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Cover Sheet for In-State Institutions
New Program or Substantial Modification to Existing Program

Institution Submitting Proposal	University of Maryland Eastern Shore

Each action below requires a separate proposal and cover sheet.

- ○ New Academic Program
- ◉ New Area of Concentration
- ○ New Degree Level Approval
- ○ New Stand-Alone Certificate
- ○ Off Campus Program
- ○ Substantial Change to a Degree Program
- ○ Substantial Change to an Area of Concentration
- ○ Substantial Change to a Certificate Program
- ○ Cooperative Degree Program
- ○ Offer Program at Regional Higher Education Center

Payment Submitted:	Payment Type:	Payment Amount:	Date Submitted:
◉ Yes ○ No	◉ R*STARS # ○ Check #		

Department Proposing Program	School of Business and Technology (CSET and EAVS)	
Degree Level and Degree Type	Ph.D. with En Passant M.S.	
Title of Proposed Program	Applied Computing and Engineering: AoC in Mechatronics and Control	
Total Number of Credits	60	
Suggested Codes	HEGIS: 90100.00	CIP: 140101.0000
Program Modality	◉ On-campus ○ Distance Education (fully online) ○ Both	
Program Resources	◉ Using Existing Resources ○ Requiring New Resources	
Projected Implementation Date (must be 60 days from proposal submisison as per COMAR 13B.02.03.03)	◉ Fall ○ Spring ○ Summer	Year: 2023
Provide Link to Most Recent Academic Catalog	URL: http://catalog.umes.edu/index.php	
Preferred Contact for this Proposal	Name: Derrek B. Dunn, Ph.D.	
	Title: Dean, School of Business adn Technology	
	Phone: (410) 651-6348	
	Email: ddunn@umes.edu	
President/Chief Executive	Type Name: Heidi M. Anderson	
	Signature: [signature]	Date: 11/14/2022
	Date of Approval/Endorsement by Governing Board:	

Revised 1/2021

UNIVERSITY OF MARYLAND EASTERN SHORE
Office of the President

November 14, 2022

James D. Fielder, Jr., Ph.D.
Secretary of Higher Education
Maryland Higher Education Commission
6 N. Liberty Street, 10th Floor
Baltimore, Maryland 21201

RE: New Academic Program Proposal – Doctor of Philosophy in Applied Computing and Engineering with an AoC in Mechatronics and Control

Dear Dr. Fielder:

The University of Maryland Eastern Shore hereby submits a new academic program proposal as indicated below:

Program: Ph.D. in Applied Computing and Engineering with a concentration in Mechatronics and Control

The School of Business and Technology is proposing to offer a Ph.D. degree in Applied Computing and Engineering (ACE) with a concentration in Mechatronics and Control. The proposed program UMES would like to offer will play a crucial role in preparing professionals to work in various positions related to applied computing and engineering.

The proposed Ph.D. in Applied Computing and Engineering program with a concentration in Mechatronics and Control aims to produce the next generation leaders in computing and engineering and offer prospective students a graduate program with strong foundations in a versatile and dynamic field that blends knowledge across multiple disciplines in applied computing and engineering. The curriculum of the program is devised to harness faculty expertise and experience in various technical fields in the School of Business and Technology at UMES. The program, if established, will facilitate and promote students to develop innovative technologies in emerging fields such as mechatronics and control for a wide range of applications including business, finance, agriculture, healthcare, automobile, aerospace, and clean energy systems, etc. that are critical to the economic development of the region and the state.

The attached proposal has undergone the established UMES curriculum approval process and I fully support the proposed program.

I greatly appreciate your considering this request.

Sincerely,

Heidi M. Anderson, Ph.D., FAPhA
President

Copy: Dr. Rondall Allen, Provost and Vice President for Academic Affairs
Dr. Derrek Dunn, Dean, School of Business and Technology
Dr. Payam Matin, Professor and Acting Chair, Department of Computer Science and Engineering Technology
Dr. Yuanwei Jin, Professor and Chair, Department of Engineering and Aviation Sciences

Proposal for New Graduate Degree Program

Doctor of Philosophy in Applied Computing and Engineering (PHACE) with En Passant M.S.

The Department of Computer Science and Engineering Technology, jointly with the Department of Engineering and Aviation Sciences, proposes to establish an Interdisciplinary program of Ph.D. in Applied Computing and Engineering (PHACE) within the School of Business and Technology (SBT) at UMES. The PHACE aims to offer prospective students a graduate program with strong foundations in theory and practice to meet the needs of technical professionals including but not limited to those in the Eastern Shore of Maryland with more advanced learning in a specialized discipline of cybersecurity, electrical, and mechatronics engineering and applied computer science. The program, if established, will help students develop new technologies in the emerging fields such as cybersecurity, data, and computational sciences, software engineering, robotics and automation, drone design, unmanned systems and control, mechatronics, computer networks, wireless communications, and Internet of Things (IoT) for a wide range of applications including business, finance, agriculture, health care, automobile, aerospace, and clean energy systems, etc. It will also prepare them, especially those with disadvantaged backgrounds, with the knowledge and tools necessary to take on computing and engineering leadership roles to shape the future of technology advancement.

The proposed PHACE program will have the following concentration:

- Mechatronics and Control

The concentration aligns with the expertise and research focus of existing faculty in both departments and emerging research areas in related fields. The PHACE requires a minimum of sixty (60) credit hours of graduate-level coursework.

Bachelor degree holders who are directly admitted into the proposed doctoral program will have the option to obtain a Master's degree once he/she passes the qualifying exam and completes the coursework equivalent to the curriculum in the Master's Degree under the following situations.

Prospective bachelor's degree holders with direct admission into the proposed doctoral program who choose the Mechatronics and Control concentration will receive a Master's degree in Electrical and Mechatronics Engineering. Since the Department of Engineering and Aviation Sciences does not have a graduate program at the current time, a separate proposal will be submitted from the department to establish an M.S. in Electrical and Mechatronics Engineering.

A. Centrality to Institutional Mission Statement and Planning Priorities

1. **Provide a description of the program, including each area of concentration (if applicable), and how it relates to the institution's approved mission.**

   The proposed Ph.D. in Applied Computing and Engineering program with a concentration in Mechatronics and Control. The mission of the PHACE program is to provide a unique

opportunity for graduate education to individuals who are motivated to advance to become higher-level experts in widely related areas of Applied Computing and Engineering. The program is targeted to those who have a BS degree in mathematics, sciences, engineering, and technology, or related areas as well as those who already have an MS degree in these or related areas. The potential graduates of this program will have advanced growth opportunities in government agencies, higher education, and computational engineering in various industries, such as data science, software engineering, electrical and computing engineering, network-related areas, and a variety of technical specializations. Their research work is intended to promote innovation and technology development in the emerging field of robotics, automation, drones, and autonomous systems, cybersecurity, as well as related computing fields that will drive the UMES research enterprise; and contribute to the economic development in the State of Maryland, especially in the Eastern Shore region where learning opportunities in applied computing and engineering disciplines is severely lacking.

This proposed program is grounded in the Institution's mission as an 1890 HBCU land-grant institution whose stated purpose is to promote distinctive learning, discovery, and engagement opportunities in the arts and sciences, education, technology, engineering, agriculture, business, and health professions. Central to this purpose is the guided interest in providing individuals, including first-generation college students, access to a holistic learning environment that fosters multicultural diversity, academic success, and intellectual and social growth. The proposed program imbibes itself in this mission and it is guided by the opportunity to increase the graduation rate of the underrepresented minorities in the fields of science and engineering.

2. **Explain how the proposed program supports the institution's strategic goals and provide evidence that affirms it is an institutional priority.**

The proposed graduate program supports the institution's strategic goals. According to the UMES Strategic Plan 2018-2020, (see the link https://www.umes.edu/uploadedFiles/_DEPARTMENTS/President/Content/Strategic%20Plan%202020_Full.pdf), in particular with the following two goals:

- "Goal II: Become Eminent in Research, Innovation, and Economic Competitiveness" to foster and facilitate interdisciplinary collaboration for research on local, regional, and global challenges to include workforce needs, and
- "Goal V: Achieve and Maintain National Eminence and Global Impact" to enhance research activity and doctoral programs to retain and sustain Carnegie Doctoral University (DU- High Research Activity) Classification, and of building partnerships with other research universities to strengthen research and development enterprise.

The proposed degree program will substantially help the institution achieve its strategic goals listed above, and position UMES at the forefront of emerging research in critical areas such as cybersecurity, data, and computational sciences, software engineering, robotics and automation, drone design, unmanned systems, and control, mechatronics, computer networks, wireless communications, and Internet of Things (IoT) for a wide range of applications including business, finance, agriculture, health care, automobile,

aerospace, and clean energy systems, etc. While there currently exists some collaborations across disciplines on campus, the proposed PHACE program is expected to enable stronger and multi-disciplinary research collaborations across the campus community, thus fueling research in many other different disciplines more than in the applied science and engineering disciplines and creating a much broader impact on the entire campus as well as the Eastern Shore community.

3. **Provide a brief narrative of how the proposed program will be adequately funded for at least the first five years of program implementation. (Additional related information is required in section L).**

With the commission of the Engineering and Aviation Science Complex, a $103 million investment from the state, the proposed program will be supported by about two dozen state-of-the-art engineering laboratories such as Robotics and Automation Lab, MEMS Lab with a class ISO 5 cleanroom, and Microwave Anechoic Chamber Lab, etc. The collaborating departments on this proposal are housed in this facility with adequate lab space for both programs. Additionally, the provision of funding for additional faculty lines and other resources required to implement this program will be derived from the $577 million settlement funds reached by the state and the HBCUs as a result of providing inequitable resources to its four historically black colleges and universities. UMES is expected to receive about 9 million dollars each year over the next ten years and funding for this initiative has already been assigned. By the beginning of the 2022 – 2023 academic year, it is expected that two faculty positions will be funded. This process will continue for the next five years.

4. **Describe the institution's commitment to:**

a. **ongoing administrative, financial, and technical support of the proposed program**

As indicated in the preceding section, the leadership of UMES is committed to adequately funding this program and it has made this program one of the priority areas of extending the footprint of the institution. With the HBCU Lawsuit Settlement fund, UMES and the School of Business and Technology are equipped with the needed resources and are committed to supporting the program in every way, including ongoing administrative support, financial support, and technical support of the program.

b) continuation of the program for a period of time sufficient to allow enrolled students to complete the program.

This degree program is created by leveraging, in part, the existing faculty and staff in the Departments of Computer Science and Engineering Technology and Engineering and Aviation Sciences at UMES, as well as the state-of-the-art engineering laboratories in the Engineering and Aviation Science Complex on UMES campus. The current computer science and engineering faculty (tenured and tenure-track) and dedicated support staff will collectively assist in the proposed Ph.D. degree program. The

university is fully committed to continuing the proposed Ph.D. program for a sufficient period to allow enrolled students to complete the program.

B. Critical and Compelling Regional or Statewide Need as Identified in the State Plan

1. Demonstrate demand and need for the program in terms of meeting present and future needs of the region and the State in general based on one or more of the following:

a. The need for the advancement and evolution of knowledge

According to the International Society for Applied Computing: "Applied computing refers to the practical application of computer principles, concepts, and technologies to address real-world problems. Applied computing uses aspects of computer science to solve problems in various disciplines, including politics, business, education, environment, engineering, biology, chemistry, physics, nano-sciences and nano-technology, statistics, economics, finances, and social sciences. Working in this field, you'll likely use a range of programming, software engineering, graphic applications, networking, and operating systems management skills to collect, analyze, store and distribute information that will help resolve issues for individuals, groups, and companies."

Interdisciplinary engineering has a broader scope than traditional engineering, which incorporates the knowledge and skills associated with other disciplines, which requires students to take courses from different non-traditional disciplines. Interdisciplinary Engineering is a much better fit for some jobs which need knowledge outside any traditional engineering scope. This degree program enables a synergistic integration of applied computing, electrical, mechanical systems with electronics, and intelligent computer control in the design and manufacturing of products and processes. The blending of electrical, mechanical, electronic, software, and control theory engineering topics into a unified framework that enhances the design process. Electrical Engineering with a mechatronics background applies mechanical, electrical, and computer engineering theories and techniques to create automated, intelligent products, smart devices, and industrial control systems - systems that can then be "taught" to improve their performance. This is where many future engineering jobs are headed. For example, in the automotive industry, mechatronics engineering is a fast-growing discipline, one that today's electric vehicle (EV) manufacturers hope to leverage in gaining a leg up with tomorrow's vehicles. In other areas, mechatronics engineers will be engaged in the automation of process industries. They will design insulin pumps for diabetics, robotic systems for law enforcement, and autonomous flying machines to support military troops on the ground (such as unmanned aerial vehicles or UAVs). They may even create automated systems for tomorrow's vast farming industry called precision agriculture, and robots that will learn to efficiently explore the surface of Mars. The newly proposed Ph.D. combines the advantages of Applied Computing and Engineering, allowing students to go well beyond any traditional program, which fits well for the current market since interdisciplinary

principles and multi-disciplinary knowledge and skills are in large demand and getting more desirable by industrial and governmental organizations.

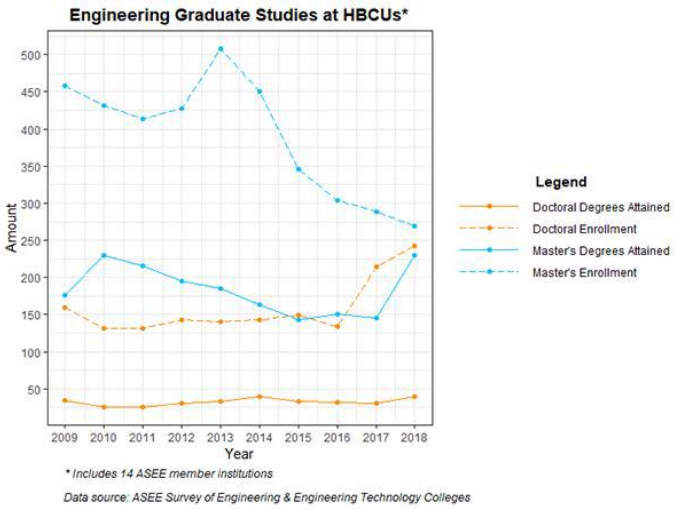
b. **Societal needs, including expanding educational opportunities and choices for minority and educationally disadvantaged students at institutions of higher education**

UMES is located in Maryland's Somerset County, which is among the poorest counties in the state according to the US Census Bureau. UMES currently offers the only engineering Bachelor's degree program on the Eastern Shore of Maryland. The Department of Computer Science and Engineering Technology currently offers a Bachelor's degree in Computer Science and a Master's degree in Applied Computer Science and a Master of Science in Cybersecurity Engineering Technology. Offering the proposed Ph.D. program will open opportunities for all races and ethnic groups. However, since UMES is one of the four HBCUs in Maryland, it is well positioned to attract more African American and educationally disadvantaged students, thus expanding the educational opportunities and choices for minorities as well as addressing critical needs of the state and the local economy.

c. **The need to strengthen and expand the capacity of historically black institutions to provide high quality and unique educational programs**

The proposed Ph.D. program will significantly strengthen and expand the capability of UMES, one of the four HBIs in the state, to provide high quality and unique educational experiences to students. It is a terminal degree, which will advance the increase of minority Ph.D. grantees in the fields of applied science and engineering. It will also strengthen and expand the research capacity of historically black institutions to provide high quality and unique educational programs to a high level.

The chart below from the American Society for Engineering Education (ASEE) clearly shows how the establishment of a doctoral program in engineering has had a positive impact on the graduate enrollments at HBCUs.



Also, the above figure supports why UMES has chosen to pursue a Doctor of Philosophy in Applied Computing and Engineering with En Passant Master's as the increase in graduate engineering enrollment at HBCUs is occurring at the doctoral level.

2. **Provide evidence that the perceived need is consistent with the Maryland State Plan for Postsecondary Education.**

The proposed Ph.D. degree program is well aligned with the 2017-2021 Maryland State Plan for Postsecondary Education in all three areas: Access, Success, and Innovation.

Access – Ensure equitable access to affordable and quality postsecondary education for all Maryland residents.
The Ph.D. Degree Program is intended to prepare highly trained scientists and engineers at the graduate level in an emerging area of cybersecurity, data, and computational science, software engineering, mechatronics and control, communications and networks, etc. that is becoming increasingly important and relevant to our society. However, applied science and engineering are specialized fields with many barriers to student access. The proposed graduate degree program will provide equitable access and quality education to all Maryland residents, including those with disadvantaged backgrounds, to develop a strong applied science and engineering workforce for the state.

Success – Promote and implement practices and policies that will ensure student success.
The practices and policies concerning the proposed Ph.D. degree program align with all existing policies at the University, which will ensure student success. By providing a carefully developed curriculum, sufficient computer science and engineering laboratory facilities, equipment, and adequate faculty members for advising and teaching, the proposed degree program will help ensure student graduation and successful job placement.

Innovation – Foster innovation in all aspects of Maryland higher education to improve access and student success

Specifically, the proposed Ph.D. degree program aligns with the goal of "Innovation" of the State Plan, which aims to "foster innovation in all aspects of Maryland higher education to improve access and student success." The proposed program will help achieve the goal of "Economic Growth and Vitality," which is centered on supporting a knowledge-based economy through increased education and training and is to ensure that Historically Black Institutions are "competitive, both in terms of program and infrastructure," with Maryland's other state institutions. Ultimately, the proposed degree program will prepare highly qualified scientists and engineers to contribute to the economic growth and vitality of Maryland by providing them with new knowledge and skill sets in emerging technologies so they can maintain the skills they need to succeed in the workforce.

C. Quantifiable and Reliable Evidence and Documentation of Market Supply and Demand in the Region and State

1. **Describe potential industry or industries, employment opportunities, and expected level of entry (*ex: mid-level management*) for graduates of the proposed program.**

The current engineering program at the Bachelor's Degree level has produced over 100 graduates. Many of them have been employed as engineers by major engineering companies such as Lockheed Martin, Boeing, Northrop Grumman Corporation, as well as government sectors such as NASA, US Navy, US Army, etc. By leveraging its success, it is expected that graduates of the proposed Master's degree program will lead to mid-level technical and management jobs in the industry and the government sectors where the engineering workforce is highly sought. Our current graduates with a Bachelor's degree in Computer Science or Engineering Technology, or MS in Applied Computer Science or Cybersecurity Engineering Technology are working for various companies from small to large, including Microsoft, General Electric, and Amazon, to name a few. Some are working for government sectors such as NASA, and the Department of Defense. Graduates with BS degrees normally start with entry level positions, while graduates with MS degrees normally start with mid-level positions.

Those who will graduate with a degree in the Ph.D. in Applied Computing and Engineering program will be proficient in their area of research focus and related areas, and this knowledge will propel them to land jobs in both the private and public sectors. Graduates can work in a wide array of positions from middle level to top level, including but not limited to: Senior Data and Computational Scientist, Senior Information Security Analyst, or Senior Software Architecture. For the type of positions in Computer and Information Research Scientists, the U.S. Bureau of Labor projected the job increase of 22% from 33000 (in 2020) to 402000 (in 2030), and the Maryland Department of Labor projected the job increase of 13.3% from 2794 in 2018 to 3168 in 2028 in the state of Maryland. For the type of jobs in Computer Science Teacher (Postsecondary), the Maryland Department of Labor projected a job increase of 17.52% from 959 in 2018 to 1127 in 2028 in the state of Maryland alone. The

graduates from our proposed Ph.D. in Applied Computing and Engineering are a nice fit for most of these positions in both Computer Science Teacher (Postsecondary) and Computer and Information Research Scientists.

Letters of support from industry or governmental organizations which describe potential industry employment opportunities or needs can be found at the following link.

2. **Present data and analysis projecting market demand and the availability of openings in a job market to be served by the new program.**

The Bureau of Labor Statistics indicates that employment in computer and information technology occupations is projected to grow 13 percent from 2020 to 2030, faster than the average for all occupations. These occupations are projected to add about 667,600 new jobs. Demand for these workers will stem from greater emphasis on cloud computing, the collection and storage of big data, and information security. The Bureau of Labor Statistics further indicated that the overall employment of electrical and electronics engineers is projected to grow 7 percent from 2020 to 2030, about as fast as the average for all occupations. About 22,700 openings for electrical and electronics engineers are projected each year, on average, over the decade. Many of those openings are expected to result from the need to replace workers who transfer to different occupations or exit the labor force, such as to retire.

3. **Discuss and provide evidence of market surveys that clearly provide quantifiable and reliable data on the educational and training needs and the anticipated number of vacancies expected over the next 5 years.**

The employment data from the Bureau of Labor Statistics (BLS) is typically used to determine market demand. The proposed degree program will produce engineers working in an interdisciplinary area that requires skill sets in electrical engineering and mechanical engineering. In particular, Electrical Engineers will conduct research, design, develop, test, or supervise the manufacturing and installation of electrical equipment, components, or systems for commercial, industrial, military, or scientific use. According to the BLS data in 2018, there were 330,300 jobs in the Electrical and Electronics Engineering field. For engineers with a broader skill in electro-mechanical systems, it is predicted a 5% increase in employment in the next decade. The broad skill sets in electrical, electronics, and mechatronics engineering will help sustain demand for their service. All the jobs in the emerging industry and market sectors such as unmanned systems, self-driving automobiles, next generation communications systems and networks, and renewable energy industry require a workforce with a background in electrical engineering fields.

The Maryland Department of Labor Licensing and Regulation (DLLR) website does not have a specific job category for applied computing, however, there is an umbrella category of Computer and Information Research scientists which is representative of the field of applied computing. Therefore, according to the Maryland Department of Labor Licensing and Regulation (DLLR) website, there is a current need of over 2,700 positions in the State of

Maryland for a person with the educational background or graduate degree, to fill positions related to Computer and Information Research Scientist.

Table #1 Employment outlook of computer and information research scientist occupations

Job Title	# of Maryland Positions (2018)	# of Maryland Position (2028)	Percentage Growth
Computer and Information Research Scientists	2,794	3,168	13.3%

Source: http://www.dllr.state.md.us/lmi/iandoproj/maryland.shtml (accessed February 17, 2022).

While the United States Bureau of Labor Statistics (USBLS) website does not have a specific job category for applied computing, however, there is an umbrella category of Computer and Information Research scientists which is representative of the field of applied computing. Therefore, according to the United States Bureau of Labor Statistics (USBLS) website located there is a current need for 33,000 positions nationally for a person with an education background or graduate degree, to fill positions related to Computer and Information Research Scientist. The median salary for an individual who is properly credentialed in the field is estimated to be $126,830, according to the USBLS.

Table #2 Employment outlook of computer and information research scientist occupations

Job Title	# of Positions (2020)	# of Positions (2030)	Percentage Growth
Computer and Information Research Scientists	33,000	40,200	22%

Source: https://www.bls.gov/ooh/computer-and-information-technology/computer-and-information-research-scientists.htm (accessed February 17, 2022).

Table #3 Employment outlook of electrical and mechatronics engineering occupations

Employment projections data for electrical and electronics engineers, 2020-30			
Occupation Title	**Employment 2020**	**Projected Employment 2030**	**Change 2020-2030**
Electrical and Electronics Engineers	313,200	333,600	7%
Electrical Engineers	188,000	200,700	6%
Electronics Engineers, Except Computer	125,200	132,900	6%

Table #4 Computer Occupations, Projected employment 2019-2029

Computer occupations projected employment 2019-2029			
Occupation Title	**Employment 2019**	**Projected Employment 2029**	**Change 2019-2029**
Total, all occupations	162,795.6	168,834.7	3.7%
Computer occupations	4,633.4	5,164.6	11.5%
Information security analysts	131	171.9	31.2%
Software developers and software quality assurance analysts and testers	1,469.2	1,785.2	21.5%
Computer and information research scientists	32.7	37.7	15.4%
Database administrators and architects	132.5	145.3	9.7%
Web developers and digital interface designers	174.3	188.3	8%
Computer user support specialists	687.2	741.9	8%
Computer systems analysts	632.4	679	7.4%
Computer network support specialists	195.1	207.7	6.4%
Computer network architects	160.1	168.1	5%
Network and computer systems administrators	373.9	389.9	4.3%
Computer programmers	213.9	193.8	-9.4%

The data from the Maryland Department of Labor job projections as shown below supplement the current trend projected by the U.S. Bureau of Labor Statistics

Table #5 Maryland Occupational Projects

Maryland Occupational Projections 2018 - 2028			
Occupation Title	**Employment 2018**	**Employment 2028**	**Change 2018-2028**
Computer and information systems manager	13,644	15,444	13.2%
Computer and mathematical occupations	113,209	130.011	14.8%
Computer Occupations	104,469	118,979	13.9%
Computer and Information Research Scientists	2,794	3,168	13.4%
Computer Systems Analysts	15,927	18,014	13.1%
Information Security Analysts	4,116	5,727	39.1%
Software developers, applications	9,311	11,773	26.4%
Software developers, systems software developers	13,025	14,762	13.3%
Database Administrators	2,993	3,420	14.3%
Network and computer systems administrators	2,913	3,312	13.7%
Computer Network Architects	12,868	14,561	13.2%

Computer Users Support Specialists	4,629	5,281	14.1%
Computer Network Support Specialists	10,101	11,569	14.5%
Computer Occupations, all other	6,717	7,594	13.1%
Computer science teacher postsecondary	14,550	15,457	6.2%

4. **Provide data showing the current and projected supply of prospective graduates.**
The number of graduates from the current Bachelor of Science in Computer Science (BSCS), Bachelor of Science in Engineering (BSE) Master of Science in Applied Computer Science (MSACS), and Master of Science in Cybersecurity Engineering Technology (MSCSET) at UMES is summarized as follows:

Program	2014-2015	2015-2016	2016-2017	2017-2018	2018-2019	2019-2020*
BSCS	17	15	11	18	23	22
BSE	14	11	11	7	22	19
MSACS	3	10	8	4	4	5
MSCSET	-	-	-	3	6	6
Total	**34**	**36**	**30**	**32**	**55**	**52**

Based on the above number of graduates who will be eligible to enroll in the proposed Doctoral program with a pass-through Master's, the projected supply of prospective graduates from the program is estimated to be 10 in the first year with a projection of five new students per year for the initial five years of the program's operation.

D. **Reasonableness of Program Duplication**

1. **Identify similar programs in the State and/or same geographical area. Discuss similarities and differences between the proposed program and others in the same degree to be awarded.**

The proposed program is unique and builds upon the existing faculty expertise in the general engineering program at UMES. There are no other Ph.D. degree programs in the Eastern Shore of Maryland. Although other institutions in Maryland, such as the University of Maryland College Park, University of Maryland Baltimore County, and Morgan State University offer Ph.D. degrees, these institutions are located about 140 miles away from the Eastern Shore. Moreover, the proposed program offers a unique curriculum with a research focus in cybersecurity, data and computational science, software engineering, mechatronics and control, and communications and networks, aiming to offer a non-conventional pathway towards a degree that prepares students for emerging technologies in unmanned system

design, automation and control, communications and networks for internet of things (IoT), precision agriculture, and aerial imaging for crop monitoring, etc.

The proposed UMES program does not duplicate similar programs offered by other Maryland institutions as we serve a different geographical area and academic program degree-level.

2. **Provide justification for the proposed program**

By leveraging the existing computer science and engineering faculty expertise from the two Departments as well as the new positions to be filled for this program starting from the 2022 – 2023 academic year, we are positioned, uniquely, to address challenges in an emerging industry and job sectors in automation, unmanned systems, IoTs, intelligent systems, cyber operations, software engineering, computer animation, etc. There is a huge market demand for skills in automation, artificial intelligence, and unmanned system technology. The leading companies in the US – Google, GM, Tesla, etc., have research and development groups that actively recruit educated professionals in this area. There are many startups and opportunities to attract venture capital given the growing number of possible applications of unmanned system technology. Other leading drone manufacturers in the US include Boeing Co., Lockheed Martin Corp., AeroVironment Inc. produce drones largely as defense contractors, and AeroVironment manufactures unmanned aircraft as its principal line of business. Companies such as Microsoft and Apple are developing new technologies to defend, mitigate, and prevent cyber-attacks. Companies such as Amazon and IBM are leading the research in new methods to make software systems more efficient.

However, in all these areas and others, the United States is simply not producing enough STEM majors with graduate degrees in general, and particularly, in computer science and engineering, to satisfy the demands that US companies and the federal government have in terms of their workforce needs.

E. **Relevance to High-demand Programs at Historically Black Institutions (HBIs)**

1. **Discuss the program's potential impact on the implementation or maintenance of high-demand programs at HBI's.**

There is no comparable degree program offered at the Ph.D. level at any of the Historically Black Institutions in Maryland. It is stated in the mission that "UMES prepares graduates to address challenges in a global knowledge-based economy while maintaining its commitment to meeting the workforce and economic development needs of the Eastern Shore, the state, the nation, and the world." It is the University's strategic plan to "Meet the educational needs of the state of Maryland with high-quality and innovative academic programming." Since the area of Applied Computing and Engineering is in high demand both locally and globally, and such a program is fully offered in UMES, an HBI, the PHACE is not only consistent with UMES established mission, and strategic plan, but also will extend our existing doctoral programs in a new area in computing and

engineering. While the new PHACE program is for all people of any race or ethnic group, it will attract and provide opportunities for more African Americans and it will have a positive impact on HBIs overall. This program is consistent with UMES's established mission, identity, and uniqueness, as well as being consistent with Maryland State Plan for Postsecondary Education towards access, success, and innovation for African Americans and all people, both locally and globally. The PHACE will promote UMES and state education to a wide perspective nationally and internationally.

F. **Relevance to the identity of Historically Black Institutions (HBIs)**

1. **Discuss the program's potential impact on the uniqueness and institutional identities and missions of HBIs.**

More than 85% of the students at UMES are students of color, and 73% of students in the Engineering program identify themselves as people of color. The mission of UMES and the proposed PHACE program is to provide opportunities for minorities and first-generation college students, allows many individuals who might not otherwise have a chance to earn a graduate degree in areas of cybersecurity, data and computational science, software engineering, mechatronics and control and communications and networks to do so. The establishment of the proposed Ph.D. degree program is critical to the mission of UMES as a Historically Black 1890 land-grant institution, and to its unique identity as a higher learning institution to facilitate social mobility for those from a disadvantaged background, especially for those from the Lower Shore region where learning opportunities in advanced sciences and engineering are severely lacking. Additionally, the program will enhance UMES' Carnegie Classification as a High Research Activity Doctoral University. Furthermore, it will open doors for non-traditional students to advance themselves as they can combine work and school for a greater relevance at their places of employment.

G. **Adequacy of Curriculum Design, Program Modality, and Related Learning Outcomes** (as outlined in COMAR 13B.02.03.10):

1. **Describe how the proposed program was established, and also describe the faculty who will oversee the program.**

The proposed program was established through a rigorous review of unmet needs by the institution. It started from the faculty of the computer science and engineering programs, with approval from the Departmental Curriculum Committee, School Curriculum Committee, Graduate Faculty Council, Senate Curriculum Committee, etc.

The courses of the curriculum in the proposed Ph.D. degree program with a Master's option will be taught by faculty in the Departments of Computer Science and Engineering Technology and Engineering and Aviation Sciences, with an additional 6 engineering

faculty members to be hired to balance the teaching load, and a Lab Specialist for supporting the operation of the specialized engineering laboratories in the Department.

2. **Describe educational objectives and learning outcomes appropriate to the rigor, breadth, and (modality) of the program.**

Graduates with a Ph.D. in Applied Computing and Engineering will be able to:

- Demonstrate in-depth knowledge of the fundamental principles, concepts, terminologies, and methodologies used for design and analysis of broader areas of research namely cybersecurity, data and computational science, software engineering, mechatronics and control, and communications and networks.
- Demonstrate the ability to solve real-world problems in the aforementioned areas.
- Demonstrate the ability to be gainfully employed in research-based industries and academia upon graduation from the program.
- Demonstrate the ability to be in leadership positions in cybersecurity, data and computational science, software engineering, mechatronics and control, and communications and networks, and related disciplines.

Students will learn interdisciplinary and cross-disciplinary methods that are broadly applicable in the emerging field of unmanned systems design, mechatronics and control cybersecurity, data and computational science, software engineering, communications and networks, etc.

3. **Explain how the institution will:**

a. **provide for assessment of student achievement of learning outcomes in the program**

Assessment Methods based on established departmental standards will include the following:

- Assessing written and oral student presentations, written assignments, and research projects.
- Evaluating student performance in exams, quizzes, and assignments in required major courses.

- Passing the comprehensive examination for becoming a candidate for the degree.

- Assessing comprehensive dissertation/thesis or research project report in cybersecurity, data and computational science, software engineering, mechatronics and control, and communications and networks areas of focus. Tracking performance in regional and national competitions and publication records of the students before graduation.

b. **document student achievement of learning outcomes in the program**

The department will document student achievement of the learning outcomes in the program in the same fashion as its current accredited engineering undergraduate program, periodically, as well as its computer science undergraduate and Applied Computing degree programs.

4. **Provide a list of courses with title, semester credit hours, and course descriptions, along with a description of program requirements**

a. **Courses and General Requirements for the Ph.D. Degree with an option for a Master's Degree**

All students in the Masters of Science Degree will take thirty (30) credit hours with the Thesis option or thirty-three (33) credit hours with the Non-thesis option of graduate-level courses to graduate from the program, not including any provisional admission course requirements, over four semesters. All courses that are to count towards graduation must be passed with a minimum grade of B, and students must also pass at least five of these courses with a grade of A. Students can enroll in concentration courses only if they have been admitted to the program or given permission by the course instructor.

The time limit for completing the M.S. degree is five (5) years from the first enrollment in the graduate program. This includes any Provisional Admission course requirements to be met. Any exception to the time limit must be approved by the UMES Graduate School.

Thesis option: the student is required to take three core (9 credits) and a minimum of five free elective (15 credits) graduate level courses and six credits of Thesis. The thesis must be supervised by a member of the faculty as a thesis advisor and the initial thesis proposal must be defended with an oral presentation (see below) and approved by the student's thesis committee (three members including the advisor). The thesis must be submitted to the department in a bound form after the oral defense which will take place after the thesis research is completed. A student is required to submit at least one journal/conference paper from his/her thesis work before the defense.

Non-thesis option: the student is required to take three core (9 credits) and a minimum of seven free elective (21 credits) graduate level courses and a 3-credit hour research project that must be approved by the project advisor. A copy of the resulting scholarly paper (if any) must be submitted to the department. A Student is advised to do a scholarly activity out of his/her project work.

All M.S. students must choose either the thesis or non-thesis option. There is no course-only option.

MS General Requirements

1. A maximum of two graduate-level course units may be transferred from another institution to apply toward the MS degree. Transferred courses must logically fit into the student's graduate program. The student's graduate advisor decides which courses are acceptable. UMES approval of transfer credit may also be required. These two courses should not have been used in fulfillment of any other degree(s).
2. Any coursework more than six years old at the time of the final examination will not be used to fulfill any of the MS degree requirements.
3. All graduate credits must have letter grades of A, B, or C, or pass/fail grades of S (Satisfactory). No More than two graduate courses with letter grade C will be accepted.
4. A minimum grade point average (GPA) of 3.0 is required to remain in good standing and to graduate.
5. Elective courses should be primarily from the concentration specified in this document. Students in each concentration can take 2 courses (6 credits) from the other concentration to satisfy graduation requirements upon approval of both student's advisor and the Director of the graduate program.
6. Up to a maximum 2 courses (6 credits) from other UMES departments of the physical, mathematical, biological, agricultural, or similar sciences may be included to round out a student's overall program of study. All courses from outside of the Engineering Master's Program must be graduate 500-600 level graduate courses. Prior approval of both student's advisor and the Director of the graduate program is required for all external courses.
7. Up to a maximum of 3 credits of Independent Study are allowed upon the student's advisor and Director of the graduate program's approval. Independent Study needs to be structured by the faculty member with a clearly defined syllabus for prior approval.

Ph.D. General Requirements

The Ph.D. program will consist of a minimum of 60 credit hours broken down as follows:

(A)	Core courses	12 hrs.
(B)	Free Electives	12 hrs.
(C)	Concentration courses	24 hrs.
(D)	Dissertation hours	12 hrs.

The general requirements as outlined for the Master's option apply following the breakdown of courses as shown above. The courses applicable to the Ph.D. program will be numbered 600 – 700 level courses. A residency requirement of a year full-time on campus is required.

PHACE Degree Curriculum

The PHACE Degree curriculum combines the courses for the Ph.D. Degree along with the courses that will result in granting a student the Master's Degree should the student choose that option.

The following are new ENEM courses for the PHACE program.

MECHATRONICS AND CONTROLS COURSES

ENEM 601 Linear Systems Theory – 3 Credits (New)

Methods of linear system analysis, in both time and frequency domains for continuous and discrete systems, as well as the analysis and design of systems control. This course will introduce time-domain systems dynamic control fundamentals and their design issues for electrical engineering applications. Emphasis will be on linear, time-invariant, multi-input multi-output continuous-time systems. Topics include open and closed-loop state-space representations, analytical solutions, computer simulations, stability, controllability, observability, and controller/observer design.

ENEM 602 Computational Methods in Engineering – 3 Credits (New)
Fundamentals of linear algebra and basic operations of vectors and matrices; error analysis; solution of a system of linear equations; iterative solution of nonlinear equations; numerical integration; numerical solution of differential equations; introduction to Matlab software; programming and applications relating to the computational functions in Matlab.

ENEM 603 Random Signals Analysis – 3 Credits (New)
Foundations for the engineering analysis of random signals and stochastic processes: Review of probability theory, Introduction to stochastic processes, Continuous time and discrete time processes, Mean functions, correlation functions, covariance functions, noise, Strict- and wide-sense stationarity, ergodicity, Gaussian processes, power spectral densities, mean square estimation, Markov processes, estimation of random variables, and model parameters.

ENEM 611 Mechatronics – 3 Credits (New)
Physical and mathematical modeling of mechanical, electrical, electromechanical, thermal, fluid, and multidisciplinary physical systems; sensors and electronics for measurements of the system; embedded/external feedback control using conventional and intelligent control algorithms; computer aided engineering tools for mechatronic system design and analysis; practical applications using mechatronic devices.

ENEM 612 Microelectronic Devices and Circuits – 3 Credits (New)
Introduces Modeling of microelectronic devices, and basic microelectronic circuit analysis and design. The topics covered include modeling of microelectronic devices, basic microelectronic circuit analysis and design, physical electronics of semiconductor junction and MOS devices, the relation of electrical behavior to internal physical processes, development of circuit models, and understanding the uses and limitations of various models.

ENEM 613 Digital Control Systems – 3 Credits (New)
The course addresses the theoretical foundation needed to implement the microprocessor in control applications. Effects of sampling, data conversion, quantization, finite word length, and time delays on system response and stability are examined. Pole-placement and observer/estimator techniques. The actual construction of a microcomputer-based controller culminates the course.

ENEM 614 Robotics – 3 Credits (New)
Introduction to industrial manipulator systems; Kinematic and dynamic models of robotic arms; homogeneous transformations; forward and inverse kinematics; motion control through coordinate transformations; robotic vision and sensors.

ENEM 615 Nonlinear Systems Analysis and Control – 3 Credits (New)

Introduction to Nonlinear Phenomena: Multiple Equilibria, Limit Cycles, Complex Dynamics, Bifurcations Second Order Nonlinear Systems: Phase Plane Techniques, Limit Cycles - Poincare-Bendixson Theorem, Index Theory, Input-output Analysis, and stability: Small Gain Theorem, Passivity, Describing Functions Lyapunov Stability Theory: Basic stability and instability theorems, LaSalle's theorem, Indirect method of Lyapunov Linearization by State Feedback: Input-Output and Full State Linearization, Zero Dynamics, Inversion, Tracking, and Stabilization.

ENEM 616 Embedded Systems Design – 3 Credits (New)
Topics covered include automotive embedded system requirements, verification during design, sneak circuit analysis, worst-case circuit analysis, design considering component tolerances and non-ideal behavior, thermal analysis, EMC analysis, FMEA analysis, grounding rules for circuits, six sigma, fault tolerance, risk analysis, reliability issues, trade-offs in design, delays in automotive networks, and software-in-the-loop and hardware-in-the-loop tests.

ENEM 617 Autonomous Systems – 3 Credits (New)
Present applications and future roles of autonomous manned and unmanned systems. The course introduces theoretical and practical backgrounds for components and integration of autonomous vehicle systems. Topics include mobility dynamics and control, sensors and perception, cognition and decision, action and commands, computer communications, and integration. Case studies include lane following, obstacle avoidance, leader following, waypoint navigation, and guidance.

ENEM 618 Mechatronic System Design, Integration, and Test – 3 Credits (New)
This course addresses in detail the systems engineer's responsibilities and activities during the conceptual, design, integration, and test and Evaluation phases of a system development program. Systems engineering tools commonly employed at these stages of a program are presented along with selected problems that illustrate both the applicability and limitations of commonly employed tools and procedures. The course steps through conceptual design beginning with an analysis of needs and objectives, and proceeding to the exploration of alternative concepts and the selection of a concept that best meets goals of performance, timeliness, and affordability. Topics include a definition of operational scenarios, functional analysis, risk assessment, system tradeoffs, measures of effectiveness, and requirements formulation.

ENEM 619 Micro-Electro-Mechanical Systems – 3 Credits (New)
A comprehensive overview of MEMS technique and MEMS control. Topics include MEMS fabrication processes, MEMS sensors and actuators, Dynamic modeling of MEMS, control, signal processing, and electronics for MEMS, and case studies of MEMS devices.

ENEM 620 Mechanical Vibrations – 3 Credits (New)
Linear free and forced response of one and multiple degrees of freedom systems. Equations of motion of discrete systems. Free vibration eigenvalues and eigenvectors. Applications to engineering systems include vibration isolation, rotating imbalance, vibration absorbers and balancing of rotating machinery, and energy harvesting.

ENEM 621 Structural Design – 3 Credits (New)

Introduction to elasticity, stress, strain, material properties, stress function, failure criteria, fracture, fatigue, elasticity solution to bending, advanced torsion, buckling of columns, energy methods, plates and shells, and plastic deformation.

ENEM 622 Advanced Dynamics – 3 Credits (New)
The course deals with the study of mechanical systems undergoing a change of state described by the motions of their part under the influence of surrounding factors. The primary objective of this course is to equip students with the analytical tools needed to conduct accurate and realistic dynamic analysis, and it is recommended for students pursuing an interest in system dynamics, mechanics, robotics, controls, and other relevant areas of mechanical and aerospace systems. The fundamental concepts of Newtonian mechanics and Hamilton's principle from the viewpoint of the Variational approach will be taught in this class. Students will also learn the analytical applications of Euler's and Lagrange's equations of motion to model rigid body system dynamical properties.

ENEM 623 Finite Element Method and Applications – 3 Credits (New)
This course covers the introduction to finite element methods and applications such as unmanned and mechatronics systems; relations between stresses, strains, displacements, temperature, and material properties; discretization and meshing; force vector, displacement vector, stiffness matrix, assembly process, solution techniques; truss elements, beam elements; triangular and quadrilateral elements; iso-parametric formulation; plane stress and plane strain applications; penalty and Lagrangian methods; software applications and simulations.

ENEM 624 Aerodynamics for Unmanned Aerial Systems – 3 Credits (New)
This course covers the introduction to aerodynamics fundamental concepts such as lift, drag, moment, pressure distribution, boundary layers for design and testing of unmanned aerial systems (UAS) with fixed or rotary wings; potential theory of bodies; airfoil theory and applications; finite wing theory and applications; introduction to Navier-Stokes equations; laminar boundary layers; turbulent boundary layers; instability and turbulence/separation; introduction to airfoil design; computational fluid dynamics (CFD) technique.

ENEM 670 Selected Topics in Engineering – 3 Credits (New)
This course covers selected topics on special or current topics and issues relating to electrical engineering, mechatronics control, communications, networks, etc. for master's students in engineering and other areas.

ENEM 688 Independent Study – [1-3 credits] Credits (New)
An independent study is conducted with a faculty member on a relevant topic. The course must be structured by the faculty member with a clearly defined syllabus for the Master's student. The course requires the prior approval of the student's advisor and graduate program director.

ENEM 696 Master Project – 3 Credits (New)
The student will conduct advanced research of interest to the student and the instructor. A written proposal, which outlines the nature of the project, must be submitted for approval. This course is only available to project option students. Prerequisite: Masters standing and Consent of advisor.

ENEM 697 Master Thesis - credits var. (3-6). (New)
Master of Science thesis research will be conducted under the supervision of the thesis committee chairperson leading to the completion of the Master's thesis. This course is only available to thesis option students. Prerequisite: Master standing and Consent of advisor.

DOCTORAL LEVEL MECHATRONICS AND CONTROLS COURSES

ENEM 711 Continuum Mechanics – 3 Credits (New)
The general theory of continuous medium governs both solid and fluid mechanics. Kinematics of large deformation, stress, and strain tensors, conservation laws including conservation of mass, energy, linear and angular momentum, constitutive equations, and material models for elasticity, viscoelasticity, and plasticity.

ENEM 712 Elasticity – 3 Credits (New)
Fundamentals of solid mechanics and deformation, stress-strain and equilibrium and compatibility equations, generalized Hooke's law, boundary conditions. Plane strain, generalized plane stress, and planar elasticity. Airy stress function, torsion and bending, St. Venant principle, introduction to thermoelasticity, and numerical methods.

ENEM 713 Mechanics of Composite Structures – 3 Credits (New)
Current and potential applications of composite materials, fibers, matrices, manufacturing methods for composites, anisotropic elasticity, micromechanics for determining mechanical properties of composite materials, classical lamination theory, failure and strength analysis of composite materials, mathematical modeling, and other advanced topics related to mechanics of composite materials.

ENEM 714 Design of Autonomous Aerial Systems – 3 Credits (New)
Introduction to unmanned aerial vehicles, unmanned aircraft design; conceptual unmanned aerial vehicles design based on concepts drawn from weight estimation, aerodynamics, aircraft structure, stability and control, propulsion, navigation, guidance, communication, and design of control system; design for efficiency, design for performance, design for stability; flight dynamics equations are emphasized for design purposes; introduction to ground, wind tunnel, and flight testing.

ENEM 715 Nano-mechanics – 3 Credits (New)
Topics in computational nanomechanics, which involve the study of materials properties and structures down to a nanometer; classical molecular dynamics, lattice mechanics, Methods of thermodynamics and statistical mechanics, multiple-scale modeling, bridging scale and numerical applications, the material design.

ENEM 716 Advanced Fluid Mechanics – 3 Credits (New)
Advanced topics in fluid mechanics include Navier-Stokes equations and their exact solutions for classic cases, approximate solutions of Navier-Stokes equations, inviscid flow, irrotational flow, potential flow, and applications; boundary layer theory, introduction to compressible flow, and introduction to turbulent flow.

ENEM 717 Computational Fluid Dynamics – 3 Credits (New)
Physical and mathematical foundations of computational fluid mechanics with emphasis on applications. Classification of partial differential equations and solution techniques, Finite Difference Formulations, Solution methods for model equations, the Euler and the Navier-Stokes equations. The finite volume formulation of the equations, Truncation errors, stability, conservation, monotonicity, mesh generation. Computer coding and commercial software projects are included.

ENEM 718 Advanced Vibrations – 3 Credits (New)
Free and forced vibrations of multi-degree-of-freedom systems, modal analysis, Hamilton Principle and Energy Method to analyze free and forced vibrations of continuous systems such as axial bars, beams, shafts, etc. with different boundary conditions; different numerical methods and in particular finite difference methods to analyze discretized multi-degree-of-freedom systems.

ENEM 719 Optimal Control – 3 Credits (New)
Principles of optimal control theory for dynamics systems, constrained and unconstrained optimization problems, vibrational calculus, dynamic programming, Pontryagin's maximum principle, Hamilton-Jacobi-Bellman equation. Interactive numerical techniques for finding optimal trajectories.

ENEM 720 Adaptive Control – 3 Credits (New)
Introduction to control of systems with undetermined or time-varying parameters. Theory and application of self-tuning and model reference adaptive control for continuous and discrete-time deterministic systems. Model-based methods for estimation and control, stability of nonlinear systems, adaptation laws, and design and application of adaptive control systems.

ENEM 770 Special Topics – 3 Credits (New)
Topics of current interest selected by the faculty.

ENEM 797 Dissertations – 3 ~ 12 Credits (New)
This is the Ph.D. Dissertation for engineering graduate students.

The tables below are mappings for students who enter the Ph.D. program with the proposed M.S. in Electrical and Mechatronics Engineering.

MECHATRONICS AND CONTROLS CONCENTRATION

Courses	Master's			Ph.D.			
	Core	Elective	Project/Thesis	Core	Con	Elective	Diss
ENEM 601	X				X		
ENEM 602	X				X		
ENEM 603	X				X		
ENEM 611		X			X		
ENEM 612		X				X	
ENEM 613		X				X	
ENEM 614		X				X	
ENEM 615		X				X	

ENEM 616		X				X	
ENEM 617		X				X	
ENEM 618		X				X	
ENEM 619		X				X	
ENEM 620		X				X	
ENEM 621		X				X	
ENEM 622		X				X	
ENEM 623		X				X	
ENEM 624		X				X	
ENEM 670		X					
ENEM 688		X					
ENEM 696			X				
ENEM 697			X				
ENEM 711		X			X		
ENEM 712		X			X		
ENEM 713		X			X		
ENEM 714		X			X		
ENEM 715		X			X		
ENEM 716		X			X		
ENEM 717		X			X		
ENEM 718		X			X		
ENEM 719		X			X		
ENEM 720		X			X		
ENEM 770		X			X		
ENEM 797							X

Note:

1. ENEM 797 Dissertation 3 - 12 credits for Ph.D. Dissertation
2. Students who hold an MS degree in Engineering can take 600-level courses as electives approved by the advisor toward the Ph.D. degree
3. Students who started with a BS in Engineering are expected to work towards MS in Electrical and Mechatronics Engineering first, then move on toward the Ph.D. program

b. **Admission Standards**

To be considered for admission into the Ph.D./M.S. Degree Program in PHACE, a student (US and international) must satisfy the university-wide requirements for admission to graduate programs as established by the Graduate School of the university. However, the graduate committees for the various research areas may require higher academic standards for admitting students to the departments' graduate programs. In general, the applicant must have completed a Bachelor's degree in electrical engineering, computer engineering, mechatronics engineering, general engineering, or a closely related technical field from an accredited undergraduate program. The applicant must have an acceptable GRE score. The applicant must submit all documents required by the graduate school to the admission office of the graduate school. In addition, each applicant should also submit:

- Graduate Record Examination (GRE) basic test scores;
- A letter of intent describing his/her graduate studies goals and objectives.
- Three letters of reference from faculty, engineers, or supervisors that can certify his/her ability to pursue studies at the Ph.D./Master of Science level.

5. **Discuss how general education requirements will be met, if applicable.**

The section is not applicable as the proposed program is at the graduate level and does not contain any general education requirements.

6. **Identify any specialized accreditation or graduate certification requirements for this program and its students.**

The section is not applicable as the proposed program is at the graduate level and therefore, is not required to meet any specialized accreditation of graduate certification requirements.

7. **If contracting with another institution or non-collegiate organization, provide a copy of the written contract.**

The section is not applicable as the proposed program will not have a contract with another institution or non-collegiate organization.

8. **Provide assurance and any appropriate evidence that the proposed program will provide students with clear, complete, and timely information on the curriculum, course and degree requirements, nature of faculty/student interaction, assumptions about technology competence and skills, technical equipment requirements, learning management system, availability of academic support services, financial aid resources, and costs and payment policies.**

The entire curriculum and course specific information of the proposed degree program will be posted on the websites of the Departments of Computer Science and Engineering Technology and Engineering and Aviation Science. Information about the availability of academic/student support services, financial aid resources, and tuition payment policies can be found on the UMES Office of Graduate Studies website, as well as in the Financial Aid Office of UMES.

9. **Provide assurance and any appropriate evidence that advertising, recruiting, and admissions materials will clearly and accurately represent the proposed program and the services available.**

As with all other academic programs offered by the University of Maryland Eastern Shore, the proposed program will ensure that advertising, recruiting, and admissions materials will clearly and accurately represent the proposed program and the services available. In addition, the program will be advertised alongside other academic graduate programs within the School of Business and Technology at UMES. Proper venues include Public Radio WESM 91.3, and social media such as UMES Facebook page, the University Key, as well as through UMES alumni association, and other professional societies.

H. **Adequacy of Articulation**

1. **If applicable, discuss how the program supports articulation with programs at partner institutions. Provide all relevant articulation agreements.**

   The proposed program does not have articulation partners currently at the Ph.D./Master's degree level. However, the proposed program will support establishing an articulation with other system institutions at the bachelor's degree level, for example, a B.S./Ph.D. articulation between the B.S. in Physics program at Salisbury University and the proposed doctoral program at UMES. The goal of UMES is to work with partner institutions to provide a pathway for students interested in engineering or closely related fields to obtain a Ph.D. degree in engineering.

I. **Adequacy of Faculty Resources**

1. **Provide a brief narrative demonstrating the quality of program faculty. Include a summary list of faculty with appointment type, terminal degree title and field, academic title/rank, status (full-time, part-time, adjunct) and the course(s) each faculty member will teach in the proposed program.**

   There are seven (7) full-time faculty qualified to teach Electrical and Mechatronics Engineering courses in the concentration, i.e., Mechatronics and Control. Three (3) new faculty members will be hired over the next five years to support the Mechatronics and Control concentration. Therefore, at the end of the five-year period, there will be ten (10) full-time faculty dedicated to the Mechatronics and Control concentration.

   The existing seven (7) faculty are listed below.

   Dr. Ibibia K. Dabipi, **Professor of Electrical Engineering**. He received his Ph.D. and M.S. in Electrical Engineering from Louisiana State University. His experiences include working at Bell Communications Research and AT&T Bell Labs as a member of the technical staff with a primary research focus in communications and networks.

   Dr. Yuanwei Jin, Professor of Electrical Engineering and Chair. He received a Ph.D. degree in Electrical Engineering from the University of California at Davis. Before joining UMES, he was with Carnegie Mellon University. His research interests are in the general area of signal processing and sensor array processing, with applications in communications, radar/sonar, and networks.

   Dr. Payam Matin, **Professor of Mechanical Engineering**. He received his Ph.D. in Mechanical Engineering from Oakland University, Rochester, Michigan. His research has been in the areas of computational mechanics and experimental mechanics with applications in solid mechanics, structural design, plasticity, sheet metal forming, drone design, etc.

   Dr. Lanju Mei, **Assistant Professor of Aerospace Engineering**. She received her Ph.D. degree in Aerospace and Mechanical Engineering from Old Dominion University. Her

primary research interests include MEMS sensors, additive manufacturing, and computational fluid dynamics.

Abhijit Nagchaudhuri, **Professor of Mechanical Engineering**. He received a Ph.D. degree in Mechanical Engineering from Duke University. His teaching and research area is in the fields of robotics and mechatronics, remote sensing and precision agriculture, and biofuels and renewable energy.

Dr. Alvernon Walker, Associate Professor of Electrical Engineering. He received his Ph.D. in Electrical Engineering from North Carolina State University. His primary research area is electronics, digital system design, and mixed-signal system design.

Dr. Lei Zhang, Associate Professor of Electrical Engineering. He received his Ph.D. in Electrical Engineering from the University of Nevada, Las Vegas. His primary research area is in computer networks, microprocessors and microcomputers, embedded system design, etc.

2. Demonstrate how the institution will provide ongoing pedagogy training for faculty in evidenced-based best practices, including training in:

a) Pedagogy that meets the needs of the students

The Center for Teaching Excellence (CTE) provides ongoing pedagogy training for faculty in evidence-based best practices to support high-impact practices pedagogy to meet the needs of UMES students. To accomplish its mission of ensuring expanding and enhancing faculty pedagogy training, CTE has developed three broad program areas to support faculty teaching success which includes evaluation of teaching techniques, professional development of faculty as it relates to pedagogy, and recognition of faculty who have demonstrated outstanding pedagogy methodology.

The evaluation of teaching techniques program includes the use of student experience of learning surveys, peer observation of teaching, and open classroom week. The professional development of the faculty program includes funding to attend pedagogy conferences, faculty workshops, FACTE working group, seminar series for new faculty, and innovation in teaching & learning conferences. Lastly, CTE's faculty recognition program includes student choice for teaching excellence e-badge, CTE website – faculty spotlights, and SOTL publication opportunities.

b) The learning management system

The Center for Instructional Technology and Online Learning (CITOL) at UMES supports the development, design, and delivery of online and hybrid programs, classes, and workshops with a focus on flexibility, resiliency, equity, accessibility, privacy, and safety (FREAPS). CITOL assists faculty, staff, and students in all aspects of digital teaching and learning concerning pedagogy and technology. This includes the use of the Canvas Learning Management System, Echo360, Google Workspace, Respondus 4.0, and Respondus LockDown Browser.

c) Evidence-based best practices for distance education, if distance education is offered.

The Center for Instructional Technology and Online Learning (CITOL) at UMES supports the development, design, and delivery of online and hybrid programs, classes, and workshops with a focus on flexibility, resiliency, equity, accessibility, privacy, and safety (FREAPS). CITOL assists faculty, staff, and students in all aspects of digital teaching and learning concerning pedagogy and technology. This includes the use of the Canvas Learning Management System, Echo360, Google Workspace, Respondus 4.0, and Respondus LockDown Browser. Other Services offered by the Center for Instructional Technology and Online Learning include: supporting Canvas Learning Management System (LMS) and other instructional software which can be found on the CITOL website: new resources; providing ongoing professional development through virtual workshops; conducting UMES Online Teaching Certification & Course Quality Review; developing interactive and assessment materials for classes; and helping troubleshoot student problems on LMS.

J. Adequacy of Library Resources

1. Describe the library resources available and/or the measures to be taken to ensure resources are adequate to support the proposed program.

The Frederick Douglass Library is the only library on the University of Maryland Eastern Shore (UMES) campus. As a member of the University of System of Maryland and Affiliated Institutions (USMAI) consortium, the Frederick Douglass Library is affiliated with 17 public universities and colleges in the state of Maryland. The integrated library system ALEPH makes it possible for patrons to have 24/7 access to USMAI library collections and electronic resources. In-person visits to the library are available 91.5 hours per week including weekends.

The Frederick Douglass Library has the following resources available and/or the measures to be taken to ensure resources are adequate to support the proposed programs:

Books, periodicals, and other reference materials may be located and obtained for patron usage at any time online via the library catalog, online databases, interlibrary loan, inter-campus loan, or by visiting the library.

ILLIAD (Interlibrary Loan) service allows students, faculty, and staff to take advantage of the millions of items from other universities that are not available at the Frederick Douglass Library.

Interlibrary Loan allows the borrower to request items (books, and articles from non-university of Maryland System libraries. The average time to receive an article is 2 weeks. The average time to receive a book is 3 weeks. There is also Rapid Interlibrary Loan (Rapid ILL) where most articles may be received within 24 hours.

Borrowers are notified by email from the FDL staff to pick up items from the Inter-Library Loan service desk. Many articles requested will be received electronically and available to be accessed within ILLIAD.

Inter-campus loans may be requested from another University of Maryland System Library and delivered to the FDL for patron pick up. The average time to receive a book is 3-5 days.

Resources that are available electronically via the Frederick Douglass webpage are databases, e-books and e-journals. Open Education Resource Textbooks is a search interface that allows faculty to retrieve OER resources to be used as course materials at no cost to students.

There are over 140 databases pertaining to research in 17 subject areas.

Databases by Subject

Agriculture	Health & Medicine
Business Management & Accounting	History
Computer Science & Engineering Technology	Hospitality & Tourism Management
Criminal Justice & Government	Human Ecology
Education	Life Sciences
Engineering & Aviation Science & Built Environment	Pharmacy
English & Modern Languages	Physical Sciences
Fine Arts	Physician Assistant
	Social Sciences

Library Holdings as of 2022 for Proposed Degree Programs

New Program(s)	eJournal Titles	eBooks
Applied Computing and Engineering	125	500
Construction Engineering Program	150	750
Biomedical & Bioengineering Program	20	400
Simulation & Game Development Program	40	150
Aviation Science	25	100

Print books and periodicals are located on the three floors of the Frederick Douglass Library. Periodicals are housed on the Lower Level. Reference books are on the first floor. Circulating and Special Collections books are located on the second floor of the library.

To ensure that resources are adequate to support the proposed programs, the library director and library liaisons will network and collaborate with program faculty with the selection of resources to be housed in the library. There is a one-credit Library Information Literacy class that is taught each semester, winter and summer sessions. Individual classroom library sessions are also taught

upon request by the instructor. This instruction can range from basic research and knowledge of the library to the highest level of research for those seeking graduate degrees.

The University assures that institutional library resources meet the new program's needs. For the proposed degree program, typically library resources include textbooks, reference books, and technical papers. Although UMES does not have the IEEE Digital Library IEEE Xplore, the technical papers could be accessed through the Interlibrary Loan (ILL) services.

K. Adequacy of Physical Facilities, Infrastructure, and Instructional Equipment

1. **Assure that physical facilities, infrastructure, and instruction equipment are adequate to initiate the program, particularly as related to spaces for classrooms, staff and faculty offices, and laboratories for studies in the technologies and sciences.**

   The UMES Department of Engineering and Aviation Sciences is housed in the Engineering and Aviation Science Complex, a 166,000 square feet facility that houses more than 20 engineering laboratories. They include Robotics Lab, Fluid/Thermal lab, Materials lab, Aerospace Lab, Electronics Lab, Circuits Lab, Micro-Electro-Mechanical Systems (MEMS) Lab with a Clean Room (ISO Class 5, 6 and 7), Control System Lab: an Embedded System Lab, Communications Lab, Microwave Chamber, CAD/VLSI Lab, High Bay Area, multiple computer labs, etc. The before-mentioned labs can support the proposed new courses and research activities. A complete list of engineering labs with brief descriptions can be viewed at the following link:
   https://www.umes.edu/Engineering/DynContent/Laboratories/

   The Department of Computer Science and Engineering Technology is located in the Engineering and Aviation Science Complex, a state-of-the-art building with 166,000 square feet facility that houses classrooms, laboratories, tutorial rooms, an auditorium, student lounges, study areas, and a fast-food restaurant. All faculty and staff have individual offices where they can conduct various works, including student advising, office hours, research, and services.

   The Department of Computer Science and Engineering Technology has six dedicated computer laboratories (where students learn programming and coding using C++, COBOL, Assembly, Java, Python, Networking, SAS, etc.) at their disposal, including:

   - EASC 2112 - Supercomputer Lab (contains the mainframe)
   - EASC 2108 - Graduate Lab (22 computer stations with private desks and overhead storage that graduate students may use for conducting research and completing projects)
   - EASC 2122 - CS Computer Lab Computer Programming (classroom/lab with 31 computer stations loaded with software, applications, and programs)
   - EASC 2121 - CS Computer Lab Computer Programming (classroom/lab with 35 computer stations loaded with software, applications, and programs)
   - EASC 2090 - Software Engineering Lab (classroom/lab with 28 computer stations loaded with a variety of software, applications, and programs)

- EASC 2091 - Database Lab (classroom/lab with 35 computer stations loaded with software, applications, and programs)
- The Department has five dedicated laboratories for engineering technology:
- ATC 1046 – Electronics Lab: The Electronics Lab contains circuit analysis and test equipment utilized by the Electrical/Electronic Engineering Technology program. The equipment includes function generators, oscilloscopes, digital multimeters, a PCB milling machine, high power generation, and transmission trainer, soldering equipment, and other various test equipment. The lab is fitted with 14 computers with double screen monitors that host several types of software related to electronics.
- ATC 1050 – Communications Lab: The Communications Lab contains specialized equipment for analyzing and testing Radio Frequency (RF) and Microwave communication signals and systems. The equipment includes two network analyzers, two spectrum analyzers, two Lab-Volt analog communications, trainers, two Lab-Volt digital communication trainers, LCR meters, frequency counters, oscilloscopes, and an antenna design and testing trainer.
- ATC 1045 – Global Positioning Systems (GPS) Laboratory: The GPS Lab is a dedicated lab space for developing and testing communication systems related to GPS. This lab includes a grant funded $250,000 CAST Navigation system for simulating and modeling advanced navigation technology related to military, federal, and commercial sectors of industry.
- EASC 1028 – Communications Laboratory: The Communications Laboratory is a shared laboratory space with the Department of Engineering. This Lab includes 32 computers with various engineering, programming, and simulation software. This computer lab is fitted with five wall mounted LCD screens for multiple viewing angles and small work groups.
- EASC 1028 – Embedded Systems Laboratory: The Embedded Systems Laboratory is a shared laboratory with the Department of Engineering. This laboratory contains equipment for designing, testing, and simulating embedded devices and systems. The equipment in this lab includes benchtop multimeters, oscilloscopes, function generators, 3D printers, Bolt Sphero robots, digital logic analyzers, digital electronics trainers, soldering stations, and 10 computers.

These labs can support the instruction in the new courses and research activities as part of the proposed degree program. A complete list of computer science and engineering technology labs with brief descriptions can be found using the link: https://wwwcp.umes.edu/cset/cset-laboratories/

All engineering faculty and staff have individual offices that will facilitate student advising, office hours, etc. Sufficient classrooms are also available in the same building, which makes it very convenient for students to take classes and conduct laboratory experiments.

2. Provide assurance and any appropriate evidence that the institution will ensure students enrolled in and faculty teaching in distance education will have adequate access to:

a) An institutional electronic mailing system, and

b) A learning management system that provides the necessary technological support for distance education

(a) and (b): Faculty support for the development and instruction is provided by the Information Technology Department and also Academic Computing Unit professionals. Consultation is available for issues such as instructional design, software development, educational research, Blackboard learning management system, etc. These technologies and opportunities ensure students enrolled in and faculty teaching have adequate access to learning resources.

L. **Adequacy of Financial Resources with Documentation**

1. **Complete** Table 1: Resources and Narrative Rationale**. Provide finance data for the first five years of program implementation. Enter figures into each cell and provide a total for each year. Also, provide a narrative rationale for each resource category. If resources have been or will be reallocated to support the proposed program, briefly discuss the sources of those funds.**

TABLE 1: RESOURCES					
Resources Categories	(Year 1)	(Year 2)	(Year 3)	(Year 4)	(Year 5)
1. Reallocated Funds[1]	$161,292	$214,444	$207,188	$257,475	$306,089
2. Tuition/Fee Revenue[2] (c+g below)	$95,208	$135,056	$236,812	$281,025	$326,912
a. # FT Students	5	10	15	20	25
b. # Annual Tuition/Fee Rate	$9,300	$9,486	$9,676	$9,869	$10,067
c. Annual / Full Time Revenue (a x b)	$37,200	$75,888	$116,109	$157,908	$201,332
d. # PT Students	5	5	10	10	10
e. Credit Hour Rate	$413	$422	$430	$439	$447
f. Annual Credit Hours	18	18	18	18	18
g. Total Part Time Revenue (d x e x f)	$58,008	$59,168	$120,703	$123,117	$125,579
3. Grants, Contracts & Other External Sources[3]	$0.00	$0.00	$0.00	$0.00	$0.00
4. Other Sources	$0.00	$0.00	$0.00	$0.00	$0.00
TOTAL (Add 1 - 4)	$256,500	$349,500	$444,000	$538,500	$633,000

2. **Complete** Table 2: Program Expenditures and Narrative Rationale**. Provide finance data for the first five years of program implementation. Enter figures into each cell and provide a total for each year. Also provide a narrative rationale for each expenditure category.**

TABLE 2: EXPENDITURES					
Expenditure Categories	(Year 1)	(Year 2)	(Year 3)	(Year 4)	(Year 5)
1. Total Faculty Expenses (b + c below)	$189,000	$283,500	$378,000	$472,500	$567,000
a. # FTE	2	3	4	5	6
b. Total Salary	$140,000	$240,000	$280,000	$350,000	$420,000
c. Total Benefits [35%]	$49,000	$73,500	$98,000	$122,500	$147,000
2. Total Administrative Staff Expenses (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. Total Support Staff Expenses (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	$50,000	$50,000	$50,000	$50,000	$50,000
5. Library	0	0	0	0	0
6. New or Renovated Space	0	0	0	0	0
7. Other Expenses	$17,500	$16,000	$16,000	$16,000	$16,000
TOTAL (Add 1 - 7)	$256,500	$349,500	$444,000	$538,500	$633,000

Narrative Rationale for Table 1: Resources

1. Reallocated Funds
   The University will reallocate funds to support the new academic program as follows: Year 1: $161,292; Year 2: $214,444; Year 3: $207,188; Year 4:$257,475; and Year 5: $306,089.

2. Tuition and Fee Revenue
   We assumed that tuition and fees will increase for the next five years ($9,300, $9,486, $9,676, $9,869, and $10,067). The in-state part-time tuition rate per credit hour is currently $413 per credit. This value was used in calculating the revenue assuming 9 credits per semester for full-time students and 18 credits per academic year for part-time students.

3. Grants and Contracts
   No additional sources of funding are expected at this time.

4. Other Sources
   No additional sources of funding are expected at this time.

5. Total Year: 5-year estimate is provided.

Narrative Rationale for Table 2: Expenditures

1. Faculty (# FTE, Salary and Benefits)

   Over the next five years, new full-time tenure-track faculty members (with backgrounds in the proposed concentration) will be hired. The new faculty hires, in addition to the current faculty, will support the proposed doctoral programs including the pass-thru master's program(s).

   There will be no need for additional administrative staff. The existing departments and school administrative staff will be sufficient to operate the program.

2. Support Staff (# FTE, Salary and Benefits)
   None

3. Equipment
   Funds, $50,000 per year for the first five years, in this budget line will be used to purchase major equipment to support the research efforts of the proposed granted program.

4. Library
No funds are requested to purchase additional library materials.

5. New and/or Renovated Space
Not needed

6. Other Expenses
Funds allocated in this line will be used for the start-up package to support the new faculty. The funds will be used for professional development, including developing proposals for grants and contracts, travel, and supplies for specialized engineering labs.

M. **Adequacy of Provisions for Evaluation of Programs**

1. **Discuss procedures for evaluating courses, faculty, and student learning outcomes.**
2. **Explain how the institution will evaluate the proposed program's educational effectiveness, including assessments of student learning outcomes, student retention, student and faculty satisfaction, and cost-effectiveness.**

1 and 2:
UMES has a comprehensive course and program evaluation process. Each course syllabus has a set of written student learning outcomes. The course learning outcomes are assessed through embedded questions on tests, assignments, and portfolios that address specific course outcomes. Data is collected and analyzed and results are used to improve course curriculum and pedagogy.

Once the program is launched, its courses will enter the course evaluation system. Teaching evaluations ask students to reflect on the course structure, the course content, and the instructor's performance. Summary data will be reviewed by faculty members, the program chair, and the school administration, to determine whether revision or improvement actions are necessary.

In addition, every faculty is evaluated each year. The evaluation process includes an assessment of faculty teaching, faculty research record and productivity, and school-wide and department service. To receive a high evaluation, a faculty member must demonstrate effective teaching, active scholarly activities, publication, etc. There is also a provision for the administration to set out an improvement plan for faculty members who have not done well in the area of teaching. Tenured faculty will undergo a five-year post-tenure review.

Program assessment takes place in a six-year cycle. Data regarding program enrollment, retention, and graduation rates are collected by the Institutional Advancement, Marketing, and

Research Division in conjunction with the program coordinator. The data are analyzed against program outcomes and results are used to improve the program.

N. **Consistency with the Commission's Minority Student Achievement Goals**

1. **Discuss how the proposed program addresses minority student access & success, and the institution's cultural diversity goals and initiatives.**

UMES's mission is compatible with the State of Maryland's minority achievement goals. UMES is an 1890 land grant HBCU. Our programs attract a diverse set of students with the majority of the student population being African-American and those who are multiethnic and multicultural. The University actively recruits minority populations for all undergraduate and graduate-level degrees. Special attention is also provided to recruit females into the STEM and multidisciplinary programs at all degree levels – undergraduate, Master's, and doctoral. The same attention will be given to the M.S. in Electrical and Mechatronics Engineering program.

O. **Relationship to Low Productivity Programs Identified by the Commission:**

1. **If the proposed program is directly related to an identified low productivity program, discuss how the fiscal resources (including faculty, administration, library resources, and general operating expenses) may be redistributed to this program.**

The proposed program is not directly related to an identified low-productivity program at UMES.

P. Adequacy of Distance Education Programs (as outlined in COMAR 13B.02.03.22)

1. **Provide affirmation and any appropriate evidence that the institution is eligible to provide Distance Education.**

At UMES, we are committed to continually improving our online courses and our distance education program. UMES participates in *The State Authorization Reciprocity Agreement*. Some of the benefits for students of our institutional participation in SARA include greater access to online programs, improved the quality of distance education, and reduced institutional costs (which keeps everyone's costs lower). Currently, 47 states and the District of Columbia participate in SARA. "*The State Authorization Reciprocity Agreement* is a voluntary agreement among its member states and U.S. territories that establishes comparable national standards for interstate offering of postsecondary distance-education courses and programs. It is intended to make it easier for students to take online courses offered by postsecondary institutions based in another state" (NC-SARA.org).

The University of Maryland Eastern Shore (UMES) is submitting a proposal for a Master of Science in Data Science and Analytics Engineering. The proposed program will be offered both online and in a traditional face-to-face format. The current faculty in the Department of Business, Management and Accounting, Department of Computer Science and Engineering Technology, Department of Engineering and Aviation Sciences, and Department of the Built Environment will serve as the majority of the instructors in the new program. Any new instructors recruited to teach online would be required to meet the same qualifications as the current faculty. All faculty teaching

in the online version of the program will be required to complete UMES Online Learning Training and the School of Business and Technology recommends Quality Matters training, Online Learning Consortium, or other comparable training for its instructors.

2. Provide assurance and any appropriate evidence that the institution complies with the C-RAC guidelines, particularly as it relates to the proposed program.

UMES' commitment to online teaching is demonstrated by the resources of its Center for Instructional Technology and Online Learning (CITOL) founded in 2006, which provides a faculty computer lab, course development, instructional, and technical support to new and current faculty. The Center for Instructional Technology and Online Learning (CITOL) at UMES supports the development, design, and delivery of online and hybrid programs, classes, and workshops with a focus on flexibility, resiliency, equity, accessibility, privacy, and safety (FREAPS). CITOL assists faculty, staff, and students in all aspects of digital teaching and learning concerning pedagogy and technology. This includes the use of the Canvas Learning Management System, Echo360, Google Workspace, Respondus 4.0, and Respondus LockDown Browser. As C-RAC 2021 requires programs to provide details about practices to engage and assist distance education students; CITOL facilitates student-centered training and workshops, provides students mentoring and help desk support, and hosts a repository of student-centered LMS and online learning resources. The School of Business and Technology in addition to the Center for Instructional Technology and Online Learning will assure the degree program adheres to C-RAC Guidelines for the Evaluation of Distance Education.

Appendix A: Funding Letter from Microsoft Corporation

Microsoft Corporation
One Microsoft Way
Redmond, WA 98052-6399

Tel 425 882 8080
Fax 425 706 7329
www.microsoft.com

Microsoft

March 2, 2022

Dr. Derrek B. Dunn
University of Maryland Eastern Shore
30665 Student Services Center
EASC Complex, Suite 3087
Princess Anne, MD 21853

Dear Dr. Dunn,

Microsoft is pleased to provide the University of Maryland Eastern Shore with an unrestricted gift of $75,000 to support the School of Business and Technology in funding the Computing and Interdisciplinary Engineering Degree Programs Branding Project, the Student Club Combined Organization Project, the Micro-credential/Badge Initiative Project and the Aviation and Cybersecurity Project.

Microsoft is committed to compliance with any and all applicable laws, regulations and ethics rules concerning the receipt of contributions, including university policies. Microsoft engaged with the University of Maryland Eastern Shore without seeking promises or favoritism for Microsoft or any of its affiliates in any bidding arrangements. Further, no exclusivity will be expected from you, your institution, or its affiliates in consideration for this engagement.

Dr. Brissa Quiroz will be your main contact regarding Microsoft's financial support. If you have any questions regarding this contribution, please feel free to contact her by e-mail at brissaq@microsoft.com or by phone at (559) 290-9079.

Sincerely,

Kathryn Neal

Dr. Kathryn Neal
Senior Director, University Relations

Appendix B: Support Letters from Corporations, Government, and Educational Entities

SALISBURY-WICOMICO ECONOMIC DEVELOPMENT

Dr. Derrek B. Dunn, Professor and Dean
School of Business and Technology
30665 Student Services Center
EASC Complex, Suite 3087
Princess Anne MD 21853

Re: Ph.D. in Applied Computing and Engineering

February 23, 2022

Dear Dr. Dunn,

Please accept this letter in support of the proposed Ph.D. in Applied Computing and Engineering academic program at the University of Maryland Eastern Shore (UMES).

Our leading economic sectors include agriculture, aeronautics, wireless component manufacturing, life sciences (animal and human) and health care. All of these areas can greatly benefit from the proposed program by encouraging advanced degrees among existing employees and in offering job opportunities at advanced levels to program graduates. This would strengthen these important sectors, help in attracting additional jobs and investments from prospective companies and further stabilize and offer growth opportunities for the Lower Eastern Shore's economy.

Thank you for your leadership and please let me know how I or my office may further assist.

Very Truly Yours,

David Ryan
Executive Director

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