

MARYLAND HIGHER EDUCATION COMMISSION
ACADEMIC PROGRAM PROPOSAL

PROPOSAL FOR:

- NEW INSTRUCTIONAL PROGRAM
 SUBSTANTIAL EXPANSION/MAJOR MODIFICATION
 COOPERATIVE DEGREE PROGRAM
 WITHIN EXISTING RESOURCES or REQUIRING NEW RESOURCES

Cecil College
Institution Submitting Proposal

Fall 2016
Projected Implementation Date

Associate of Science in Engineering (A.S.E.)
Award to be Offered

Electrical Engineering
Title of Proposed Program

0909.00
Suggested HEGIS Code

14.1001
Suggested CIP Code

Science
Department of Proposed Program

Veronica Dougherty, Ph.D.
Name of Department Head

Rebecca Walker
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Maury Way Bolt
Signature and Date

9/15/16 President/Chief Executive Approval

October 19, 2015 Date Endorsed/Approved by Governing Board

A. Centrality to institutional mission statement and planning priorities:

Founded in 1968, Cecil College is an open-admission, learner-centered institution located in a rural community in Maryland's most northeastern county. The College's mission includes career, transfer, and continuing education coursework and programs that anticipate and meet the dynamic intellectual, cultural, and economic development challenges of Cecil County and the surrounding region. Through its programs and support services, the College strives to provide comprehensive programs of study to prepare individuals for enriched and productive participation in society. The College enrolls approximately 8,500 students in credit and non-credit programs.

Electrical Engineering is the branch of engineering that focuses on designing and analyzing components and systems that utilize electrons and photons. Electrical engineers also work in information technology and software development and function on multidisciplinary teams. The program supports the College's strategic goals by preparing students to transfer to four-year programs in Electrical Engineering.

B. Adequacy of curriculum design and delivery to related learning outcomes consistent with Regulation .10 of this chapter:

Student Learning Outcomes:

As a result of completing program requirements for the Electrical Engineering A.S.E. Program, students will:

- Design and conduct experiments, as well as analyze and interpret data
- Understand and apply the engineering design process
- Function on multidisciplinary teams
- Demonstrate an understanding of units, engineering notations, and circuit terminology
- Demonstrate an understanding of Ohm's law, Kirchhoff's laws, and the Wye-Delta transformations
- Demonstrate an understanding of AC and DC circuit analysis
- Demonstrate an understanding of Laplace transform analysis technique
- Demonstrate an understanding of Boolean algebra and discrete combinational gates
- Analyze and design synchronous sequential circuits
- Communicate in an effective and professional manner both verbally and in writing

Electrical Engineering Associate of Science in Engineering (A.S.E.)

General Program Information: 410 287-1000 or information@cecil.edu

This program option prepares students to transfer to a four-year institution for continued study in electrical engineering. Electrical Engineering is the branch of engineering that focuses on designing and analyzing components and systems that utilize electrons and photons. Electrical engineers also work in information technology and software development and function on multidisciplinary teams. Students with a bachelor's degree in electrical engineering continue their education in graduate school or enter industry. The computer literacy requirement will be met throughout the course work in the degree program.

	<i>General Education Requirements</i>	<i>General Education Code</i>	<i>Credits</i>
ARTS/HUM	Arts and Humanities Elective ¹	H	3
EGL 101	Freshman Composition	E	3
EGL 102	Composition and Literature	H	3
MAT 121	Precalculus ²	M	4
MAT 201	Calculus I with Analytic Geometry	M	4
PHY 217	General Calculus Physics I with Lab	SL	4
PHY 218	General Calculus Physics II with Lab	SL	4
SOC SCI	Social Science Electives ³	SS	6
<i>Program Requirements</i>			
CSC 205	Computer Science I		3
MAT 202	Calculus II with Analytic Geometry	M	4
MAT 203	Multivariable Calculus	M	4
MAT 240	Introduction to Linear Algebra	M	4
MAT 246	Introduction to Differential Equations	M	3
PHE 101	Introduction to Engineering Design		3
PHE 225	Digital Electronics and Instrumentation with Lab		4
PHE 285	Principles of Electric Circuits with Lab		4
PHY 219	General Calculus Physics III with Lab	SL	4

Total Credits Required in Program: 64

¹Selection may not include EGL designation

²Students placed in MAT 201 or higher Math may replace MAT 121 with MAT, PHY, PHE, CSC or CHM elective(s) **students must satisfy the four credit requirement**

³Courses must be from two different disciplines

Course Descriptions:

CSC 205 Computer Science I is an introduction to the basic concepts of an object-oriented programming language such as Java or C++. This course introduces such programming concepts as data types, structures, decision making, looping, functions, arrays, files, and objects.

Pre-requisites: CSC 106 and/or CSC 109 or permission of instructor

EGL 101 Freshman Composition teaches students the skills necessary to read college-level texts critically and to write effective, persuasive, thesis-driven essays for various audiences. The majority of writing assignments require students to respond to and synthesize texts (written and visual) through analysis and/or evaluation. Students also learn how to conduct academic research, navigate the library's resources, and cite sources properly. The course emphasizes the revision process by integrating self-evaluation, peer response, small-group collaboration, and individual conferences. Additionally, students are offered guided practice in appropriate style, diction, grammar, and mechanics. Beyond completing multiple readings, students produce approximately 5,000 words of finished formal writing in four-five assignments, including a 2,000-word persuasive research essay. 3 credits

Pre-requisites: C or better in COL081 and EGL093 or equivalent skills assessment

EGL 102 Composition and Literature (H) introduces students to the genres of fiction, poetry, and drama in order to gain a fuller understanding and appreciation of these literary forms.

Several brief compositions and a term paper will be assigned. 3 credits

Pre-requisites: CIS 101 and EGL 101

MAT 121 Precalculus (M) prepares the student for the study of calculus, discrete mathematics, and other mathematics intensive disciplines through the study of algebraic, exponential, logarithmic, and trigonometric functions. Topics include functions, laws of logarithms, trigonometric and inverse trigonometric functions, trigonometric identities, solutions of trigonometric equations, the Laws of Sines and Cosines, and polar coordinates. A problem solving approach utilizes applications and a graphing calculator throughout the course. 4 credits

Pre-requisites: Grade of C or better in MAT093, EGL093

MAT 201 Calculus I with Analytic Geometry (M) introduces students to the mathematical techniques for limits (including L'Hospital's Rule), differentiation, and integration of algebraic, trigonometric, inverse trigonometric, logarithmic, exponential, hyperbolic, and inverse hyperbolic functions. Applications of differentiation and integration are studied. 4 credits

Pre-requisites: EGL 093 and grade of C or better in MAT 121

MAT 202 Calculus II with Analytic Geometry introduces integration techniques, improper integrals, sequences, infinite series, conic sections and polar coordinates. Students will solve applied problems related to limits, differentiation, integration, and infinite series. A computer algebra system, such as Maple, is introduced and used. 4 credits

Pre-requisite: Grade of C or better in MAT 201

MAT 203 Multivariable Calculus provides the student with a study of three-dimensional space, introduction to hyperspace, partial differentiation, multiple integration, vectors in a plane, and

topics in vector calculus to include Green's Theorem, Stokes' Theorem, and the divergence theorem. Knowledge of a computer algebra system, MAPLE, is expanded. 4 credits
Pre-requisite: MAT 202

MAT 240 Introduction to Linear Algebra (M) introduces the basic concepts of linear algebra: vector spaces, applications to line and plane geometry, linear equations and matrices, similar matrices, linear transformations, eigenvalues, determinants, and quadratic forms. A computer algebra system will be used.

Pre-requisites: Grade of C or better in MAT 202 or permission of the Math Department Chair

MAT 246 Introduction to Differential Equations introduces the basic techniques for solving and/or analyzing first and second order differential equations, both linear and nonlinear, and systems of differential equations. The use of a mathematical software system is an integral part of the course. 3 credits

Pre-requisite: Grade of C or better in MAT 202

PHE 101 Introduction to Engineering Design is a project-based course that introduces the product development process. Working in teams and using modern computer tools, students complete the design of a complex system requiring problem specification, product research, product design, product modeling and analysis, fabrication, testing, redesign, and product presentation. Engineering fundamentals such as units and dimensions, CAD modeling and analysis, creation of engineering drawings, data analysis with spreadsheets, properties of materials, mechanics, heat transfer, circuits, computer programming and other engineering topics are studied.

Co-requisite: MAT 201

PHE 225 Digital Electronics and Instrumentation with Lab will introduce students to the science of digital design. The topics covered include: Boolean algebra, logic theorems, logic circuits and methods for their simplification (Karnaugh maps), gates, timing, arithmetic circuits, flip flops, programmable logic arrays (PLAs), sequential circuits and similar devices. The student will gain an understanding of digital design principles and will simulate, construct and analyze digital circuits using industry standard circuit design software along with a digital breadboard. Problem-solving and electrical laboratory skills will be emphasized in this course.

Pre-requisites: PHE 185 or PHY 208

PHE 285 Principles of Electric Circuits with Lab will introduce students to the analysis, simulation, construction, and evaluation of analog electrical circuits. The topics covered include: Kirchhoff's laws, Thévenin's and Norton's theorems, node and mesh analysis, DC and AC steady state and transient analysis for first and second order circuits, operational amplifiers and diode elements, as well as Laplace transform analysis. Problem-solving, software simulation, and electrical laboratory skills will be emphasized in this course.

Pre-requisite: PHY 208

Co-requisite: MAT 246

PHY 217 General Calculus Physics I with Lab (SL) is the first course of a three semester calculus-based general physics course sequence. This course provides a comprehensive introduction for students interested in physics and engineering. Topics related to mechanics include linear and rotational kinematics and dynamics, energy and momentum conservation, collisions, equilibrium of rigid bodies, and oscillations. Problem-solving and laboratory skills will be emphasized in this course. Previous exposure to physics principles and strong mathematics skills are highly recommended. 4 credits

Prerequisite: MAT 121

Co-requisite: MAT 201

PHY 218 General Calculus Physics II with Lab (SL) is the second course of a three semester calculus-based general physics course sequence. This course provides a comprehensive introduction to students interested in physics and engineering. Topics include: thermodynamics, electricity, magnetism, and radioactivity. Problem-solving and laboratory skills will be emphasized in this course. 4 credits

Prerequisite: PHY 217 with a grade of C or better

Co-requisite: MAT 202

PHY 219 General Calculus Physics III with Lab (SL) is the third course of a three semester calculus-based general physics sequence. Topics from modern physics that will be emphasized: vibrations, waves, sound, geometrical and physical optics, special relativity, black body radiation, the photoelectric effect, Compton scattering, the Bohr model and atomic structure, quantum mechanics, nuclear structure and semiconductors. Problem-solving and laboratory skills will be emphasized in this course.

Prerequisite: PHY 218 with grade of "C" or better

Co-requisite: MAT 203

C. Critical and compelling regional or Statewide need as identified in the State Plan:

The job outlook for engineers is shaped both by society's growing need to devise solutions to technically challenging problems — global warming, a shortage of clean water, the demand for faster and smarter computing — and by short supply. Only 4.5 percent of all undergraduates come out of school with engineering degrees, according to the National Science Foundation.¹

Engineering is the discipline, art, and profession of acquiring and applying technical, scientific, and mathematical knowledge to design and implement materials, structures, machines, devices, systems, and processes that safely realize a desired objective or invention. Engineers solve problematic technical issues by using the fundamentals of math and science to develop cost effective solutions. Engineers not only work in the development and design of new products, they also work in the testing, production, and maintenance of new products. Engineers oversee production assembly lines, determine why products break down, and administer tests to improve product quality. They also determine how much money and time is necessary to finish projects.

¹ You're an Engineer: You're Hired. *U.S. News & World Report*, March 2012.

The proposed program meets the critical and compelling regional and statewide need outlined in Goal 5 of *Maryland Ready: 2013 Maryland State Plan for Postsecondary Education* – “Maryland will stimulate economic growth, innovation, and vitality by supporting a knowledge-based economy, especially through increasing education and training and promoting the advancement and commercialization of research.”

In addition, the *2013 Maryland State Plan for Postsecondary Education* notes “Increasing the number of STEM degrees awarded to students is another key goal for Maryland postsecondary education. STEM-related occupations are critical because they are closely tied to technological innovation, economic growth, and increased productivity. Currently, workers with STEM competencies and degrees are in high demand” (p.12). The Plan notes that “Data from the Georgetown University Center for Education and the Workforce (2011) rank STEM jobs as the second fastest-growing occupational category in the nation, behind health care” (p.12).

D. Quantifiable & reliable evidence and documentation of market supply & demand in the region and State:

According to the Maryland Department of Labor, Licensing, and Regulation, the following employment openings are forecast through 2024 for occupations in Electrical Engineering for persons with a Bachelors’ degree²

Occupational Title	2014 Employment	2024 Employment	Change	Replacements	Total Openings
Electrical Engineers	4,408	4,982	574	962	1,536
Electronics Engineers Except Computer	5,192	5,638	446	1,133	1,579
				Total	3,115

In addition, there are many electrical engineering related occupations that require an Associate’s degree. According to the Maryland Department of Labor, Licensing, and Regulation, the following employment openings are forecast through 2024 for occupations in Electrical Engineering for persons with an Associate’ degree.³

Occupational Title	2014 Employment	2024 Employment	Change	Replacements	Total Openings
Electrical and Electronics Drafters	448	498	50	60	110
Electrical and Electronics Engineering Technicians	3,878	4,296	418	803	1,221

² Maryland Department of Labor, Licensing, and Regulation, Maryland Occupational Projections 2014 – 2024, retrieved from <http://dlr.maryland.gov/lmi/iandoproj/maryland.shtml>.

³ Ibid.

Occupational Title	2014 Employment	2024 Employment	Change	Replacements	Total Openings
Electro-Mechanical Technicians	256	273	17	53	70
Engineering Technicians, except drafters, all other	1,668	1,782	114	345	459
Total					1,860

E. Reasonableness of program duplication:

A search of the Maryland Higher Education Commission’s Academic Program Inventory database reveals that there are seven similar programs in the state. However, the closest program is more than 30 miles from Cecil College, so our proposed program would not have an adverse effect on any of the other programs in the state.

Institution	Program Name	Degree Offered
Anne Arundel Community College	ELECTRICAL ENGINEERING (A.S.E.)	Associate Degree
Baltimore City Community College	ELECTRICAL ENGINEERING	Associate Degree
Carroll Community College	ELECTRICAL ENGINEERING (ASE)	Associate Degree
College of Southern Maryland	ELECTRICAL ENGINEERING (ASE)	Associate Degree
Community College of Balto. County	ELECTRICAL ENGINEERING	Associate Degree
Garrett College	ELECTRICAL ENGINEERING (A.S.E.)	Associate Degree
Howard Community College	ELECTRICAL ENGINEERING (ASE)	Associate Degree

F. Relevance to Historically Black Institutions (HBIs)

No impact is anticipated on the state’s historically black institutions.

G. If proposing a distance education program, please provide evidence of the Principles of Good Practice (as outlined in COMAR 13B.02.03.22C).

Not applicable.

Faculty Member	Credentials	Status	Courses Taught
Gail Wyant, Professor of Physics and Geosciences	M.S., Stony Brook University	Full-time	PHY 217 General Calculus Physics I with Lab PHY 218 General Calculus Physics II with Lab PHY 219 General Calculus Physics III with Lab

I. Adequacy of library resources (as outlined in COMAR 13B.02.03.12).

Cecil College's Cecil County Veterans Memorial Library is a member of Maryland Digital Library and the Maryland Community College Library Consortium.

Requested from Lorraine Martorana on 9-12-16.

J. Adequacy of physical facilities, infrastructure and instructional equipment (as outlined in COMAR 13B.02.03.13)

The Engineering Program is housed on the North East campus in the Engineering and Math building. The Engineering and Math building houses the program labs and classrooms, student lounge, conference rooms. Engineering students will also have the opportunity to utilize additional physical facilities on campus including the Library; the Arts and Sciences Building, housing the Biology and learning labs; and the Technology/Conference Center, housing the computer lab, simulation labs, a student lounge / dining area and a Conference Center.

In the Engineering and Math building, the Engineering program has two dedicated classrooms, one dedicated machine shop and one printer room. The classrooms are equipped with desks, chairs, locked storage areas, a sink, counter top, whiteboard and computer projector system for Power Point, Blackboard and Internet access. The classrooms are also equipped with computers and laptops that allow engineering students to access CAD software like AutoCAD and SolidWorks, programming languages like C, C++ and MATLAB, along with other software like MS Word, MS Excel and MS PowerPoint. The Machine Shop is a spacious room equipped with materials and equipment for students to work on a variety of lab experiments and projects, providing them with technical skills and hands-on experience. The Printer Room is equipped with a 3-D printer that allows students to import and print designs from CAD software.

The Engineering Program has sufficient dedicated office space for program faculty and staff and students. The faculty offices includes table and chairs available for private conferences with students and/or faculty, bookshelves for department resources and four locked file cabinets to secure program materials. On the second floor of the Engineering and Math building, there is also dedicated office space for adjunct faculty. The adjunct office is equipped with computers, desks, chairs and telephones. A conference room is available for faculty meetings and or private conferences with students. In a faculty work area, the faculty has access to table, chairs, faculty

mailboxes, courier service as well as a copy and fax machine. Also in this work area are a refrigerator, sink, cupboards and microwave for faculty use.

Program faculty and students utilize technology systems to enhance teaching and learning experiences and to support the technical didactic and clinical educational experiences as evident in the curriculum. Available technology includes state-of-the-art electronic classrooms and clinical labs with interactive white boards, projection systems, immediate capture and documentation cameras, wireless internet access; and the college-wide Course Management System 'Blackboard', which can provide on-line learning to supplement courses.

The North East campus computer lab, housed in the Technology Center, provides 28 computers and technology resource staff, during regular lab hours, to assist students. Engineering faculty works closely with the Technology Resources department to provide up-to-date hardware and software to faculty and students.

K. Adequacy of financial resources with documentation (as outlined in COMAR 13B.02.03.14)

Please see next page.

**Cecil College – A.S.E. Electrical Engineering Program
Projected Revenues**

TABLE 1: RESOURCES					
Resource Categories	Year 1	Year 2	Year 3	Year 4	Year 5
1. Reallocated funds	N/A	N/A	N/A	N/A	N/A
2. Tuition revenue (c+g below)	\$58,957	\$66,768	\$66,768	\$71,048	\$76,719
a. Number of F/T students	7	8	8	8	9
b. Annual Tuition/Fee Rate	\$107/credit	\$107/credit	\$107/credit	\$107/credit	\$107/credit
c. Total F/T Revenue (a * 33 * b)	\$24,717	\$28,248	\$28,248	\$28,248	\$31,779
d. Number of P/T students	16	18	18	20	21
e. Credit Hour Rate	\$107/credit	\$107/credit	\$107/credit	\$107/credit	\$107/credit
f. Annual Credit Hour Rate	N/A	N/A	N/A	N/A	N/A
g. Total P/T Revenue (d * 20 * e)	\$34,240	\$38,520	\$38,520	\$42,800	\$44,940
3. Grants, Contracts, & Other External Sources	0	0	0	0	0
4. Other sources: Student Dev. Fees	\$4,408	\$4,992	\$4,992	\$5,312	\$5,736
Registration Fees	\$3,450	\$3,900	\$3,900	\$4,200	\$4,500
Total (Add 1-4)	\$66,815	\$75,660	\$75,660	\$80,560	\$86,955

Assumptions:

- Tuition revenue is conservatively projected based on an in-county rate of \$107/credit
- Full-time students complete 33 credits per year on average; Year one tuition revenue = 7 students * 33 credits = 231 total credits * \$107/credit = \$24,717
- Part-time students complete 20 credits per year on average; Year one tuition revenue = 16 students * 20 credits = 320 total credits * \$107/credit = \$34,240
- Student Development Fee is \$8/credit hour; Fees for year one = 551 total credits * \$8 = \$4,408
- Registration fee = \$75/semester; registration fees are assumed to be two semesters each year or \$150, but students may elect to also take courses in the summer; Year one registration fees = 23 students * \$150 = \$3,450

TABLE 2: EXPENDITURES					
Expenditure Categories	Year 1	Year 2	Year 3	Year 4	Year 5
1. Faculty (b + c below)	\$49,148.06	\$49,951.74	\$50,769.19	\$51,600.67	\$52,446.42
a. #FTE	.50	.50	.50	.50	.50
b. Total Salary	\$36,659.07	\$37,208.96	\$37,767.09	\$38,333.60	\$38,908.60
c. Total Benefits	\$12,488.99	\$12,742.78	\$13,002.10	\$13,267.07	\$13,537.82
2. Administrative Staff (b + c below)	0	0	0	0	0
a. #FTE	0	0	0	0	0
b. Total Salary	0	0	0	0	0
c. Total Benefits	0	0	0	0	0
3. Support Staff (b + c below)	0	0	0	0	0
a. #FTE	0	0	0	0	0
b. Total Salary	0	0	0	0	0
c. Total Benefits	0	0	0	0	0
4. Equipment	0	0	0	0	0
5. Library	0	0	0	0	0
6. New or Renovated Space	0	0	0	0	0
7. Other Expenses	0	0	0	0	0
Total (Add 1-7)	\$49,148.06	\$49,951.74	\$50,769.19	\$51,600.67	\$52,446.42

Assumptions:

- Programs will be implemented with existing faculty resources and administrative staff, so there are no new expenses for personnel.
- Salaries and benefits have been allocated based on percentage of time for full-time faculty in the Sciences Department who are teaching in the program
- Library resources and equipment are budgeted in the operating budget on an ongoing basis.
- Salaries are forecasted to increase @ 1.5% each year
- Health benefits are forecasted to increase @ 2.5% each year

L. Adequacy of provisions for evaluation of program (as outlined in COMAR 13B.02.03.15).

Individual course assessment reports document student learning outcomes which are taken directly from the course syllabus. The Assessment Committee has established a rubric for course assessment reports which requires documentation of desired learning outcomes (taken from the syllabus), indicators of student learning outcomes, direct and indirect methods of assessment,

quantitative and qualitative data on student performance, and how assessment results will be used to further improve student learning outcomes in the future. Each report is reviewed to ensure that it meets the guidelines established by the Assessment Committee. Reports are collected for one-third of all courses offered during the fall and spring semesters each academic year, resulting in a review of all courses within 36 months.

Faculty members are evaluated each and every semester by students enrolled in their courses. The College uses an electronic survey process (Evaluation Kit) and students are required to complete the evaluation within a specified time frame at the end of the semester or they are locked out of the learning management system (Blackboard) until they complete the survey. This has resulted in a very high response rate for all courses.

The College has an established Program Review Policy and a Program Review and Assessment Plan. Both of these documents have been endorsed by the Faculty Senate and approved by the Board of Trustees. One-fifth (20%) of the programs are reviewed each year so that all programs are reviewed on a five-year cycle. A repository, which is accessible to all faculty members, is kept for all Program Review and Assessment documents. Additionally, a database has been established to track the status of recommended changes/revisions to programs.

Faculty members are assessed in the classroom by the Dean of Academic Programs each year for their first five years at Cecil College and every three years thereafter.

All faculty members are contractually obligated to complete an annual report: inclusive of assessment results.

M. Consistency with the State's minority student achievement goals (as outlined in COMAR 13B.02.03.05 and in the State Plan for Postsecondary Education).

Cecil College has qualified professional staff in the student advising and student support areas. Advisors seek and support other-race students consistent with the core values of the College, which encompass diversity and inclusiveness. In addition, the College has adopted a Strategic Initiative to "create educational opportunities for a diverse community of learners." The College plans to employ broad recruitment efforts to attract a racially diverse student body. Statements of non-discrimination are included in College publications and will appear in any marketing pieces for the program. In addition, the Director of Minority Student Services will assist in marketing and referring students to the new program.

N. Relationship to low productivity programs identified by the Commission:

Not applicable.