be encouraged to pursue optional co-op assignments during summer or full-semester terms. The EAB will assist with the identification of such co-op opportunities.

All field experiences will conclude with an exit interview of both the student participant and the student's immediate supervisor of the project.

At the freshman level, the applications for BSE, BSEE, and BSME are similar, and the students will work jointly on lab projects. Furthermore, students in both programs will be integrated in the ENGR 451 - Project Management. Course descriptions are included in Appendix D.

1.2.5 Program Delivery:

The proposed BSEE program will utilize classical instructional delivery methodologies. It will use the same instructional methods that are common in engineering education and supported or recognized by the American Society of Engineering Education (ASEE).

2. Program Need and Justification

2.1 Existing Programs:

Currently, there are two West Virginia state supported institutions (WVU &WVUIT) that offer an ABET-accredited degree program in Electrical and/or Computer Engineering or closely related fields. West Virginia lags behind surrounding states in the number of accredited electrical and computer engineering programs as illustrated in the table below. West Virginia could realistically justify adding at least one additional BSEE program and related fields and still remain barely at the average of the neighboring states which have, on average, 1.41 programs per million residents. It is also noteworthy to mention that many BSEE or closely related programs listed in the table below are larger than those in the State of West Virginia and can accommodate larger student populations. For Instance, Ohio has at least eight programs that are comparable in size of the BSEE program at WVU or larger.

Table 4: Existing BSEE Programs in Surrounding States

State	BSEE Programs	Population	BSEE Programs/Million
Kentucky	6	4.34 million	1.38
Ohio	16	11.25 million	1.42
Pennsylvania	20	12.70 million	1.57
Virginia	13	8.01 million	1.62
West Virginia	2	1.89 million	1.05

West Virginia also lags behind comparable states in the number of degrees awarded in Engineering in general and Electrical Engineering and Computer in particular. The total number of undergraduate BSEE degrees awarded by all USA institutions in 2012-2013 was about 14,600 at an average of 48 per million capita (www.asee.org/college). However, West Virginia universities in 2013-2014 awarded only 79 degrees of which 31 in Computer Engineering (www.asee.org/college) at an average of 42 per million capita of West Virginians.

The same situation is true in enrollments in BSEE programs. In the 2012-13 academic year, there were about 91,000 students enrolled in BSEE programs nationwide (Engineering Enrollment 2012-13, www.asee.org/college). The total enrollment in state supported BSEE programs in West Virginia during the 2014 academic year was 298 students (Engineering Enrollment 2013-14, www.asee.org/college) at a rate of 157 per million capita—146 per million lower than the national average.

West Virginia University (WVU) and West Virginia Institute of Technology (WVIT) currently offer a Bachelor of Science in in electrical and computer engineering programs. These degrees can be obtained through their Morgantown and Montgomery campuses. They enrolled 298 students in Fall 2014. There are no other public or private institutions in the State of West Virginia offering a B.S. in Electrical and/ or Computer Engineering. The WVU as well as WVIT offer two separate degrees in in electrical engineering and computer engineering. In contrast, the proposed MU BSEE program would offer a single degree in Electrical and Computer Engineering with two areas of emphasis: Electrical Engineering (BSEE-Electrical Emphasis) and Computer Engineering (BSEE-Computer Emphasis).

2.2.1 National Needs:

The need to take actions for maintaining technological leadership of the United States is progressively becoming more urgent. Developing cutting-edge technology through cultivating innovation is critically important in the global competitive environment. Engineering education is one of the most important aspects of this innovation-cultivating process. Many states are now recognizing a shortage of engineers and are taking actions to address this urgent problem.

The U.S. Bureau of Labor projected a 10-13 percent increase in the national demand for electrical/computer engineering and closely related fields (software engineering, power, telecommunications, cyber security) between 2012 and 2022. The demand for engineers with expertise in the design and development of electrical and computer systems for power, renewable energy, cyber security and biomedical applications is projected to increase 21% nationally over the same period.

Several studies at the national, state, and local levels have delineated the overall needs for additional engineers and scientific personnel. For example, the National Academy of Engineering, the National Academy of Sciences and the Institute of Medicine produced a report (2007): "Rising Above The Gathering Storm: Energizing and Employing America for a Brighter Economic Future." This report summarizes the huge demand for engineers and science (STEM) graduates in U.S. industries and universities. The report indicates that to address the deficit in engineering and scientific knowledge, the nation must import foreign nationals to close the gap between supply and demand. As financial opportunities in foreign countries increasingly develop via globalization, the U.S. is going to find itself with a deficit of talent that will negatively impact its ability to maintain its world leadership in science and engineering. The Gathering Storm report defines a "compelling call to action" to draw more underrepresented U.S. citizens into engineering and science.

Thomas Friedman in his highly acclaimed book "The World is Flat" highlights staggering statistics showing how far the U.S. trails the world in meeting its science and technology needs. Societal need for graduates of science and engineering has been a concern of policy makers and educators for many years and now this concern is exacerbated with advances in China and India. Foreign graduates are being sought for high-paying, knowledge-based jobs or the work is being outsourced because of a lack of qualified U.S. educated engineers. In his more recent publication, "Hot, Flat and Crowded," Mr. Friedman takes a look at the rapid changing of the world through climate change, population growth and globalization. In this 2008 book, he urges the U.S. to become a world leader in developing 'green' technologies needed for the coming era he

calls the "Energy-Climate Era." Without becoming a leader in these technologies, he fears that the U.S. will be shunted aside by other nations. The need to take actions for maintaining the technological leadership of the United States is progressively becoming more urgent. Developing cutting-edge technology by cultivating innovation is critically important in this competitive environment.

Engineering education is one of the most important aspects of this innovation cultivating process. Many states are now recognizing a shortage of engineers and are taking actions to address this urgent problem. These conclusions have been reached through a deliberate process of studying the current state of engineering education in the state and country, future trends and needs of society, the role of the U.S. in the knowledge-based society and global economy for high-impacting jobs and markets, the need of the state for economic development and the role of MU as a public supported university in economic development.

The career prospects for new graduates in Electrical and Computer Engineering are excellent. According to the U.S. Department of Labor, the total number of electrical and computer engineers employed in the U.S. in 2004 was about 216,000 (13% of the total number of engineers.

2.2.2 State and Local Needs:

Electrical and Computer Engineering and related disciplines saw enrollment gains of 5 percent to 11 percent between 2013 and 2014 (www.asee.org). Within college populations sophomore and junior engineering classes showed the largest enrollment growth, each rising 11 percent over 2012.

Student interest in electrical and computer engineering at MU is remarkably high. In the past academic year (2014-15), about 200-220 prospective students made direct contact with the University about engineering programs, of which about 40-50 students showed strong interest in electrical and computer engineering. Furthermore, 21 of incoming freshmen of Fall-15 indicated a strong interest in electrical or computer engineering and they would choose it as a field of study should the program exist at MU. Without a local electrical/computer engineering option, some students have commented that they are reluctantly completing an engineering degree at MU.

2.3 Employment Opportunities:

The U.S. Department of Labor, Bureau of Statistics, reported that nationwide, the number of electrical and computer engineers and closely related jobs grew by 11 % between 2006 and 2014 (from 216,000 to 240,000); and it is expected to grow to about 290,000 in year 2022. The U.S. Census Bureau (Field of Bachelor's Degree in the US: 2009; Issued February 2012) reported that there are 4.452 million engineers of 25 years and over in the USA; with 1.410 million in the age bracket of 25-39 and 2.252 million in the age bracket of 40-64. Therefore, the overall job opportunities in engineering are expected to be good because the number of engineering graduates should be in rough balance with the number of job openings between 2010 and 2020. In addition to openings from job growth, many openings will be created by the need to replace current engineers who retire or transfer to management, sales, or other occupations; or leave engineering for other reasons. Therefore, in the next 20-25 years US academic institutions are expected to graduate, on average, about 125,000 engineers per year to keep up with demands. The American Society of Engineering Education (ASEE), in its annual report (Engineering by the Number-2011; www. asee.org/colleges) reported that in 2010-2011, all US Institutions graduated only 83, 001 engineers of which 6.7% were nonresident aliens.

Employment of engineers is expected to grow about as fast as the average for all occupations over the next decade, but growth will vary by specialty. Electrical and computer engineers are projected to have about 20 percent employment growth over the projected decade, slower than the average for all occupations. But, some new job opportunities will be created due to emerging technologies in biotechnology, smart grid, power systems, cyber systems and security, and mobile technologies. Additional opportunities outside of electrical and computer engineering will exist because the skills acquired through earning a degree in electrical/computer engineering often can be applied in other engineering specialties.

Competitive pressures and advancing technology will force companies to improve and update product designs and to optimize their manufacturing processes. Employers will rely on engineers to increase productivity and expand output of goods and services. New technologies continue to improve the design process, enabling engineers to produce and analyze various product designs much more rapidly than in the past. Unlike some other occupations, however, technological advances are not expected to substantially limit employment opportunities in engineering because engineers will continue to develop new products and processes that increase productivity.

In West Virginia, as reported by many industrial leaders, a substantial percentage of all engineering jobs in the state are filled by graduates of out-of-state or foreign institutions. There are more than thirty large businesses in the Tri-State region that employ electrical or computer engineers. In recent years, many of these companies have had difficulty hiring qualified engineers and also had difficulty retaining them longer than five years. Local leaders assert that a substantial problem for them is the absence of a BSEE in this region of the State to support local industries. Sample letters of support are available in Appendix C.

2.4 Program Impact:

Clearly, the addition of the BSEE will make MU a more effective public university. The BSEE program will allow science and biomedical students interested in high-tech devices to apply advanced software, control, computer, and transport techniques to biotechnology and/or bioengineering problems.

In terms of program features, the proposed BSEE program will differ significantly from WVU's and WVIT's programs in that there will be much more emphasis on the core liberal arts component and learning communities approach, more cross-integration of subject materials in the engineering courses for a systems approach. The program will, also, contain unique features that differentiate it from most traditional electrical or computer engineering offerings in West Virginia and surrounding universities. The students in MU's BSEE program will take MU's core curriculum through which they learn interpersonal skills, team efforts, and many other skills that are of value as a practicing professional. A strong emphasis on a systems approach to problem solving will be incorporated in all the engineering curricula resulting in multidisciplinary activities especially at the senior level. Accordingly, MU's BSEE students will be trained to work professionally and ethically, as individuals and in multi-disciplinary teams, in both the electrical and computer engineering areas, including the design, and control of such systems. Moreover, they will develop a deep understanding of the impact of engineering solutions from a global, financial, environmental, societal, political, ethical, health and safety, and sustainability perspective. The curriculum will include courses directly related to MU-'s Tri-State location that will address issues related to mining, materials, manufacturing, bio-technology and fuels, etc. Moreover, the program will incorporate an optional five-year schedule involving a cooperative educational experience whereby the students in the latter part of their studies have periodic full-time work experiences in their area of interest with

participating industries and businesses. Alternatively, a student may choose a fast-track approach and finish in four years (A Co-Op Plan is attached in Appendix B).

In sum, the proposed BSEE program specifically targets the unique requirements of the 300,000-400,000 residents. The demand for high-tech workers in the State is unlikely to diminish in the foreseeable future. West Virginia, like other states in the country, must increase the number of graduates to meet the demand for high-tech workers during the next decade and beyond. U.S. and West Virginia universities need to produce more graduates because international competition for high-tech workers has increased sharply in recent years. West Virginia industries need to be insulated from the future uncertainty of international politics by having access to a guaranteed supply of new BSEE graduates. Many developed and developing countries, with their own rapidly growing high-tech industries, are becoming very competitive for the same pool of high-tech workers. Therefore, unless new degree programs are offered in high-tech areas in the regions of the country where there is a demand for such programs, the supply of skilled workers will continue to be less than adequate for the rapidly growing regional and statewide high-tech industry. In addition, in order to draw more students, especially underrepresented students, the engineering programs must be established in the vicinity of the families of the targeted students.

2.5 Cooperative Arrangement:

The proposed BSEE program has a strong support of the local, State and Tri-State Industry. Many employers expressed current and future needs for the electrical or computer engineers, and are willing to provide Co-Op and employment opportunities for the program's future students and graduates (Letters of Support are included in Appendix C).

2.6 Alternatives to Program Development:

There are two West Virginia state supported institutions (WVU &WVUIT) that offer an ABET-accredited degree program in Electrical, or Computer Engineering, or closely related fields. West Virginia lags behind surrounding states in the number of accredited electrical or computer engineering programs. After careful and in-depth analysis, the faculty of the Weisberg Division of Engineering along with the Engineering Advisory Board believe creating a Bachelor of Science in Electrical and Computer Engineering (BSEE) is the appropriate approach to address current and future demands for engineers within the discipline

3. Program Implementation and Projected Resource Requirement

1. Program Administration

The BSEE program will be housed in the Weisberg Division of Engineering- College of Information Technology and Engineering. The Chairman of the Weisberg Division of Engineering will supervise and manage the program. No changes in the administration of the Division is projected.

2. Program Projections

The estimates for student enrollment are conservative and based upon the number of student inquiries and interest shown in the proposed degree. The estimates also assume that all students will be full-time and incorporates a dropout rate of approximately 20-25%. The 20-25% average drop rate is based on MU's experience with the BSE program and on data from similar institutions (WVU, WVIT, Ohio University and UK) with electrical and computer engineering programs. Some of the current BSE, BSME, or BSCS students will undoubtedly transfer to BSEE and these will tend to stay since they have achieved a level of success in their programs and will be better prepared for the BSEE than students who are new to the program. It is conceivable that once the BSEE program is approved and ABET accredited, the newly

founded INTO program on the MU may recruit foreign students interested in the BSEE degree, but these figures are not included in the table below.

This new degree is projected to have around 100 majors in its fifth year. MU has a very strong commitment to recruiting students from underrepresented groups. The engineering program will actively recruit students from the underrepresented groups and International students to advance this mission. The Program is expected to graduate 8 students in 2019-2020 and 12 students in 2020-21.

Table 5: Student Enrollment Projections

	Change of Major	New Students	Attrition	Graduation	Cumulative Head Count
1st year 2016	10	20	0	0	30
2nd Year 2017	5	25	6	0	54
3rd Year 2018	0	30	10	0	74
4th Year 2019	0	30	12	0	92
5th Year 2020	0	30	13	8 (2019)	102

Form 1: Five-Year Projection of Program Size

	First Year 2016	Second Year 2017	Third Year 2018	Fourth Year 2019	Fifth Year 2020
Number of Students Served through Course Offerings of the Program:					
Headcount	30	54	74	92	102
FTE	2.2	14.2	33.0	50.3	51.0
Number of student Credit hours generated by Courses within the program (entire academic year):	66	426	992	1508	1531
Number of Majors:					
Headcount	30	54	74	92	102
FTE majors	33	60.2	81.4	101.2	112.2
Number of student Credit hours generated by majors in the program (entire academic year):	990	1806	2442	3036	3366
Number of degrees To be granted (annual total):	0	0	0	8	15

3. Faculty and Instructional Requirements

The MU Faculty of Engineering and Computer Science are uniquely prepared to develop an Electrical and Computer Engineering Program that meets the expectations of the NAE report. Engineering graduates in the 21st Century must be technically competent and dedicated to the improvement of humankind. The proposed BSEE Engineering Program will be organized to educate engineers for careers devoted to the integration of discoveries from multiple fields and take advantage of multiple disciplines available in the University's liberal arts environment. MU already has all necessary academic units and complementary programs in general engineering to support this proposed Program. Weisberg Engineering faculty and academic resources will support needs for the new Program; however, five new faculty, five electrical engineering related labs, about thirty new courses in the targeted electrical and computer engineering areas and one support staff will be needed.

As it was mentioned earlier electrical and computer engineering are wide engineering disciplines that require faculty with different expertise and knowledge. Therefore, a strong BSEE program should have the support of faculty with following areas of expertise: Controls (or closely related), Power and Power Electronics, Electronics, Communications, Computer Architecture and Hardware. In addition the BSEE program will require a technician to manage the electrical engineering labs and to provide support for faculty and students.

The listed tables to provide information about Core. An asterisk (*) indicates the individual who will have direct administrative responsibilities for the program.

Table 6: B.S. of Electrical and Computer Engineering Faculty

Name of Core Faculty and Faculty Rank	Highest Degree	% of time assigned to the Program
Salem, Asad * [Primary responsibility for administering the program]	PhD in Mechanical Engineering	25
New Faculty (I) in Year 2017-18	PhD in Electrical Engineering	75
New Faculty (2) in Year 2017-18	PhD in Electrical/ Computer Engineering	75
New Faculty (3) in Year 2017-18	PhD in Electrical Engineering	75
New Faculty (4) in Year 2018-19	PhD in Electrical Engineering	75
New Faculty (5) in Year 2018-19	PhD in Electrical/Computer Engineering	75

Faculty Course Load Mapping

The following table shows a typical faculty course load when the program is fully staffed and implanted.

Table 7: Course Offerings by Semester

	Fall	Faculty	SCH	Spring	Faculty	SCH
2019-20	ENGR 201	Faculty I	4	ENGR 202	Faculty I	4
	ENGR 204	Faculty II	4	EEC 330	Faculty I	3
	EEC 210	Faculty II	3	EEC340	Faculty II	4
	EEC 310	Faculty III	3	EEC 370	Faculty III	3
	EEC 320	Faculty III	3	EEC 380	Faculty V	3
	EEC 350	Faculty IV	3	EEC 420	Faculty IV	3
	EEC 360	Faculty I	3	EEC Elective IV	Any	3
	EEC 410	Faculty IV	3	EEC Elective V	Any	3
	EEC 412	Faculty V	3			
	EEC Elective I	Any	3			
	EEC Elective II	Any	3			
	EEC Elective II	Any	3			

From the above listed table, it is noticed that during a typical academic year the teaching load for a designated BSEE faculty is 7-8 Credit Hours in fall and 6-7 Credit Hours in spring of undergraduate related courses.

4. Library Resources and Instructional Materials

MU libraries have many of the resources necessary to support a new program in Electrical and Computer Engineering. Monographic, journal and database holdings enable the libraries to provide initial support for the program. Most of the resources available are not discipline specific but are available through multidisciplinary databases and may provide the depth of breadth of material required to support such a degree. Keeping in mind, MU libraries are currently supporting the BSE and the MSE, BSCS, MSCS, BSIS, MSIS, BSME and MSME programs. However, some improvements in the collections will be required to ensure that they can adequately support the Electrical and Computer Engineering program consistently over the long-term.

The College of Information Technology and Engineering (CITE) will require at least one additional full-text database, IEEE, to support existing BSCS, MSCS, MSIS and future programs in Electrical and Computer Engineering. This shared resource will cost approximately $20,000 for the first year, with estimated increase in costs of 10-20% per year annually (based on increases for comparable databases). Additional costs will be incurred for the purchase of electronic full-test reference resources, standards, technical manuals and guides, and monographs to support the program. Additional funding needed in the first year will be approximately $20,000 for these resources. Maintenance costs for these resources will be recurring annually and will be established at the time of contract negotiation and signing. However, it is

projected that the required additional resources will cost about $125,000 during the first five years (please refer to the spread sheet in Appendix F).

5. Support Services Requirements

The approach for building this Program proposal has been to leverage MU resources and complement engineering programs of other organizations to meet the State's needs for practicing engineers. The needed facilities (teaching labs, research labs, computer labs, classrooms, and offices) for the BSEE will require approximately 6,000 square feet. All needed space will be accommodated in the Weisberg Family Applied Engineering Complex (WAEC), the Weisberg Engineering Lab (WL), and Gullickson Hall (GH).

CITE has five related laboratories (Circuits, Controls, and Computers) that are associated with the existing engineering program. Most of these facilities can be utilized as associated electrical and computer engineering laboratories with the proper equipment complement. In addition to the five existing laboratories, a Capstone lab with moderate capabilities and five new laboratories are needed to provide specialized electrical and computer engineering teaching and research competences. The needed laboratories are: Power Systems, Electronics and Power Electronics, Communication, Digital and Embedded Systems, and Microprocessor Systems and Interfacing.
The following equipment is needed in the next three years of the program for the basic teaching labs:

Table 9: Needed Equipment

Equipment	Yr. 1	Yr. 2	Yr. 3	Cost
Power Systems (GH 05)	$45,000	$70,000	$50,000	$165,000
Communications (GH 205)		$75,000	$75,000	$150,000
Electronics and Power Electronics (WAEC 2218)	$30,000	$35,000	$10,000	$75,000
Digital and Embedded Systems (WL 101)	$30,000	$40,000	$55,000	$125,000
Microprocessor and Interfacing (WL)		$50,000	$50,000	$100,000
Capstone (WL)		$20,000	$20,000	$40,000
Total	$105,000	$290,000	$260,000	$655,000

The total projected, therefore, for the teaching labs for the basic electrical and computer engineering courses is $655,000. Budget projections include $10,000/year for normal supplies and materials for the first three years and $6000/year thereafter.

6. Facilities Requirements

Adequate resources exist for laboratory and support services. No new needs are anticipated. Space for classrooms is adequate. The proposed program will not require the addition of new space or facilities or the remodeling or renovation of existing space.

7. Operating Resource Requirements

Normal operating expenses will be necessary for his program. Office space for the additional faculty is available. Additional office supplies would be required, along with voice and data services and devices. Other requirements may include nonrecurring expenses such as program start-up/development expenses

are presented in FORM 2 and in the attached spreadsheet (Appendix F). The operational budge will come from student tuitions and fees.

8. Expenses and Revenue Projection

All operational support will come from student tuitions and program specific fees.

FORM 2 and a spread-sheet (Appendix F) show the operating resources requirements as well as the sources of operating resources, including personnel expenses, and nonrecurring expenses (such as program start-up/ development expenses), annual operating expenses. It also, shows the total and net annual revenues and the cumulative return.

Form 2: Five-Year Projection of Total Operating Resources

	First Year 2016	Second Year 2017	Third Year 2018	Fourth Year 2019	Fifth Year 2020
A. FTE POSITIONS					
1. Administrators	0.25	0.25	0.25	0.25	0.25
2. Full-time Faculty	0	3	5.0	5.0	5.0
3. Adjunct Faculty	0	0	0	0	0
4. Graduate Assistants	0	0	0	0	0
5. Other Personnel:					
a. Clerical Workers	0.0	0.0	0.0	0.0	00
b. Professionals	0.0	1.0	1.0	1.0	1.0
B. OPERATING COSTS (Appropriated Funds Only)					
1. Personal Services:					
a. Administrators	$ 38,100	$ 39,243	$ 40,420	$ 41,633	$42,882
b. Full-time Faculty	$0.0	$372,818	$ 466,181	$480,166	$494,571
c. Adjunct Faculty	$8,000	$0.0	$0.0	$0.0	$0.0
d. Graduate Assistants	$0.0	$0.0	$0.0	$0.0	$0.0
e. Non-Academic Personnel:					
Clerical Workers	$0.0	$0.0	$0.0	$0.0	$0.0
Professionals	$0.0	$64,751	$66,693	$68,694	$70,755
Total Salaries	$46,100	$476,812	$573,294	$590,493	$608,208
2. Current Expenses (Recurring)	$20,000	$20,000	$11,000	$9,000	$9,500
3. Repairs and Alterations	$0.0	$0.0	$0.0	$0.0	$0.0
4. Equipment:					
Educational Equip.	$105,000	$280,000	$260,000	$0.0	$0.0
Library Books	$15,000	$25,000	$25,000	$30,000	$30,000
5. Nonrecurring Expenses : See the attached spreadsheet	$28,000	$76,100	$110,736	$81,785	$50,542
Total Costs	$214,100	$857,912	$980,030	$711,278	$698,250
C. Sources					
1. General Fund Appropriations	$239,451	$452,131	$646,934	$844,181	$967,993
D. Net Revenue	$25,351	($405,781)	($333,096)	$132,903	$269,743

Appendix A
Bachelor of Science –Electrical & Computer Engineering (BSEE)

Pattern Sheet

Semester 1	SCH	Semester 2	SCH
MTH 229 Calculus I (CT)	5	MTH 230 Calculus II	4
ENG 101 English Composition I	3	Core II Social Science (CT,W/I,W)	3
FYS 100 First Year Seminar	3	PHY 211 Physics I	4
Core II Communications (W/I)	3	CS 110: Computer Science I	3
ENGR 103 Freshman Seminar	1	CHM 211 Chemistry I	3
ENGR 104 Engineer. Profession	1		
	16		17
Semester 3		Semester 4	
MTH 231 Calculus III	4	ENGR 202: Circuits II	4
EE 210 Programming Lab	3	MTH 220 Discrete Structures	3
ENGR 201 Circuits I	4	MTH 335 Diff. Equations	3
PHY 213 Physics II	4	ENGR 217 Co-Op	1
PHY 204 Physics II lab	1	ENGR 265 Engineering Analysis	4
		ENGR 215 Engr. Materials	3
	16		18
Semester 5		Semester 6	
EE310 Electromagnetic Fields	3	ENG 201 English Composition II	3
EE320 Signals & Systems	3	EE 330 Random Signals & Systems	3
EE 360 Linear Systems & Control Theory	3	EE 370 Electric Machinery and Power systems^ Or EE 380 Microprocessors**	3
ENGR 204 Introduction to Digital Systems	4	ENGR 221 Engr. Econ	3
EE 350 Elec. Properties of Materials	3	EE 340 Computer Architecture & Design	4
	16		16

Semester 7		Semester 8	
EE 410 **Electrical** Engineering Design^ or EE 412 Computer Engineering Design**	3	EE 420 Capstone	3
ENGR 451 Project Management (W/I)	3	EEC Elective ***	3
EE Elective ***	3	EEC Elective***	3
EE Elective***	3	Free Elective	3
EE Elective***	3	Core II, Fine Arts	3
Core II, Humanities	3		
	18		15
		Total Credits:	132

** Computer Engineering Area of Emphasis
^ Electrical Engineering Area of Emphasis
*** To support the Areas of Emphasis

Appendix B

Weisberg Division of Engineering
Bachelor of Science – Electrical & Computer Engineering (BSEE)

Cooperative Education Program
Student Schedule Layout
OPTION I

	Fall	Spring	Summer
Freshman Year	Classes	Classes	
Sophomore Year	Classes	Classes	
Junior Year	Classes Apply to CO-OP	CO-OP	CO-OP
Senior Year 1	Classes	Classes	CO-OP
Senior Year 2	CO-OP	Classes	

FRESHMAN YEAR & SOPHOMORE YEAR

Students spend their freshman and sophomore years in classes trying to earn the highest GPA as possible. In the summer between freshman and sophomore and the summer between sophomore and junior year, students are encouraged to pursue internships, participate in research, or take summer courses to get ahead or improve GPAs. These years should be dedicated to building strong resumes for the Co-Op program.

JUNIOR YEAR

FALL: Students apply to the CO-OP program, attend an orientation meeting, attend all professional preparation meetings, and interview with companies looking for students.

SPRING and SUMMER: Students gain full-time engineering experience at a company while receiving pay.

SENIOR YEAR 1

FALL: Students continue their education and complete more classes.

SPRING: Students continue to take classes, but again go through the interview process for a second CO-OP position. This position could be with the same company the student first CO-OPed with, but does not need to be. Many students prefer to explore multiple kinds of companies.

SENIOR YEAR 2

FALL: Students continue their second CO-OP experience.

SPRING: Students complete their final semester of classes in order to graduate. CO-OP students report ease in finding full-time positions in a competitive market due to their professional experience.

OPTION II

	Fall	Spring	Summer
Freshman Year	Classes	Classes	
Sophomore Year	Classes	Classes Apply to CO-OP	CO-OP
Junior Year	CO-OP	Classes	CO-OP (Optional)
Senior Year 1	Classes	CO-OP	CO-OP
Senior Year 2	Classes	Classes	

FRESHMAN YEAR & SOPHOMORE YEAR

Students spend their freshman and sophomore years in classes trying to earn the highest GPA as possible. In the summer between freshman and sophomore years, students are encouraged to pursue internships, participate in research, or take summer courses to get ahead or improve GPAs. These years should be dedicated to building strong resumes for the CO-OP program.

SOPHOMORE

SPRING: Students apply to the CO-OP program, attend an orientation meeting, attend all professional preparation meetings, and interview with companies looking for students.

SUMMER: After accepting a CO-OP position in the spring, students spend the summer gaining full- time, paid, engineering experience at a company.

JUNIOR YEAR

FALL: Students continue to gain full-time, paid, engineering experience at a company.

SPRING: Students resume taking and completing coursework.

SUMMER: Some students will be given the opportunity by their companies to complete a summer CO-OP. While only the length of a typical internship, summer CO-OP students are typically still provided the same level of work as a CO-OP because they do not need to be retrained by the company. This extra summer CO-OP is not required for the program.

SENIOR YEAR 1

FALL: Students resume taking classes, but again go through the interview process for a second CO-OP position. This position could be with the same company the student first CO-OPed with, but does not need to be. Many students prefer to explore multiple kinds of companies.

SPRING: After accepting a CO-OP in the fall, students gain full-time, paid, engineering experience at a company.

SENIOR YEAR 2

FALL: Students resume taking classes.

SPRING: Students complete their final semester of classes in order to graduate. CO-OP students report ease in finding full-time positions in a competitive market due to their professional experience.

Appendix C

Letters of Support

Catlettsburg Refining, LLC
A subsidiary of Marathon Petroleum Company LP

To Whom It May Concern:

On behalf of Marathon Petroleum Corporation I would like to express support for the development and accreditation of an Electrical and Computer Engineering program at Marshall University. Marathon maintains a strong presence in the Huntington, WV, area in the form of our Catlettsburg (KY) Refinery, and other local facilities. 85 Marshall graduates are currently employed at the Catlettsburg site but only two of those are recent engineering graduates. Having a vibrant Electrical and Computer Engineering presence locally would provide an excellent source of engineers for Marathon and a source of jobs for Marshall graduates.

Marathon employs a large number of engineers throughout our seven-refinery system and support groups. The Catlettsburg Refinery currently employs 113 degreed chemical, mechanical, electrical, and civil engineers. We utilize Electrical Engineers in a variety of roles including project engineering, project management, maintenance support, and equipment and instrument reliability in addition to supervisory positions. We also utilize a robust co-op student program that involves the employment of engineering students to fill over 80 year-round positions. Marathon would welcome a quality, local source of engineers to fill these full-time and co-op positions.

Currently we recruit at a number of universities within reasonable proximity to our refineries including several that surround Marshall (Virginia Tech, West Virginia Tech, Ohio State, Toledo, Cincinnati, Louisville, Kentucky). Marshall would make a nice fit into our recruiting network and Marathon would provide an attractive source of employment opportunities for Marshall EE graduates.

In summary, Marathon wholeheartedly supports the continued development of Marshall's Engineering Department in general and the Electrical and Computer Engineering Department in particular. A recent forecast by Kelly Services quoted in Civil Engineering magazine (September 2014) predicts an increase of almost 250,000 engineering jobs in the US economy in the next ten years of which over 16,000 of those will be electrical engineers. With the continued growth in the oil and gas sector including the Utica and Marcellus shale areas in West Virginia, Ohio, Pennsylvania, and New York, many of those jobs will be very reachable for Marshall graduates. Now is an excellent time to begin meeting the needs of the engineering market.

Sincerely,

Richard Hernandez
Division Manager
Catlettsburg Refining, LLC

ZMM
ARCHITECTS & ENGINEERS

September 18, 2015

Asad A. Salem, Ph.D
Professor and Chair
Weisberg Division of Engineering
College of Information Technology and Engineering
Marshall University
Huntington, WV 25755-2586

Dear Dr. Salem:

This letter is written in strong support of Marshall University adding Electrical and Computer Engineering (BSEEC and MSEEC) to the Weisberg Division of Engineering.

ZMM, Inc., Architects and Engineers, in addition to hiring architectural personnel, hires engineers in the disciplines of structural, civil, mechanical and electrical engineering. By far the most difficult position to fill is that of a Professional Electrical Engineer. It sometimes takes us years to fill a position.

Electrical and computer engineering is a diverse field with many job opportunities. ZMM looks for candidates in the building industry field primarily in power, communication, and data distribution.

I think a BSEEC and MSEEC are critical in building a comprehensive College of Engineering.

I applaud Marshall University for initiating the engineering curriculum. It is a great asset to the State of WV and our area.

ZMM will be pleased to work with the Weisberg Division of Engineering to provide summer internships at our office in Charleston.

Sincerely,

ZMM, INC.

Robert Doeffinger

Robert Doeffinger, PE, BSME, MSAE
President

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September 17, 2015

Dr. Asad Salem, Ph.D.
Professor and Chair
Weisberg Division of Engineering
College of Information Technology and Engineering
Marshall University
Huntington, WV 25755-2586

Re: Support for Electrical and Computer Engineering Programs at Marshal University

Dear Dr. Salem:

As President of the West Virginia ASHRAE (WV ASHRAE) Chapter, I would like to thank you for working with us to bring our November 20, 2015 chapter meeting and technical session on ASHRAE Standard 189.1 – "Standard for the Design of High-Performance Green Buildings" to Marshall University. We are also looking forward to touring the new Engineering Complex as part of our visit to Marshall.

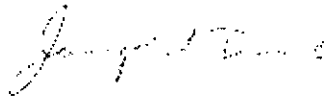
I, as both an engineer for ZDS Design and WV ASHRAE President, would also like to thank you for contacting me about the growing Engineering degree program at Marshall University. It is exciting to see the expansion of the Engineering programs being offered at Marshall, and I am fully in support of adding the Electrical and Computer Engineering degree programs to the College. This will present an excellent opportunity for students not only from West Virginia, but also the neighboring areas of Ohio and Kentucky to continue their educational pursuits of these degrees within the State of West Virginia.

Graduates from these programs will provide this area of the State and beyond a much needed Professional resource for development and enhancement of technology based services as well as contributions to our local and regional economy. These individuals will be highly sought after in the years to come, given the advancements in technology, especially in the fields of energy conservation, development of alternative energy sources and sustainability projects. These are high profile issues in our industry and major topics of ASHRAE support around the world.

On behalf of the WV ASHRAE, we would like to congratulate Marshall University for having the vision to expand the Engineering degree programs it will offer in the near and foreseeable future.

If I, or WV ASHRAE, can be of further assistance, please do not hesitate to contact me.

Sincerely,



Jennings, L. Davis II, P.E.
WVASHRAE President
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281 Smiley Drive
St. Albans, WV 25177
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Email: jennings.davis@zdsdesign.com

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Branch: P.O. Box 369 • Jeff, Kentucky 41751
Branch: P.O. Box 707 • Danville, WV 25053

September 9, 2015

Asad A. Salom, Ph. D
Professor and Chair
Weisberg Division of Engineering
College of Information Technology & Engineering
Marshall University
Huntington, WV 25755-2586

Dear Dr. Salom,

Thank you for your recent communication detailing the two new electrical engineering degrees you are proposing at Marshall. As a past President of an electrical service company in West Virginia, I know first-hand how lacking we are in these areas. We could not find any applicants in the Tri-State that had this kind of educational accreditation.

I am in full support of both new degrees. I feel not only will you be able to fill currant job vacancies but will create new, whereas, unseen opportunities for high paying careers. Please let me know if I can assist you in this process.

Best Regards,

Danny A. Vance

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www.enengineering.com

10 September 2015

Asad A. Salem, Ph.D
Professor and Chair
Weisberg Division of Engineering
College of Information Technology and Engineering
Marshall University
Huntington, WV 25755-2586
304-696-3207
salema@marshall.edu

SUBJECT: Letter of Support for Electrical Engineering Programs at Marshall University

Dear Asad:

I was very happy to get your note about the addition of Electrical and Computer Engineering to your existing programs at the Weisberg Division of Engineering at Marshall University. We here at EN Engineering are excited about the relationship we have developed with you, your staff, and students. We currently have nine (9) civil engineering staff members that are Marshall Graduates or current students:

1. Adam Weible
2. Jacob Browning
3. Chris Brumfield
4. Kyle Merritt
5. Morgan Ferguson
6. Jonathan Lambert
7. Zachary Hatfield
8. Brigham Ash
9. Bryce Merritt

We look forward to the opportunity to interview Marshall Mechanical Engineering students / graduates in the near future and Electrical and Computer Engineers as soon as they become available. We also have an extensive student intern / co-op program in which we fully expect Marshall Student's to be heavily involved and represented. This is an exciting time for the education of engineers and the profession of engineering as a whole in the Tri-State Area. EN Engineering is interested and willing to support the Weisberg Division of Engineering in any way possible to improve the education of future engineers.

EN Engineering is a national, full service engineering firm concentrated on work in the Energy Market. Here at our Catlettsburg office, we concentrate on Industrial Solutions providing engineering consulting services to industrial facilities such as refineries, bulk product terminals, chemical production, steel making, manufacturing, and the natural gas industry. We have a full complement of engineering disciplines here in Catlettsburg with civil/structural, mechanical, chemical, and electrical engineers along with specialty designers and drafters.

Our electrical work is made up of power distribution, instrumentation, PLC controls & programing, and automation. For the last several years, electrical engineers have been the most difficult discipline to attract and hire in this geographic region. We currently have unfulfilled needs for electrical engineers. The ability to have EE students and graduates at Marshall could obviously be a great benefit to a firm such as EN Engineering.

We would fully support the BS & MS in Electrical and Computer Engineering (BSEEC & MSEEC) at Marshall University. Please do not hesitate to contact us for ways to support your programs. We are willing to participate in senior design projects, provide guest speakers for classes / seminars, participate on advisory boards, or any other activity you feel beneficial to your students or staff. We hope you will allow us to assist you wherever possible to help train excellent future engineers.

Thank you for keeping EN Engineering informed of your plans and goals for the expanded engineering programs at Marshall. We look forward to our continued relationship and the interaction with your students of all engineering disciplines.

Sincerely,

Jason C. Merritt, P.E.
Senior Project Manager
Industrial Solutions Business Unit
O: 606-653-1420
C: 304-544-5034
jmerritt@enengineering.com

Attachments:

1. EN Engineering Electrical Brochure
2. EN Engineering Automation Brochure
3. EN Engineering Industrial Solutions Brochure

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September 21, 2015

Asad A. Salem, Ph.D.
Professor and Chair
Weisberg Division of Engineering
College of Information Technology and Engineering
Marshall University
Huntington, WV 25755-2586

Re: Electrical and Computer Engineering

Dear Dr. Salem:

Please consider this as a complete endorsement of the proposal to add degrees in Electrical and Computer Engineering.

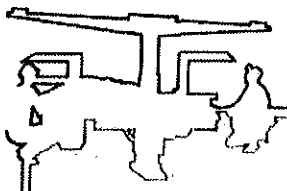
GRW employs over two hundred fifty in the fields of civil, mechanical, structural and electrical engineering in a five-state area. By far the most difficult to recruit is electrical engineers. The demand for electrical engineers is significant and academy must take bold steps if our region is to compete in the global economy.

I urge complete support from everyone connected to Marshall and the tristate region to support the addition of these two programs.

Very truly yours,

Ron D. Gilkerson, PE
President

RDG/rf



J. H. FLETCHER & CO. Box 2187 — Huntington, WV 25722-2187 — 304/525-7811 — FAX 304/525-3770

September 8, 2015

Subject; Marshall Letter of Support

To whom it may concern,

My company is J. H. Fletcher & Company, (Fletcher®). Fletcher is located in Huntington, West Virginia. Fletcher is the world's leading supplier of underground mining roof bolters. We design and manufacture roof bolters and other specialized mining equipment that keeps miners safe. We have supplied equipment for mines all around the world.

Fletcher is located in the tri-state location of Northeast Kentucky, Southeast Ohio, and Western West Virginia. Our tri-state region is in need of a university located in our community offering engineering classes and degrees.

We are in support of Marshall University establishing degree programs in both BS and MS in Electrical and Computer Engineering, (BSEEC & MSEEC). We feel our company can benefit greatly by partnering with Marshall to establish a strong and accredited engineering program in our community. Not only does Fletcher benefit but so does our tri-state community giving our children options of gaining a quality engineering education close to home.

Please let it be known J. H. Fletcher & Co fully supports Marshall University as it establishes and advances its engineering program.

Sincerely,

Tim Burgess, PE
Vice President of Engineering
J. H. Fletcher & Co.

Cc Doug Hardman
Rod Duncan
Greg Hinshaw

Salem, Asad

From: Mary Jo Hendricks <hendri4@aol.com>
Sent: Sunday, September 20, 2015 2:57 PM
To: Salem, Asad
Subject: Re: Letter of support for Electrical and Computer Engineering

Asad,
My apologies for completing this via email versus a formal letter of support for adding the two degrees in Electrical and Computer Engineering, but due to your timing needs, this was the most expedient.

As you know, I have a Bachelor of Science in Electrical Engineering from West Virginia Institute of Technology, now WVU Tech, in Montgomery,WV. My engineering degree served me well. I was able to retire from Union Carbide/Dow with 30 years of service. During my career, I served in every facet of engineering from electrical design, operation (both electrical distribution systems and chemical operations), maintenance of our technology site, site leader of our technology site, infrastructure technology leader worldwide, electrical and mechanical technology leader worldwide, distribution (barge, rail, truck, and drums) leader for the Kanawha Valley, and the health, safety, and environmental operations leader worldwide. It was a challenging and rewarding career.

When I was asked to be on the Advisory Board for Engineering at Marshall, I was thrilled. It has been very satisfying to see the journey from defining the program, receiving the Bachelor of Engineering accreditation, expanding to include emphasis in civil and mechanical engineering, and now expanding to include electrical and computer engineering. To see the involvement and commitment from business leaders and the school to reaching this level has been remarkable.

Engineering is our future. We must have qualified engineers to compete in the world today. And we can do that through the Engineering Program at Marshall University. The new engineering building is state of the art and will serve the program for many years to come. Students will want to come to Marshall for their engineering degree and we need to be able to offer the various disciplines.

I wholeheartedly support the addition of the degrees for electrical and computer engineering.

Thank you for the opportunity to comment,

Mary Jo Hendricks

Sent from my iPad

On Sep 7, 2015, at 2:23 PM, Salem, Asad <salema@marshall.edu> wrote:

> Dear All,
>
> The Weisberg Division of Engineering is in the process of adding two degrees in Electrical and Computer Engineering to the our existing General Engineering-Civil Emphasis (BSE-CE) and Mechanical Engineering (BSME and MSME). The aim of these two degrees, BS in Electrical and Computer Engineering (BSEEC) and MS in Electrical and Computer Engineering(MSEEC), is to graduate electrical and computer engineers to meet the increasing technological demands of West Virginia's and the Tri-State region . Graduates of this Program will contribute to West Virginia's and the Tri-State economic development, advance its competitive edge globally and contribute to improvement in the quality of life.
>
> Electrical engineering is a field of engineering that generally deals with the study and application of electricity, electronics, and electromagnetism. The fields of Electrical and computer engineering cover a

wide range of subfields including electronics, power engineering, telecommunications, control systems, radio-frequency engineering, signal processing, instrumentation, microelectronics, digital systems including hardware, software, compliers and operating systems, coding, cryptography, network, mobile and distributed computing system, and physical cyber systems and security. As such, the BSEEC program at Marshall University (MU) will prepare graduates with a BSEEC with two areas of emphasis: general electrical engineering, and computer engineering. It will, also, emphasize service, systems-based knowledge, and sustainability with an eye toward the interface of traditional electrical and computer engineering with new and emerging fields. In accordance with the standards set forth by the Accreditation Board for Engineering and Technology (ABET) and MU's mission, the specific educational objectives of this program are to graduate students who will:

1. Practice the electrical and computer engineering discipline successfully within community-accepted standards
2. Possess teamwork and communications skills to develop a successful career in electrical engineering
3. Fulfill professional and ethical responsibilities in the practice of electrical engineering, including social, environmental and economic considerations,
4. Engage in professional service, such as participation in professional society and community service
5. Engage in life-long learning activities, such as graduate studies or professional workshops, and
6. Develop a professional career in the prevailing market that meets personal goals, objectives and desires

Accordingly, graduates will have the ability to work professionally and ethically, as individuals and in multi-disciplinary teams, in both the electrical and computer areas, including the design, manufacture, and control of such systems. Moreover, they will develop a deep understanding of the impact of engineering solutions from a global, financial, environmental, societal, political, ethical, health and safety, and sustainability perspectives.

The purpose of this communication is to solicit your written support for these two programs. Your written support can be in form of a support letter addressed to me (sent as an attachment) or in form of an email. I am planning to submit the formal request of these two programs for the University approval on Monday September 21st, 2015.

Your support in this matter is valuable and highly appreciated.

Best Regards

Asad

Asad A. Salem. Ph.D
Professor and Chair
Weisberg Division of Engineering
College of Information Technology and Engineering
Marshall University
Huntington, WV 25755-2586
304-696-3207

Salem, Asad

From: Dewey Bocook <dbocook@bocook.com>
Sent: Tuesday, September 08, 2015 1:57 PM
To: Salem, Asad
Subject: Electrical and Computer Engineering Programs

Dear Asad,

I am writing to show my support for proposal to a two degrees in Electrical and Computer Engineering to the existing Engineering programs at Marshall University. As owner and President of Bocook Engineering, Inc. I see only positive results from the addition of the Electrical and Computer Engineering Degrees to Marshall's curriculum. The addition of the Electrical and Computer Engineering Degrees will not only help make Marshall's Engineering a more rounded program, it will be adding two fields of engineering that are essential in the development of our region. Our life's would be unthinkable without the use of electrical energy and its application. The growing utilization of electricity and computers is a decisive prerequisite for a rapid development of industry as well as agriculture.

A few examples will show the importance of electrical energy and the associated engineering. Electrical lighting is indispensable for working during the dark hours of the day. With increasing industrialization, a growing proportion of electrical energy is used for the lighting of shops, offices, dwellings and for outdoor lighting. Man is relieved from heavy physical labor by the use of electrical devices. The drive of machines, hoisting gear and lifts is enabled in a simple form by the electromotor which in railway transport also has the advantage over internal combustion engines. There are many buildings where an air-conditioning system including heating, cooling and ventilation is installed for the operation of which electrical energy is required. At higher ambient temperatures, foodstuffs can only be kept for a prolonged period of time in refrigerators or cold-storage rooms which usually are also operated with electrical energy.

Computer engineering can be seen in our day to day lives and has a vast impact on our lifestyles and jobs. Mobile phones, digital video cameras, audio players, microwave ovens, aircrafts, security systems, laser equipment, automobiles, virtually every aspect of our lives have computer engineering involved. Most people today rely on computer engineering to help enhance their lives. Business establishments are constantly perfecting their products and services using computer engineering to deliver and meet the demands of their fields. They have very high budgets for research and design, especially those in electronic and engineering fields. Computer engineers are expected to take their computer engineering skills to new heights in the future.

Engineers and engineering has one paramount reason: benefiting humankind. In modern society, we are constantly interacting with our environment. We harvest and extract all the resources that we need to sustain human life and culture human enterprise. It is the role of the engineer to minimize the effects of damage on the surrounding ecosystems, and design necessary infrastructures that are both efficient and safe. Both Electrical and Computer Engineering serve to enhance these efforts.

In conclusion, I strongly support adding both the Electrical and Computer Engineering Degrees to Marshall's Engineering Program. As a graduate of Marshall's Engineering Program, I know benefits of having a quality Engineering Program in the Region. I will definitely support this effort both financially and with time and effort.

If there is anything that I can do to facilitate this effort, please don't hesitate to contact me at your earliest convenience.

Dewey L. Bocook, Jr. PE, PLS
Telephone 606-789-5961 ext. 20 Office
606-789-7671 Fax
606-793-1115 Cell

Dewey L. Bocook, Jr. PE, PLS
Telephone 606-789-5961 ext. 20 Office
606-789-7671 Fax
606-793-1115 Cell

Salem, Asad

Subject: RE: Letter of support for Electrical and Computer Engineering

From: Charlie Neighborgall [mailto:charlie3@neighborgall.com]
Sent: Saturday, September 19, 2015 8:23 PM
To: Salem, Asad <salema@marshall.edu>
Subject: RE: Letter of support for Electrical and Computer Engineering

Per your email of 9/7/15, I completely support the adding of the BSEEC and MSEEC programs to the Marshall University engineering program. They will be very beneficial to our construction industry in West Virginia and the Tri-State Area.
Charles R. Neighborgall III
Chairman
The Neighborgall Construction Company
Huntington West Virginia
Serving the construction industry for over 90 years.

From: Salem, Asad [mailto:salema@marshall.edu]
Sent: Monday, September 07, 2015 2:24 PM
To: gary@aecvis.com; dbocook@bocook.com; sgbpe@comcast.net; tburgess@jhfletcher.com; sean.c.carter@usace.army.mil; curtis.martin@tema.toyota.com; mday@patriotcoal.com; rfisher@specialmetals.com; RGilkerson@grwinc.com; khainer@alphanr.com; dhardman@jhfletcher.com; hendri4@aol.com; Paul.A.Mattox@wv.gov; Mia.D.Crookshanks@wv.gov; Carole.A.McCoy@dom.com; Dmeadows@triadeng.com; Charlie Neighborgall <charlie3@neighborgall.com>; jrichardson@whiteoakresoruces.com; David.S.Webb@chemours.com; jmerritt@enengineering.com; drschlaeppi@marathonpetroleum.com; Jeffery_Weatherford@csx.com; joan.weisberg@arthursent.com; forresmd@middough.com; Mark W. Trimble, PE <mtrimble@huntingtonsteel.com>; Cinda Kahl <ckahl@swvainc.com>; james.ware@stateelectric.com; Sonya.Varney@servicewire.com
Subject: Letter of support for Electrical and Computer Engineering

Dear All,

The Weisberg Division of Engineering is in the process of adding two degrees in Electrical and Computer Engineering to the our existing General Engineering-Civil Emphasis (BSE-CE) and Mechanical Engineering (BSME and MSME). The aim of these two degrees, BS in Electrical and Computer Engineering (BSEEC) and MS in Electrical and Computer Engineering (MSEEC), is to graduate electrical and computer engineers to meet the increasing technological demands of West Virginia's and the Tri-State region . Graduates of this Program will contribute to West Virginia's and the Tri-State economic development, advance its competitive edge globally and contribute to improvement in the quality of life.

Electrical engineering is a field of engineering that generally deals with the study and application of electricity, electronics, and electromagnetism. The fields of Electrical and computer engineering cover a wide range of subfields including electronics, power engineering, telecommunications, control systems, radio-frequency engineering, signal processing, instrumentation, microelectronics, digital systems including hardware, software, compliers and operating systems, coding, cryptography, network, mobile and distributed computing system, and physical cyber systems and security. As such, the BSEEC program at Marshall University (MU) will prepare graduates with a BSEEC with two areas of emphasis: general electrical engineering, and computer engineering. It will, also, emphasize service, systems-based knowledge, and sustainability with an eye toward the interface of traditional electrical and computer engineering with new and emerging fields. In accordance with the standards set forth by the Accreditation Board for Engineering and Technology (ABET) and MU's mission, the specific educational objectives of this program are to graduate students who will:

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Accordingly, graduates will have the ability to work professionally and ethically, as individuals and in multi-disciplinary teams, in both the electrical and computer areas, including the design, manufacture, and control of such systems. Moreover, they will develop a deep understanding of the impact of engineering solutions from a global, financial, environmental, societal, political, ethical, health and safety, and sustainability perspectives.

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Your support in this matter is valuable and highly appreciated.

Best Regards

Asad

Asad A. Salem, Ph.D
Professor and Chair
Weisberg Division of Engineering
College of Information Technology and Engineering
Marshall University
Huntington, WV 25755-2586
304-696-3207

WE ARE ... **MARSHALL**

Appendix D

Course Descriptions

ENGR 265 Engineering Analysis: Mathematical and analytical solutions of linear and power systems that involve linear algebra, Fourier analysis, and complex variables (4 C.H, pre-requisite: MTH231).

EE 210 Programming Lab: This class provides an intensive programming experience that integrates core concepts in computer programming and familiarizes students with a variety of programming/development tools and techniques (3 C.H, pre-requisite: CS 110).

EE 310 Electromagnetic Fields: Vector analysis, Maxwell's equations, wave propagation in unbounded regions, reflection and refraction of waves, transmission line theory; introduction to waveguides and antennas (3 CH, Pre-requisite: ENGR 265).

EE 320 Random Signals and Systems: Concepts of probability and random variables necessary for study of signals and systems involving uncertainty; applications to elementary problems in detection, signal processing and communication (3 CH., Pre-requisite: MT335).

EE 330 Analysis of Signals and Systems: Introduction to the continuous-time and discrete-time signals and systems; time domain characterization of linear time-invariant systems; Fourier analysis; filtering; sampling; modulation techniques for communication systems (3 CH, pre-requisite: EE 320).

EE 340 Computer Architecture and Design: Fundamentals of Computer Design, Memory Hierarchy Design, Processor Design, Instruction-Level Parallelism and its exploitation, Pipelining, Superscalar architectures, Super-pipelining architectures, VLIW systems, and Control Design of Hardwired and Micro-programmed (4 CH, Pre-requisite: EE210, ENGR 202).

EE 350 Electrical Properties of Materials: Introduction to basic physical properties of solid materials; some solid state physics employed, but major emphasis is on engineering applications based on semiconducting, magnetic, dielectric and superconducting phenomena (3 CH, pre-requisite: ENGR 215).

EE 360 Linear Systems & Control Theory: Application of state variable and frequency domain techniques to modeling, analysis and synthesis of single input, single output linear control systems (3 CH, pre-requisite: ENGR 265).

EE 370 Electric Machinery and Fundamentals of Power Systems: Fundamentals of energy-handling electric circuits, power electronic circuits such as inverters, and electromechanical apparatus, modeling of magnetic field devices and description of their behavior using appropriate models, simplification of problems using transformation techniques, analysis of power electric circuits, magnetic circuits, and elements of linear and rotating electric machinery use of lumped parameter electro-mechanics to understand power systems models of synchronous, induction, and DC machinery, and the interconnection of electric power apparatus and operation of power systems (3CH,Pre-requisite: EE 310).

EE 380 Microprocessor Design: Introduction to microprocessors; 16/32 bit single board computer hardware and software designs; chip select equations for memory board design, serial and parallel I/O interfacing; ROM, static and dynamic RAM circuits for no wait-state design; assembly language programming, stack models, subroutines and I/O processing (3 CH, pre-requisite: ENGR 204).

EE 410 Electrical Engineering Design: Application of design process and project engineering as practiced in industry; team approach to the design process; development of a project proposal; proposed project implemented in EE 420 (3 CH, Pre-requisite: Advisor Approval).

EE 412 Computer Engineering Design: Introduction to the design process and project engineering as practiced in industry; student teams apply the design process by developing a project from proposal; proposed project implemented in EE 420 (3 CH, Pre-requisite: Advisor Approval).

EE 420 Capstone: Continuation of EE 410 or EE412; application of the design process and project engineering as practiced in industry; team approach to the design process; completion of project based

on proposal from EE410 or EE412; includes testing, evaluation and report writing (3 CH, Pre-requisite: Advisor Approval).

EE 440 Digital Control Systems: Feedback systems in which a digital computer is used to implement the control law; Z-transform and time domain methods serve as a basis for control systems design. Effects of computer word length and sampling rate (3 CH, Pre-requisite: Advisor Approval).

EE 445 Radio Frequency and Microwave Engineering: Fundamental Radio Frequency (RF) and microwave circuit analysis: scattering and ABCD matrices, return loss, insertion loss; transmission lines, lumped elements, impedance matching; theory, analysis and design of basic RF and microwave passive circuits; use of commercial CAD programs for RF and microwave circuit design and simulation (3 CH, Pre-requisite: Advisor Approval).

EE 448 Power Electronics: Electric power conditioning and control; characteristics of solid state power switches; analysis and experiments with AC power controllers, controlled rectifiers, DC choppers and DC-AC converters; applications to power supplies, airborne and space-borne power systems (3 CH, Pre-requisite: Advisor Approval).

EE 447 Digital Image Processing: Improvement of pictorial information using spatial and frequency domain techniques; two-dimensional discrete Fourier transform; image filtering, enhancement, restoration, compression; image processing project (3 CH, Pre-requisite: Advisor Approval).

EE 448 Real-Time Digital Signal Processing: Features and architectures of digital signal processing (DSP) chips; fundamental compromises amongst computational accuracy, speed and cost; real-time implementation of filtering, audio, image and video processing algorithms; rapid prototyping via MATLAB/Simulink(3 CH, Pre-requisite: Advisor Approval).

EE 450 Electronic Motor Drives: Application of semiconductor switching power converters to adjustable speed DC and AC motor drives; steady state theory and analysis of electric motion control in industrial, robotic and traction systems; laboratory experiments in power electronic motor drives and their control(3 CH, Pre-requisite: Advisor Approval).

EE 452 Control Engineering and Design Methodology: Modeling, specifications, rating and operating principles of sensors, actuators and other control system components; experiments on conceptual design, simulation and physical implementation of control systems (3 CH, Pre-requisite: Advisor Approval).

EE 454 Antenna Engineering: Introduction to antenna theory and design; includes antenna performance parameters, analysis of radiation from sources using Maxwell's equations, theory and design of wire antennas, arrays and frequency independent antennas; computer methods for antenna design (3 CH, Pre-requisite: Advisor Approval).

EE 455 Power System Fault Analysis and Protection: General considerations in transmission and distribution of electrical energy as related to power systems; calculation of electric transmission line constants; general theory of symmetrical components and application to analysis of power systems during fault conditions (3 CH, Pre-requisite: Advisor Approval).

EE 456 Power System Operation and Control: Load flow studies; power system transient stability studies; economic system loading and automatic load flow control.

EE 457 Wireless Communications: Overview of wireless applications, models for wireless communication channels, modulation formats for wireless communications, multiple access techniques, wireless standards (3 CH, Pre-requisite: Advisor Approval) .

EE 459 VLSI Circuit Design: Analysis and design of monolithic analog and digital integrated circuits using NMOS, CMOS and bipolar technologies; device modeling; CAD tools and computer-aided design; design methodologies for LSI and VLSI scale circuits; yield and economics; test and evaluation of integrated circuits(3 CH, Pre-requisite: Advisor Approval) .

EE 461 Fundamentals of Data Transmission and Networking: Foundations of computer networking; layered architecture of the Internet, analysis of protocols, new-age networks such as the Web and social networks; computer network programming and offline analysis of real network data(3 CH, Pre-requisite: Advisor Approval).

EE 462 Design of Embedded System: Embedded Systems Design covers hardware and software design for higher-end embedded systems containing X86 and ARM based technology and other embedded devices that contain a 32-bit processor, memory, and an embedded operating system (3 CH, pre-requisite: Advisor Approval).

EE 463 Computer-Human Interaction: Comprehensive study of the Computer-Human Interaction (CHI) area; includes history and importance of CHI; CHI design theories; modeling of computer users and interfaces; empirical techniques for task analysis and interface design; styles of interaction and future directions of CHI including hypermedia and computer-supported collaborative work (3 CH, Pre-requisite: Advisor Approval).

EE 464 Digital Integrated Circuit Design: Analysis and design of digital devices and integrated circuits using MOS and bipolar technologies and computer aided simulation (3 CH, Pre-requisite: Advisor Approval).

EE 465 Digital Communications: Digital transmission of information through stochastic channels; analog-to-dialog conversion, entropy and information, Huffman coding; signal detection, the matched-filter receiver, probability of error; baseband and passband modulation, signal space representation of signals, PAM, QAM, PSK, FSK; block coding, convolutional coding; synchronization; communication through fading channels; spread-spectrum signaling; simulation of digital communication systems (3 CH, Pre-requisite: Advisor Approval).

EE 468 Advanced Digital System Design: Design, modeling and verification of complex digital systems using hardware description language and electronic system level language (3 CH, Pre-requisite: Advisor Approval).

Appendix E: ABET Standards

GENERAL CRITERIA FOR BACCALAUREATE LEVEL PROGRAMS

All programs seeking accreditation from the Engineering Accreditation Commission of ABET must demonstrate that they satisfy all of the following General Criteria for Baccalaureate Level Programs

General Criterion 2. Program Educational Objectives

The program must have published program educational objectives that are consistent with the mission of the institution, the needs of the program's various constituencies, and these criteria. There must be a documented, systematically utilized, and effective process, involving program constituencies, for the periodic review of these program educational objectives that ensures they remain consistent with the institutional mission, the program's constituents' needs, and these criteria

General Criterion 3. Student Outcomes

The program must have documented student outcomes that prepare graduates to attain the program educational objectives.

Student outcomes are outcomes (a) through (k) plus any additional outcomes that may be articulated by the program.

(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 multidisciplinary 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.

Appendix F

Attached Spreadsheet
FIVE-YEAR COST and FUNDING

BSEEC PROGRAM BUDGET PRO FORMA

FISCAL YEAR EXPENSES

	Base Salary (Year 1)	Benefits 27%	Year of Hire	Year of Prom	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
	Annual Salary Increase:		3%												
Adim:Faculty Position 0 - Chair-1/4 time Existing	$ 30,000	$ 8,100	-	99		$ 38,100	$ 39,243	$ 40,420	$ 41,633	$ 42,862	$ 44,164	$ 45,493	$ 46,858	$ 48,264	$ 49,712
Faculty Position 1 - Asst. Professor (3/4 time)	$ 75,000	$ 20,250	2	99	$ -	$ -	$ 98,108	$ 101,051	$ 104,062	$ 107,205	$ 110,421	$ 113,733	$ 117,145	$ 120,660	$ 124,280
Faculty Position 2 - Asst. Professor (3/4) time	$ 67,500	$ 18,225	2	99	$ -	$ -	$ 88,297	$ 90,946	$ 93,674	$ 96,484	$ 99,379	$ 102,360	$ 105,431	$ 108,594	$ 111,852
Faculty Position 3 - Asst. Prof 3/4 time	$ 67,500	$ 18,225	2	7	$ -	$ -	$ 88,297	$ 90,946	$ 93,674	$ 96,484	$ 99,379	$ 112,596	$ 115,974	$ 119,453	$ 123,037
Faculty Position 4 Asst. prof (3/4) time	$ 68,000	$ 18,360	3	8	$ -	$ -	$ -	$ 91,619	$ 94,368	$ 97,199	$ 100,115	$ 103,118	$ 116,833	$ 120,338	$ 123,948
Faculty Position5 - Asst.Prof 3/4 time	$ 68,000	$ 18,360	3	8	$ -	$ -	$ -	$ 91,619	$ 94,368	$ 97,199	$ 100,115	$ 103,118	$ 116,833	$ 120,338	$ 123,948
Faculty Position - Assoc. Prof Exist 1/4 time(ME)	$ -	$ -	-	7	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	-
Equivalent Faculty Position - (BSE) 1/4 time	$ -	$ -	-	7	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	-
Faculty Position 0 - Asst Prof	$ -	$ -		8	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	-
Faculty Position 0 - Asst Prof	$ -	$ -		9	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	-
Classified Employee 1	$ 45,000	$ 12,150	2		$ -	$ -	$ 64,751	$ 66,693	$ 68,694	$ 70,755	$ 72,878	$ 75,064	$ 77,316	$ 79,636	$ 82,025
Classified Employee0		$ -			$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	-
Classified Employee 0	$ -	$ -			$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	-
PERSONNEL TOTAL					$ -	$ 38,100	$ 378,695	$ 573,294	$ 590,493	$ 608,204	$ 626,454	$ 655,484	$ 696,391	$ 717,283	$ 738,803
Section Notes: Update positions, salaries, year of hire and year of promotion. Annual costs will automatically calculate. Set salary of position to zero if not needed.															
PROGRAM START-UP/DEVELOPMENT															
New Program Application					$ -	$ -									
Annual Accreditation Fees						$ -	$ -	$ 1,500	$ 1,575	$ 1,654	$ 1,736	$ 1,823	$ 1,914	$ 2,010	$ 2,111
Accreditation Comprehensive Visit						$ -			$ 12,000	$ 8,000				$ 15,000	$ -
Annual Sustaining Fees						$ -	$ -			$ 1,654	$ 1,736	$ 1,823	$ 1,914	$ 2,010	$ 2,110
New Program Consultation Expenses					$ -	$ -	$ -								
Travel and Profession Conferences						$ 5,000	$ 7,500	$ 10,000	$ 10,300	$ 10,609	$ 10,927	$ 11,255	$ 11,593	$ 11,941	$ 12,299
Staff Development					$ 500	$ 1,000	$ 1,000	$ 1,000	$ 1,000	$ 1,000	$ 1,000	$ 1,000	$ 1,000	$ 1,000	$ 1,000
Recruiting Expenses						$ 12,000	$ 12,000	$ 12,000	$ 15,000	$ 15,000	$ 18,000	$ 18,540	$ 19,096	$ 19,669	$ 20,259
Professional Fees					-	$ 10,000	$ 10,600	$ 11,236	$ 11,910	$ 12,625	$ 13,382	$ 14,185	$ 15,036	$ 15,938	$ 16,895
Faculty Start-Up Allowances/Relocation							$ 45,000	$ 73,000	$ 30,000	$ -	$ -	$ -	$ -	$ -	-
PROGRAM START-UP/DEVELOPMENT					$ 500	$ 28,000	$ 76,100	$ 110,736	$ 81,785	$ 50,542	$ 46,762	$ 44,627	$ 50,554	$ 67,568	$ 64,674
Section Notes: Itemized lines are examples. Update lines and annual amounts as necessary.															
ANNUAL OPERATING EXPENSES															
Office Supplies						$ 5,000	$ 6,000	$ 8,000	$ 6,000	$ 6,500	$ 7,000	$ 7,000	$ 23,000	$ 24,000	$ 25,000
Faculty Recruitment						$ 15,000	$ 15,000	$ 5,000	$ 3,000	$ 3,000	$ 3,000	$ 3,000	$ 3,000	$ 3,000	$ 3,000
Adjunct & Part-Time Faculty Positions						$ 8,000	$ -	$ -	$ -	$ -	$ 8,000	$ 8,000	$ 8,000	$ 10,000	$ 10,000
Equipment Maintenance						$ -	$ -	$ -	$ -	$ -	$ 5,000	$ 5,000	$ 25,000	$ 25,000	$ 25,000
Equipment Replacement Fund (Increase in Year 5)						$ 105,000	$ 280,000	$ 260,000	$ 10,000	$ 12,000	$ 15,000	$ 17,000	$ 17,000	$ 18,000	$ 20,000
Library Resources						$ 15,000	$ 25,000	$ 25,000	$ 30,000	$ 30,000	$ 30,000	$ 30,000	$ 30,000	$ 30,000	$ 30,000
Contingency						$ 15,000	$ 15,000	$ 15,000	$ 15,000	$ 15,000	$ 15,000	$ 15,000	$ 15,000	$ 15,000	$ 15,000
Employee-based expenses															
Number of Employees					-	3	4	6	6	6	6	6	6	6	6
Desk Cost (Phone/Network, Internet, Software,Computer Replacement)	$ 900				$ 2,700	$ 5,400	$ 6,500	$ 7,200	$ 7,200	$ 8,000	$ 8,400	$ 8,500	$ 8,500	$ 8,500	$ 9,000
ANNUAL OPERATING EXPENSES TOTAL					$ -	$ 163,000	$ 341,000	$ 311,000	$ 64,000	$ 66,500	$ 83,000	$ 85,000	$ 121,000	$ 125,000	$ 128,000
Section Notes: Itemized lines are examples. Update lines and annual amounts as necessary. Employee count is automatic for any employee line with a salary.															
PROGRAM OPERATING EXPENSE TOTAL					$ 500	$ 191,000	$ 417,100	$ 421,736	$ 145,785	$ 117,042	$ 129,762	$ 133,627	$ 171,554	$ 192,568	$ 182,674
TOTAL EXPENDITURE ESTIMATES					$ 500	$ 229,100	$ 795,795	$ 995,030	$ 736,278	$ 725,250	$ 756,236	$ 788,111	$ 867,945	$ 909,851	$ 921,475

REVENUE ESTIMATES

	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Total students - Resident	-	24	43	59	73	82	95	105	105	105	105
Total students - Nonresident	-	6	11	15	19	20	25	28	28	28	28
Total E&G Fees Resident	$ -	$ 132,829	$ 249,885	$ 360,009	$ 467,706	$ 551,637	$ 671,046	$ 778,767	$ 817,705	$ 858,590	$ 901,520
Total E&G Fees Nonresident	$ -	$ 82,621	$ 159,046	$ 227,725	$ 302,874	$ 334,756	$ 439,367	$ 516,696	$ 542,531	$ 569,657	$ 598,140
Total Program/College Fees Resident	$ -	$ 19,200	$ 34,400	$ 47,200	$ 58,400	$ 65,600	$ 76,000	$ 84,000	$ 84,000	$ 84,000	$ 84,000
Total Program/College Fees Nonresident	$ -	$ 4,800	$ 8,800	$ 12,000	$ 15,200	$ 16,000	$ 20,000	$ 22,400	$ 22,400	$ 22,400	$ 22,400
Section Notes: Amounts above are all driven by formulas. Adjust fee and students counts below to set expected/goal amounts											
TOTAL REVENUE ESTIMATES		$238,451	$452,131	$646,934	$844,181	$967,993	$1,206,413	$1,401,862	$1,466,636	$1,534,647	$1,606,060
ANNUAL NET REVENUE		$10,351	($343,664)	($348,097)	$107,902	$242,743	$450,177	$612,752	$598,691	$624,797	$684,585
CUMULATIVE RETURN		$10,951	($333,319)	($691,761)	($240,185)	$350,645	$692,920	$1,062,929	$1,211,443	$1,223,488	$1,309,382

		YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5	YEAR 6	YEAR 7	YEAR 8	YEAR 9	YEAR 10
Program Fee - Res		800	800	800	800	800	800	800	800	800	800
Program Fee - Nonres		800	800	800	800	800	800	800	800	800	800
Fee Incr Res (E&G)			5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%
Fee Incr Nonres (E&G)			5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%
E&G Res	1st year	$ 5,535	$ 5,811	$ 6,102	$ 6,407	$ 6,727	$ 7,064	$ 7,417	$ 7,788	$ 8,177	$ 8,586
E&G Nonres	1st year	$ 13,770	$ 14,459	$ 15,182	$ 15,941	$ 16,738	$ 17,575	$ 18,453	$ 19,376	$ 20,345	$ 21,362
Total Res Students	1st year	24	24	24	24	24	31	35	35	35	35
Total Nonres Students	1st year	6	6	6	6	6	7	7	7	7	7
Total Res Students	2nd year		21	19	18	21	19	26	26	26	26
Total Nonres Students	2nd year		4	5	5	6	8	5	5	5	5
Total Res Students	3rd year		-	17	16	19	18	19	19	19	19
Total Nonres Students	3rd year		-	3	4	4	5	7	7	7	7
Total Res Students	4th year		-	-	14	18	17	18	18	18	18
Total Nonres Students	4th year		-	-	4	4	4	6	6	6	6
Retention - Resident Yr 1 to Yr 2			75%	75%	75%	75%	75%	75%	75%	75%	75%
Retention - Nonresident Yr 1 to Yr 2			65%	65%	65%	65%	65%	65%	65%	65%	65%
Retention - Resident Yr 2 to Yr 3			80%	80%	80%	80%	80%	80%	80%	80%	80%
Retention - Nonresident Yr 2 to Yr 3			80%	80%	80%	80%	80%	80%	80%	80%	80%
Retention - Resident Yr 3 to Yr 4			90%	90%	90%	90%	90%	90%	90%	90%	90%
Retention - Nonresident Yr 3 to Yr 4			90%	90%	90%	90%	90%	90%	90%	90%	90%