

# Education Policy and Student Life - November 15, 2022



November 15, 2022 09:00 AM

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OFFICE OF ACADEMIC AND STUDENT AFFAIRS

**MEMORANDUM**

**TO:** Michelle Gourdine, Chair      Ayotola Oludayo  
Linda Gooden                      Doug Peters  
Mike Gill                              Andrew Smarick  
Farah Helal                           Bill Wood  
Isiah Leggett

**FROM:** Joann Boughman, Senior Vice Chancellor

**DATE:** Wednesday, November 9, 2022

**SUBJECT:** Tuesday, November 15<sup>th</sup> Meeting of the Committee on Education Policy and Student Life

The Committee on Education Policy and Student Life of the Board of Regents will meet in public session on Tuesday, November 15, 2022. The meeting will begin at 9:00 a.m.

The meeting will take place via Zoom for members of the Committee. An Outlook invitation with connection details has been sent. Public listen-only access is available via 1-443-353-0686, Conference ID: 729 731 005.

The agenda is attached and supporting materials are posted on Diligent and the USM website at <https://www.usmd.edu/regents/agendas/>.

Committee members, please let me know if you are unable to participate on Tuesday and if you have any questions.

We look forward to engaging with you next week.

Enclosures

CC: Office of the Attorney General  
Members of the Chancellor's Council  
Academic Affairs Advisory Council (Provosts)  
Vice Presidents for Student Affairs  
Academic and Student Affairs Senior Staff  
Office of Communications  
Holly Brewer, Council of University System Faculty  
Kalia Patricio, Council of University System Staff  
Arsalan Siddiqui, USM Student Council



**BOARD OF REGENTS**  
 SUMMARY OF ITEM FOR ACTION,  
 INFORMATION, OR DISCUSSION

**TOPIC:** University of Maryland, Baltimore: Doctor of Medical Science (DMSc)

**COMMITTEE:** Education Policy and Student Life

**DATE OF COMMITTEE MEETING:** Tuesday, November 15, 2022

**SUMMARY:**

The University of Maryland, Baltimore (UMB) Graduate School is proposing to offer a Doctor of Medical Science (DMSc) program for Physician Assistants (PAs). UMB intends to offer the program as a mixture of didactic coursework and applied practical training and research, allowing partial fulfillment of credits for applicants possessing a Master of Health Science or similar Physician Assistant (PA) degree including foundational ethics, research, and health systems science course work. Most of the DMSc didactic content and courses will be accessible online, and the practical courses will include clinical and simulation instruction and assessment. The proposed degree will allow PAs to advance their education in preparation for advanced practice with a focus on intercultural healthcare leadership, quality improvement, clinical education, and promotion of health equity. The program will focus on clinical excellence, leadership, applied research, process, and quality improvement. Students will apply these principles to the practice of medicine to enhance health outcomes, improve patient care, and strengthen the clinician-patient relationship.

Graduates will be prepared to provide intercultural leadership and clinical education, contribute meaningfully to strategic development, implementation, management, evaluation, and foster continuous improvement of clinical teams, practice, and systems. They will find employment as advance practice provider directors, clinical practice team leaders, managers and clinic owners, researchers, educators, and healthcare leaders, all of which are in high demand.

**ALTERNATIVE(S):** The Regents may not approve the program or may request further information.

**FISCAL IMPACT:** No additional funds are required. The programs can be supported by the projected tuition and fees revenue.

**CHANCELLOR’S RECOMMENDATION:** That the Education Policy and Student Life Committee recommend that the Board of Regents approve the proposal from University of Maryland, Baltimore to offer the Doctor of Medical Science (DMSc).

<b>COMMITTEE RECOMMENDATION:</b>	<b>DATE:</b> November 15, 2022
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<b>BOARD ACTION:</b>	<b>DATE:</b>
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<b>SUBMITTED BY:</b> Joann A. Boughman	301-445-1992	jboughman@usmd.edu
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**DR. ROGER J. WARD, JD, MSL, MPA**  
Provost and Executive Vice President

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September 21, 2022

Jay A. Perman, MD  
Chancellor  
University System of Maryland  
3300 Metzert Road  
Adelphi, MD 20783

Dear Chancellor Perman:

The University of Maryland, Baltimore is seeking authorization to offer a Doctor of Medical Science degree. The Doctor of Medical Science will be the first in the state of Maryland, innovative in its pedagogy and delivery, and will prepare experienced Physician Assistants to advance their practice and careers in administration, leadership, and clinical education. The proposed doctorate program will require the completion of 61 credits. Courses in the programs will be taught in predominately online formats with short on campus workshops to advance clinical skills. We plan on offering this program beginning with the Fall 2023 term.

The Doctor of Medical Science is designed for students and professionals with prior PA national certification and a minimum of 2 years work experience. The proposed program emphasizes concepts, practices and skills that PA professionals need to be effective in a wide range of medical settings to improve patient care, outcomes and equity.

The need for an expanded healthcare workforce is well studied. The PA profession has rapidly grown over the last 50 years, the expected growth of the profession exceeds 30% and only 2% of PAs are doctoral trained. Every year, approximately 30,000 applicants apply to PA schools across the country. Due to a paucity of PA faculty and clinical educators only one third of eligible candidates become new PA graduates and enter the medical profession. This program is designed to prepare the next generation of PA leaders and clinical educators. This is a part time solution to help candidates who are working professionals advance their education and careers.

Should you require additional information, please contact Dr. Courtney Resnick at [cresnick@umaryland.edu](mailto:cresnick@umaryland.edu) or 410-706-1527.

Regards,

A handwritten signature in black ink, appearing to read "Roger J. Ward".

Dr. Roger J. Ward, JD, MSL, MPA  
Provost and Executive Vice President  
Dean, Graduate School

**UNIVERSITY SYSTEM OF MARYLAND INSTITUTION PROPOSAL FOR**

- New Instructional Program
- Substantial Expansion/Major Modification
- Cooperative Degree Program
- Within Existing Resources, or
- Requiring New Resources

**University of Maryland, Baltimore**

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Institution Submitting Proposal

**Doctor of Medical Science**

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Title of Proposed Program

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**Doctor of Medical Science (DMSc)**

Award to be Offered

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**Fall 2023**

Projected Implementation Date

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Proposed HEGIS Code

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Proposed CIP Code

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**University of Maryland Baltimore Graduate  
School**

Department in which program will be located

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**Mary Jo Bondy**

Department Contact

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**410-706-2298**

Contact Phone Number

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**mjbondy@umaryland.edu**

Contact E-Mail Address



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Signature of President or Designee

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**September 21, 2022**

Date

**A PROPOSAL FOR A NEW ACADEMIC PROGRAM at THE UNIVERSITY OF  
MARYLAND, BALTIMORE FOR DOCTOR of MEDICAL SCIENCE**

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**A. Centrality to Institutional Mission 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 University of Maryland, Baltimore (UMB) Graduate School submits this proposal to create a Doctor of Medical Science (DMSc) program for Physician Assistants (PAs). UMB intends to offer the program as a mixture of didactic coursework and applied practical training and research, allowing partial fulfillment of credits for applicants possessing a Master of Health Science or similar Physician Assistant (PA) degree including foundational ethics, research, and health systems science course work. Most of the DMSc didactic content and courses will be accessible online, and the practical courses will include clinical and simulation instruction and assessment. The proposed degree will allow PAs to advance their education in preparation for advanced practice with a focus on intercultural healthcare leadership, quality improvement, clinical education, and promotion of health equity. The program will focus on clinical excellence, leadership, applied research, process, and quality improvement. Students will apply these principles to the practice of medicine to enhance health outcomes, improve patient care, and strengthen the clinician-patient relationship.

In shifting to required graduate-level education, the PA profession in 2020 joined a lengthy list of health professions that have transitioned or are transitioning to a higher degree requirement for professional practice. In fact, pharmacists, physical therapists, and nurse practitioners (NPs) are among those that have now moved beyond the master's degree to a clinical doctorate. In PA education, the master's degree will remain the required credential for the near future, although doctoral level education has emerged to allow a select group of PA practitioners to advance their clinical and education leadership skills and earn qualifications to advance their careers. The designation for this proposed DMSc degree is chosen in accordance with the developing precedence in PA doctoral education. There are now fifteen DMSc programs at several types of institutions across the United States.

The DMSc plan of study is designed to build a depth of knowledge and skill in advanced practice of medicine, giving PAs the flexibility to both enhance their knowledge holistically as well as the ability to focus within a specialty. The curriculum will use clinical and practical courses taught at UMB. The hands-on practicums will be conducted and supervised by UMB faculty with advanced training and focus on relevant clinical projects and improving health outcomes at the state, regional level within and beyond Maryland Health Systems.

Graduates will be prepared to provide intercultural leadership and clinical education, contribute meaningfully to strategic development, implementation, management, evaluation, and foster continuous improvement of clinical teams, practice, and systems. They will find employment as advanced practice provider directors, clinical practice team leaders, managers and clinic owners, researchers, educators, and healthcare leaders, all of which are in high demand. According to the Bureau of Labor and Statistics PA employment and growth is projected to increase 31% over the next 8 years. In addition, graduates will be prepared and eligible for certification of advanced qualification (CAQ) from the National Commission on Certification of Physician Assistants (NCCPA). Current CAQ qualifications can be found at Specialty Certificates - NCCPA.

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

UMB has a long history of developing qualified healthcare professionals. In context to PA education, UMB partnered with Anne Arundel Community College in 2014 to augment PA certification education with master’s degree-level coursework. In 2022 the program was renamed and is now solely offered by UMB. The DMSc program continues UMB’s commitment to the PA profession by recognizing the need for advanced education and training opportunities for Physician Assistant professionals. Currently 2% of certified PAs hold doctoral degrees, and the DMSc degree is emerging as a recognized post-graduate degree for advanced practice PAs. Although there are currently 15 DMS/DMSc programs in the country, Maryland PAs currently need to enroll in out-of-state programs to gain additional PA-focused post-graduate degrees. UMB intends to pursue this path to support PA graduates and prepare state and regional PA leaders in healthcare and clinical education. The knowledge and skills provided in the DMSc are crucial to future success in patient care, PA education, research, and health equity, as well as in health system leadership.

The *Elsevier Health Clinician of the Future* study published in March of 2022 stated that one in three clinicians are considering leaving their current jobs and half of those are considering leaving healthcare altogether by 2024. The toll of COVID, health inequity, and the shifting dynamics of healthcare delivery require new skills and education to bolster and build a 21<sup>st</sup> century healthcare workforce. Survey respondents noted the needs for enhanced technology literacy, representation in leadership, and workforce expansion. Further, research conducted at UMB by faculty at the Physician Assistant Leadership and Learning Academy show that interest in doctoral level education for PAs is growing.

The DMSc program directly aligns with the first theme of UMB’s strategic plan, “Health, Justice, and Social Impact,” in order to “deepen and expand local and global engagement by providing health, legal, and social work programs and engaging in research to promote social justice and improve health.” Our proposed program leverages institutional expertise to tackle systemic problems in healthcare education and delivery to enhance health outcomes, improve patient care, and strengthen the clinician-patient relationship. This program will educate PA professionals to be more knowledgeable, skilled, technologically literate, and prepared to engage in leadership, research, clinical education, and clinical process improvement in the practice of medicine. The proposed program also supports UMB’s second theme, “Research and Scholarship,” by harnessing our interdisciplinary strengths across UMB and the Health System in Clinical Medicine, respectively, to improve care quality, clinical outcomes, and health equity through ongoing continuous improvement, applied research, and scholarly dissemination. Related to this, the proposed program also supports UMB Graduate School’s strategic goal, to achieve national prominence in Physician Assistant education and practice.

**3. Provide a brief narrative of how the proposed program will be adequately funded for at least the first five years of program implementation.**

The program will be well-resourced and will rely on existing principal faculty and incorporate adjunct faculty with clinical practice and leadership experience within the state and at UMB. Some of the course content has already been developed. Content that already exists will be updated with team-based learning and case-based learning best practices for online learning in collaboration with UMB’s Faculty Center for Teaching and Learning. New courses to be developed will be shared across the scope of doctoral training expansion at UMB. Because of this, the UMB Graduate School will have the capacity to offer the proposed degree program



leveraging existing resources and ensure continued funding to support the program in the future.

**4. Provide a description of the institution's commitment to ongoing administrative, financial, and technical support of the proposed program and continuation of the program for a period sufficient to allow enrolled students to complete the program:**

The UMB Graduate School has an ongoing commitment to sustaining new degree programs it has developed. The Graduate School has committed significant resources in the realm of administrative support including a vice provost, vice dean, assistant dean, and program director who will provide leadership for the quality and sustainability of the Doctor of Medical Science. Additionally, faculty and leadership within the Physician Assistant Leadership and Learning Academy at UMB along with the Graduate School faculty will provide additional support.

Programs such as this are expected to attract students from diverse clinical backgrounds originating both locally and regionally. UMB has a full-service student support model to ensure early identification of students who may be struggling academically and to intervene to improve the likelihood of graduate school completion.

The program curriculum will address diversity, bias, equity, social need, health equity, and social determinants of health. Disparity in health outcomes is an important challenge in the delivery of healthcare, and as such, it carries over into clinical practice and decision making. A focus on improving technology literacy and use to prevent unintended bias, which can lead to discriminatory or exclusionary practices, will prepare our graduates to prevent health inequity. Bias, equity, and social determinants of health are included in the curriculum objectives. In addition, with a focus on leadership, we intend to extend opportunities for the inclusion of intercultural leadership throughout the curriculum.

Further, the curriculum focuses on the new and innovative area of doctoral study in PA practice utilizing structured inquiry, and problem and case-based immersion experiences that provide hands-on experiences addressing real-world challenges. For those who qualify, instruction can also prepare individuals for NCCPA certification of advanced qualifications (CAQs.)

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

Nationally, 2% of the 158,430 certified PAs indicate their highest degree is a doctorate and Maryland PAs follow this trend. PAs are the only profession allowed to prescribe medications with a master's as a terminal degree and increasingly faculty postings are showing preference to or requiring a doctoral degree. Based on the Physician Assistant Education Association faculty and director survey report of 2020, 23.5% of faculty hold doctoral degrees and 45.5% of program directors hold non-clinical doctoral degrees. Employers are increasingly seeking doctoral-trained PAs to fill clinical and academic positions as well as certification of advanced qualifications (CAQ) based on specialty. According to the NCCPA state survey published in 2021, 108 of 3,5000 PAs in Maryland have earned advanced qualifications and 84 of those with CAQ designation are in Emergency Medicine.

The Association of American Medical Colleges predicts a significant physician shortage, as high as 139,000 by 2033. This report published in 2020 pre-COVID identifies the aging demographic of the US, anticipated retirements, and the maldistribution of providers, most heavily concentrated in urban areas as potential causes for the anticipated shortfall and gap

needed to meet the healthcare demands of an aging and chronically ill population. The anticipated increase in complexity of care and the trend toward care delivery out of the hospital requires additional advanced practice clinical providers prepared to work collaboratively, and demonstrate leadership at the team, department, and organizational level. The recent Supreme Court decision removing reproductive protections and limiting access to reproductive healthcare will also exacerbate a recognized shortage of providers willing or able to provide access to women's health and clinical education. The DMSc aims to produce practitioner scholars prepared to contribute to expanding the PA workforce and utilization.

The Maryland State Plan for Post-Secondary Education for 2022 identified three aims - 1) student access, 2) student success, and 3) innovation along with and multiple goals and strategies grounded in equity framework and lens. In response, the DMSc has been thoughtfully designed to optimize access for both traditional and non-traditional Maryland learners through online courses as well as impact labs designed to be delivered in person. To assure thoughtful consideration for diversity, inclusion, and equity we are purposefully including elements of trauma informed pedagogy and teaching. To apply the neuroscience of learning and best practice in adult learning theory to improve retention and success, we will be using a team based and case based experiential learning model. Each week our students will be able to learn, practice, and apply knowledge and skills while practicing clinically. This design improves knowledge and skill retention, fosters competency and benefits the citizens of Maryland improving access to competent, compassionate, and equitable care.

The program was designed to be part-time to support the needs of practicing clinicians and learners will be provided up to six years to complete the degree provides student centric flexibility to reduce attrition and improve completion rates, a consistent problem with doctoral education. To foster student success, UMB has comprehensive student services on campus and the program will incorporate both an appreciative advising model as well as coaching to foster student success. Last, to improve access we are looking at innovative partnerships to offset costs of education through engagement in clinical education and precepting. This is designed to assist all students, enhance diversity in the PA profession, and benefit Maryland programs across the state including rural, urban, and historically black institutions. Program directors across the state have been involved and given the opportunity to contribute meaningfully to the design of the curriculum including outreach to map paths for their future graduates to matriculate.

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

Workforce trends indicate that one of the greatest areas of job growth for the foreseeable future will continue to be in the healthcare professions. The US Bureau of Labor and Statistics projects healthcare professions to increase by 16% from 2020 to 2030, much faster than the average of all occupations. The Physician Assistant profession exceeds projections for the healthcare professions at large, predicting a growth rate of more than 31% in employment opportunities over the next 10 years (<https://www.bls.gov/>). A search on indeed.com identified 21,286 positions available for Physician Assistants across multiple disciplines. Consistently rated as one of the top careers by US News and World Report, PAs generalist training prepares them to work collaboratively with healthcare team members and physicians to care for patients across settings.

Healthcare professions are a leading choice among high school seniors as well as graduating undergraduate students. However, a lack of healthcare educators and clinical sites remain a

barrier to workforce development. Although PAs are needed as clinicians to see patients, they are also needed to teach the next generation of providers as preceptors for the growing number of programs. With 297 accredited PA programs nationally currently, and an estimated 34 more by 2024, a lack of clinical sites is consistently a barrier to program class size expansion. The mean PA class size is 47 nationally according to the Physician Assistant Education Association by the numbers report last published in 2020. Class and program size is largely dependent upon availability of fulltime and instructional faculty (preceptors) who must be Board certified Physicians or NCCPA certified PAs to precept and have the education and experience within their specialty discipline to teach. According to the Physician Assistant Education Association Central Application Service for Physician Assistants trend report, each year thousands of students apply through the Central Application Service for Physician Assistants and due to a lack of faculty and clinical sites from 2017-2021, one third are turned away. Each year over 10,000 new graduates enter the profession, with a current total of 158,470 certified PAs in practice according to the NCCPA 2021 Statistical report. Of those 158,470 PAs 7.8% of those surveyed are planning to leave their current clinical position with 6.7% seeking to pursue additional education.

Closer to home, at UMB we regularly receive inquiries from PA alumni about advanced practice education and further education to contribute to their clinical training. When surveyed, over 50% of the most recent graduating PA class at UMB (N=40) were interested in pursuing doctoral study.

Physician Assistants play a critical role on a health professions team and are recognized as integral to the success of our national health agenda. National policy is expanding and improving the practice, integration, and reimbursement of PA services. During the recent pandemic as the result of advocacy at the state and national level, PA scope of practice expanded in multiple states to improve access to care. The DMSc program intends to build upon foundational competency to develop leaders prepared to improve PA integration and utilization, foster ongoing process improvement, and provide leadership optimizing implementation of PAs into new and developing clinical total care models. Inclusion of Physician Assistants in health expansion efforts of the workforce and development of leadership at local, regional, and national levels are priorities for our national healthcare system. The DMSc will help meet a national need to equip PAs with the clinical and professional doctoral training not only for advanced practice but also for educating future health professionals.

### **Employment opportunities**

The DMSc aims to prepare master's prepared graduates from accredited US PA programs to serve as preceptors, team leaders, and administrators in inpatient, outpatient, community, and educational settings. This program builds upon work currently being done at UMB with the Health Professions Education PhD and the Physician Assistant Leadership and Learning Academy, a state-wide fellowship for PAs.

According to the 2022 salary report published by the American Academy of Physician Associates, one in three PAs were in a formal or informal leadership role. The majority of those in leadership roles were for positions such as PAs or lead advanced practice providers, followed by directors, managers, and chiefs. Of those in formal leadership roles, only 4.5% of PAs indicated they served at the executive level or vice-president level within their organizations. It is critical for shared governance and advancement of the profession that we improve the capacity for leadership within the profession. One in five PAs in administration reported they received formal leadership training. The profession sees the need for leadership training, and it is articulated in both the strategic plans for the American Academy of

Physician Associates and the Physician Assistant Education Association. However formal training regarding leadership is limited in traditional masters PA programs.

#### **D. Reasonableness of Program Duplication**

No Doctor of Medical Science Degree programs exist in Maryland or Washington D.C. and the closest program is in Lynchburg, Virginia. Despite four accredited PA programs in Maryland, no other institution in the state is preparing PA graduates at the doctoral level. UMB currently provides an interprofessional pathway to the PhD for PAs with a focus on Health Professions Education (HPE). The emphasis of the HPE PhD is on theoretical application of education theory and preparing independent researchers, which differs from the DMSc due to the focus on advanced clinical practice skills, clinical leadership and clinical education using applied research methods to improve practice and quality care.

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

The proposed program does not have relevance to the uniqueness and/or institutional identities and missions of HBIs.

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

The proposed program does not have relevance to the identity of HBIs in Maryland. The University of Maryland Eastern Shore has a Physician Assistant Program, and graduates of this program will have the opportunity to further their education at UMB.

#### **G. Adequacy of Curriculum Design, Program Modality, and Related Learning Outcomes**

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

The DMSC program was proposed following a Physician Assistant Summit held at UMB and aligned with the UMB Graduate School strategic plan goals and objectives. UMB PA faculty leadership under the direction of Dr. Cheri Hendrix and informed by the research of the Physician Assistant Leadership and Learning Academy led by Dr. Gerald Kayingo proposed the program and advocated for establishing the program at UMB. Following a national search, Dr. Mary Jo Bondy was selected to lead the program. A series of meetings were held by Dr. Bondy, including outreach to all four accredited PA programs in the state, developing PA program leaders, representatives from the Maryland Academy of Physician Assistants, faculty and alumni of the UMB MS Health Science program, and other Graduate School faculty. The group recognized the compelling need for advanced applied doctoral education and training for PAs that was focused on the clinical practice of medicine, clinical instruction, and improved clinical outcomes. To date those seeking applied doctoral education have been forced to seek out-of-state solutions. On campus meetings with the Director of PhD of Health Professions Education, the Director of the Master of Science in Health Science, the Director of Intercultural Leadership, and the Director of Doctor of Nursing Practice were also conducted to review and discuss the curriculum and opportunities for collaboration.

The faculty overseeing the program are listed with their credentials in Section I, subsection 1: Adequacy of Faculty Resources.

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

By the completion of the proposed Doctor of Medical Science, students will develop core competencies in seven key areas that represent the competencies of the PA profession, 1) knowledge for practice, 2) interpersonal communication skills, 3) person-centered care, 4) interprofessional collaboration, 5) professionalism and ethics, 6) practice-based learning quality improvement, and 7) society and population health. These competencies represent the most recent PA professional competencies endorsed by all four national PA organizations in 2021 and represent advanced practice skills beyond the new graduate PA competencies.

The proposed DMSc program learning outcomes are:

- Demonstrate knowledge about established and evolving biomedical and clinical sciences and the application of this knowledge to patient care.
- Demonstrate interpersonal, verbal, and written communication skills that result in the effective exchange of information, advancing learning, and healthcare in collaboration with patients, families, and health professional team members.
- Demonstrate leadership ability to engage with a variety of other health care professionals in a manner to optimize safe, effective, patient- and population centered care.
- Engage in reflection and critical analysis of one's own practice experience, the medical literature, and other information resources for the purposes of self evaluation, lifelong learning, practice improvement, and organizational health.
- Demonstrate a commitment to practicing medicine ethically and in legally appropriate ways and emphasizing professional maturity and accountability for delivering safe, quality, affordable health care to patients and populations.
- Provide person-centered care that includes patient- and setting-specific assessment, evaluation, and management and healthcare that is evidence based, supports patient safety, and advances health equity.
- Recognize and understand the influences of the ecosystem of person, family, population, environment, and policy on the health of patients and integrate the knowledge of these determinants of health into patient care decisions.
- Utilize principles of intercultural leadership, health system science, implementation and dissemination science when dealing with complex problems to promote the strategic use of resources to improve care and operational effectiveness.

To support the DMSc program learning outcomes, UMB will utilize two pedagogical approaches to educating doctoral students: 1) Clinical coursework in which PAs with experience in medical specialties work together in inpatient and outpatient settings; and 2) online coursework designed to enhance accessibility to learning for practicing physician assistants. Each pedagogical approach has broad learning objectives described in the table below.

Clinical Objectives	Online Objectives
<ol style="list-style-type: none"> <li>1. Demonstrate investigative and critical thinking in clinical situations.</li> <li>2. Access and interpret current, credible, and unbiased sources of medical information to inform decision making to limit bias and improve health equity.</li> <li>3. Interpret clinical data and utilize artificial intelligence and data informatics to improve care delivery and prevent health inequity.</li> <li>4. Work effectively and efficiently in various healthcare delivery settings and systems relevant to the PA's clinical specialty.</li> <li>5. Identify improvement goals and perform learning activities that address gaps in knowledge, skills, and attitudes.</li> <li>6. Demonstrate emotional resilience, stability, adaptability, flexibility, and tolerance of ambiguity.</li> <li>7. Understand emotions, behaviors, and responses of others, allowing for effective interpersonal communication and leadership effectiveness.</li> <li>8. Recognize situational barriers to effective communication and provide patient-centered solutions.</li> <li>9. Work effectively with other health professionals to provide collaborative, patient-centered care while maintaining a climate of mutual respect, dignity, diversity, ethical integrity, and trust.</li> <li>10. Build rapport with colleagues and other professionals to establish and enhance interprofessional teams and organizational effectiveness.</li> <li>11. Implement adaptive leadership practices and principles.</li> <li>12. Demonstrate understanding of evidence based pedagogical</li> </ol>	<ol style="list-style-type: none"> <li>1. Adhere to standards of care, and to relevant laws, policies, and regulations that govern the delivery of care in the United States.</li> <li>2. Utilize technological advancements that decrease costs, improve quality, and increase access to care and improve health outcomes and address population health needs.</li> <li>3. Understand macroeconomics and finance of healthcare delivery and ecosystem.</li> <li>4. Consider ethics when leading, advocating, and allocating resources for an individual patient or population-based care.</li> <li>5. Engage the abilities of available health professionals and associated resources to complement the PA's professional expertise and develop optimal strategies to enhance patient care.</li> <li>6. Demonstrate knowledge of personal bias, remain curious, flexible, and exhibit professional civility when adapting to change.</li> <li>7. Demonstrate commitment to lifelong learning and education of students and other healthcare professionals.</li> <li>8. Exhibit self-awareness to identify strengths, address deficiencies, and recognize limits in knowledge and expertise.</li> <li>9. Identify, investigate, analyze, and inform new knowledge, guidelines, standards, technologies, products, processes, or services that have been demonstrated to improve outcomes.</li> <li>10. Identify improvement goals and perform learning activities that address gaps in knowledge, skills, and attitudes. Mentor others in this</li> </ol>

	<p>work though clinical education and precepting.</p>
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<p>principles to guide clinical education efforts.</p> <p>13. Integrate knowledge of evidence based education strategies into practice.</p>	<p>11. Use practice performance data and metrics to identify areas for improvement.</p> <p>12. Develop professional and organizational capacity for ongoing quality improvement.</p> <p>13. Improve the health of patient populations.</p> <p>14. Demonstrate accountability, responsibility, and leadership for removing barriers to health.</p>
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**3. Explain how the institution will provide for assessment of student achievement of learning outcomes in the program and document student achievement of learning outcomes in the program.**

Faculty will assess student achievement and understanding of learning outcomes in their courses using a variety of assessments including meaningful and substantive contributions to online course discussions, satisfactory completion of assignments and reflections, scores on quizzes and examinations, scores on team collaboration, scores on written essays and term papers, and evaluation of research and capstone project.

Students will also evaluate courses and faculty through a standard evaluation of every course. Formal assessment planning is already in place throughout UMB Schools including the Graduate School. Our approach includes ensuring that student learning is in alignment with course learning outcomes, alignment of mission at institutional and program levels, alignment of mission with learning outcomes, then program outcomes with curriculum, flowing down to course outcomes and assignments. Assessment activities emphasize analysis of results and feedback loops for continuous improvement. Additional evaluation includes tracking of student retention, grade distributions, and cost-effectiveness, and regular academic program reviews consider these factors.

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

The proposed DMSc degree is comprised of 60 credits. There are six existing courses (15 credits) in the Graduate School’s Master of Science in Health Science (MSHS) program that are a required part of the DMSc and will have already been completed by PAs graduating from UMB. Consequently, UMB graduates may apply these courses to demonstrate partial fulfillment towards the degree thus acceleration time to degree. There will be two clinical impact labs integrated into clinical courses. The combined curriculum of 15 credits of MS Health Science, 5 credits of electives, 24 credits of DMSc didactic, and 16 credits Clinical and Impact Labs and Capstone build to 60 credits. The time to degree will take on average three years of part-time study and should not exceed six years.

In the near future, UMB intends to submit an additional proposal so that students will be able to earn a PBC in Applied Practice Provider Leadership by successfully completing the following four courses of the degree: DMSC 701, 712, 714 and 715.



	MSHS*	CORE	CLINICAL
MHS 600 Intro to Library Resources and Scholarly Writing (1 credit)	X		
MHS 602 Legal and Ethical Issues for Health, Human Services and Clinical Professionals (2 credits)	X		
MHS 615 Biostatistics for the Health Professional (3 credits)	X		
MHS 630 Essentials of Chronic and Infectious Disease Epidemiology (3 credits)	X		
MHS 652 Communication and Leadership (3 credits)	X		
MHS 608 Research Seminar I (3 credits)	X		
Electives (5 credits)			
DMSC 701 Healthcare System, Organizational Macro Economics and Finance (3 credits)		X	
DMSC 712 Healthcare and Education Legal Principals and Policy (3 credits)		X	
DMSC 713 Impact Institute - Clinical Practice Improvement Symposium 1 (2 credits + 4 credits)			X
DMSC 714 Applied Leadership and Advocacy (3 credits)		X	
DMSC 715 Technology Literacy, Utilization, and Integration of Clinical Informatics into Practice (3 credits)		X	
DMSC 716 Clinical Learning and Practice Reflection (3 credits)		X	
DMSC 717 Evaluation, Synthesis and Critical Appraisal of the Literature (3 credits)		X	
DMSC 718 Impact Institute-Clinical Practice Improvement Symposium 2 (2 credits + 4 credits)			X
DMSC 719 Scholarship: Writing, Publishing and Presenting (3 credits)		X	

DMSC 720 Improving Quality, Equity, and Outcomes (3 credits)		X	
DMSC 821 Capstone (4 credits)		X	
DMSC 822 Special Topics (1 - 6 credits)			

\*Existing courses

#### MS HEALTH SCIENCE COURSES (existing courses in the MSHS/PA curriculum)

- MHS 600: Introduction to Library Resources and Scholarly Writing (1 credit)**  
 This course is designed to provide graduate learners the opportunity to develop skills in both accessing relevant online library resources and engage in scholarly writing. The portion of the course focusing on library resources teach and strengthen lifelong research and information competency skills by introducing student to the nature of research and the role of library in the research process. Students learn the core concepts of information retrieval and essential techniques for finding, evaluating, analyzing, organizing, and presenting information. The topics covered include using online catalogs to locate books and other library resources; developing research strategies; exercising critical thinking to evaluate information; applying critical and search techniques to electronic databases; understanding citation formats and using the internet as a research tool. The scholarly writing of the course will place emphasis on organization, effective conveyance of thoughts through written words, and writing for multiple types of audiences. Students will have the opportunity to improve both their academic writing and their research skills as they write a literature review or a proposal. Emphasis is placed on conventions of scholarly writing and organizational strategies as well as grammar, editing, and usage.
- MHS 602: Legal and Ethical Issues for Health, Human Services, and Clinical Professionals (2 credits)**  
 This 8-week, 2-credit online course will explore ethical and legal issues that are timely and germane to health professionals. This course is based on the premise that to act in an ethical manner means to engage in conduct according to accepted principles, and to improve moral confidence and moral action we must prepare the next generation of health professionals with the ethical resources, tools, and skills. A case-based learning design will be utilized to engage students in ethical discussion, exploration, analysis with the goal of determining ethical and legal action that is sound and logical. This course will prepare students to make ethical health care decisions in the future.
- MHS 615: Biostatistics for the Health Professional (3 credits)** We live in a time exploding with data. Everything from individual wearable technology to community and national profiles, yet few students are prepared with the quantitative skills to analyze and evaluate that data and draw conclusions. This course will present basic statistical methods to a broad range of medical or public health problems. The course will emphasize the use of these methods and the interpretation of results using bio-medical and health sciences applications, healing clinicians move beyond the data to decisions.

- **MHS 630: Essentials of Chronic and Infectious Disease Epidemiology (3 credits)**

In the past 15 years, we have seen a rise in chronic disease impacted by behavior and policy, infectious disease outbreaks and new mechanisms of spread never seen before in the US. Clinicians must consider the biosocial impact of globalization and environmental change upon health and disease. In this course we present fundamental concepts of epidemiology to assist the new clinician in their efforts to critically evaluate the health and medical literature, participate in monitoring and surveillance of disease, and interpret data in their individual practice, community, and nation to improve care in their practice and professional sphere.

- **MHS 652: Communications and Leadership (3 credits)**

Students learn effective management and communication skills through case study-analysis, reading, class discussion and case-based learning. The course covers topics such as effective listening, setting expectations, delegation, coaching, performance, evaluations, conflict management, negotiation with senior management and managing with integrity.

- **MHS 608: Research Seminar 1 (3 credits)**

This is a 3-credit seminar course designed to give students the basic information regarding health sciences research discoveries. It also provides students with the tools to approach translational research in their present and future work. The course covers the core competencies in clinical and translational research, and each session addresses a core thematic area.

## **DMSc DIDACTIC COURSES**

- **DMSC 710 Healthcare System Science, Organizational Macroeconomics and Finance (3 credits)**

This course focuses on understanding the healthcare macroeconomic ecosystem and the unique and innovative Maryland waiver system. The course introduces key concepts and analytical methods for formulating strategies that add value for patients as well as for providers and other organizations that affect health care delivery. The course covers foundational concepts of practice coding and reimbursement along with the strategic management of resources, partnerships, and innovation, for organizations that offer healthcare services in multiple areas. Through the application of course concepts to complex cases, the course develops depth of understanding and critical thinking skills in strategy formulation for future leaders involved in health care delivery and ongoing quality improvement

- **DMSC 712 Health Care and Education Legal Principals and Policy (3 credits)**

This survey course covers current federal and state legal principals governing the provision of healthcare and clinical education. The course will focus on three major themes: quality of care, access to care, and clinical education. Students will learn about professional licensure, disability, equitable care and access, malpractice, the provider-patient relationship, informed consent, the regulation of healthcare facilities, public and private insurance regulation, and the application of professional ethics in healthcare.

- **DMSC 714 Applied Leadership and Advocacy (3 credits)**  
Leading is a complex endeavor and involves vision, passion, purpose, and the ability to make decisions under pressure and uncertainty while motivating others. This course analyzes the symbiotic relationship between leadership and decisionmaking and advocacy, combining ethics, recent research, adaptive leadership theory and reflective practice to teach leadership, decision-making and advocacy skills.
- **DMSC 715 Technology Literacy, Utilization, and Integration into Practice (3 credits)**  
Although digital technologies and breakthrough science hold immense potential for enhancing health care, in terms of empowering patients, improving access and equity, and delivering better health outcomes. Health care's digital transformation lags behind that of other industries. This course aims to help learners unlock hidden potential to improve health care by providing a framework to enable learners to think strategically about digital solutions, develop and deploy them in health care's unique culture and ecosystem, and navigate the sometimescompeting needs of healthcare's multiple stakeholders.
- **DMSC 716 Clinical Learning and Practice Reflection (3 credits)**  
Every doctoral student should be prepared to teach effectively. The focus of this course will be to prepare the student to be an effective clinical or field educator. Students will explore best practices, grounded in adult learning theory and evidence-based education for delivering and evaluating educational content across various domains (virtually or in-person) for diverse learning audiences. The impact of emotion and learning, intercultural leadership, communication, and professionalism will be explored in this course.
- **DMSC 717 Evaluation, Synthesis and Critical Appraisal of Literature (3 credits)**  
Participants in this course will develop proficiency in engaging in the evaluation and synthesis of research in their field. This course addresses foundational competencies for generating pertinent research questions, conducting academic reviews, engaging in critical appraisal, and synthesizing literature in a scholarly format to facilitate participants' contribution to the body of knowledge within their field. Part two of the course will build upon foundational MSHS course work, applying the principles and methods of quantitative and qualitative methods appropriate for applied health research. Learners will engage in evaluating research studies using a variety of methodologies to identify their application to specific field questions and develop their ability to analyze and interpret research data. Learners will produce the framework for a research project reflective of a design appropriate for their research question and field of practice in an applied topic.
- **DMSC 719 Scholarship: Writing, Publishing and Presenting (3 credits)** This course will provide students with the foundational skills necessary to engage in academic writing for preparation and presentation across a spectrum of scholarly outlets (journals, conference presentations, conference abstracts, technical reports, book chapters, etc.). Students will engage in the construction of logical arguments, the reporting and interpretation of data, generation of conclusions/discussions, recognition of target audience in selection of style, tone, voice, etc. as well as the process of redrafting and editing being mindful of feedback from colleagues and co-writers.

Students will have opportunity to develop skills for peer review and development of constructive feedback.

- **DMSC 720 Improving Healthcare Quality, Equity and Outcomes (3 credits)** To achieve more equitable healthcare leaders need to engage with communities where they provide care, commit to the larger programs at the federal and state levels, and take an introspective view of their own organizations. Participants in this course will apply previously learned knowledge and skills to engage with their local communities, advocate locally, regionally, and nationally for PA inclusion and implement quality improvement interventions relevant to their practice setting in pursuit of health equity.

### **DMSc Clinical Learning**

- **DMSC 713 Impact Lab/Clinical Symposium I (6 credits)**  
Designed to help busy PA professionals advance their knowledge and keep current by providing a review of innovations, recent advances, and best practices affiliate disciplines specialty groups. Focus will be on improving care quality and outcomes. Hands on impact labs will be conducted. At the conclusion of the symposium, participants will be able to: Describe and implement new diagnostic modalities, therapeutic agents, and management strategies in their respective specialty. Recognize and implement best practice, management. and care transfer of complex patients with significant comorbidities. Discuss the current and future management of patients. Impact lab topics may include 1) Ultrasound 2) Telehealth 3) Digital Monitoring 4) Advanced procedures.
- **DMSC 718 Impact Lab/Clinical Symposium 2 (6 credits)** This course builds upon DMSC 713 and is designed to help busy PA professionals advance their knowledge and keep current by providing a review of innovations, recent advances, and best practices. Focus will be on improving care quality and outcomes. Hands on impact labs will be conducted. At the conclusion of the symposium, participants will be able to: 1) Describe and implement new diagnostic modalities, therapeutic agents, and management strategies in their respective specialty; 2) Recognize and implement best practice, management. and care transfer of complex patients with significant comorbidities; 3) Discuss the current and future management of patients. Impact lab topics may include but are not limited to Ultrasound, Telehealth, Digital Monitoring, and advanced procedures.
- **DMSC 821 Capstone (4 credits)**  
DMSc students will choose a practice-based issue or problem in need of improvement during their clinical symposia courses. During the program they will define and seek to deeply understand an issue, investigate, and choose solutions or an intervention, design, and implement a pilot, collect, analyze, and present outcomes in a poster, presentation, or publication at a regional or national meeting or peer reviewed publication.
- **DMSC 822 Special Topics (1-6 credits)**  
This course is tailored to meet the needs of an individual student and involves considerable self-directed learning to address an area in need of further review, remediation, or repeated content.

## **ELECTIVES (5 credits)**

Potential electives include UMB Graduate School courses offered at the 600 level or above. Selection will be based on student learning needs, preferences, and goals and subject to program director approval and course availability. The list provided is not comprehensive and subject to change. Possible electives include course from the HPE MS/PhD, Intercultural Leadership PBC, and other health systems or services coursework.

- **MHS 607 Writing for Scholarly Publication (3 credits)**  
This course provides students with a comprehensive overview of the process of writing for scholarly journals, focusing on the IMRD (Introduction, Methods, Results, Discussion) format commonly used for empirical work. Students will read and analyze articles from a variety of journals, focusing on both form and content of research articles, case studies, meta-analyses, and book reviews. Students will apply the course content to their own writing throughout the course, culminating in a portfolio of their revised work based on extensive instructor feedback. Students can use their existing research to produce the various writing assignments during the course and use this as an opportunity to submit an article for publication.
- **INCL 625 Intercultural and Cross-Cultural Communication (3 credits)** The purpose of this course is to study communication within the context of the cultural setting. The three main goals are: to provide students with materials, both cognitive and experiential, with which they can develop an awareness of their own cultural identity; to increase their knowledge of the special communication problems to be expected in a cross-cultural situation; and to offer students the opportunity to apply new insights to cross-cultural encounters.
- **INCL 640 Practical Application of Intercultural Leadership (3 credits)** In this course students will learn and practice applying concepts of intercultural development to various aspects of their personal and professional life. Students will also gain tools to continue learning and developing their intercultural skills over the course of their lifetime.
- **DEIL 710 Employment Discrimination Law & Policy Framework (3 credits)** This course examines basic terminology and concepts related to diversity, equity, and inclusion through the exploration of US laws such as Title VII of the Civil Rights Act of 1963, the Age Discrimination in Employment Act of 1967, the Americans with Disabilities Act of 1990, and similar laws and legal protections for certain classes of individuals. This course will help current and aspiring diversity, equity, and inclusion practitioners to establish a structured framework for systematic analysis of employee issues that may have legal implications.

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

Not applicable.

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

There is no current specialized accreditation or graduate certification requirements for the proposed Doctor of Medical Science.

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

Not applicable

**6. 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 and financial aid resources, and costs and payment policies.**

The Graduate School maintains up-to-date information of its degree programs on the program explorer website (<https://www.graduate.umaryland.edu/Program-Explorer/>). The website has information on the curriculum, course descriptions, degree requirements, and cost of education. The website has links to information about the learning management system, support services, and financial aid. We affirm that the same information will be available for prospective and existing students in the proposed Doctor of Medical Science.

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

The Graduate School at UMB affirms that all advertising, recruiting and admissions materials will accurately represent the Doctor of Medical Science, as do all materials produced by UMB's Graduate School for programs it offers.

**H. Adequacy of Articulation** Not applicable.

**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.**

The following table summarizes information about the faculty who will be responsible for designing and instructing coursework in the Doctor of Medical Science program:

<b>Name</b>	<b>Terminal Degree and Discipline</b>	<b>Rank and FT/PT Status</b>	<b>Course</b>
<b>UMB Faculty</b>			
Mary Jo Bondy	DHEd, MHS, PA-C Health Education	Associate Professor FT	DMSC 714, DMSC 716, DMSC 717
Karen Gordes	PhD-Public Policy, DPT	Associate Professor FT	DMSC 717
Gerald Kayingo	PhD-Microbiology, MBA, PA-C	Professor FT	DMSC 710, DMSC 719
Jim Cawley	MPH/PA-C	Professor PT	DMSC 712, DMSC 714, DMSC 719
Niya Werts	PhD-Information Systems	Associate Professor FT	MHS 630, MHS 608, DMSC 715
Cheri Hendrix	DHEd, PA-C Health Education	Associate Professor FT	DMSC 712, DMSC 719
Shani Fleming	MSHS, MPH, PA-C	Associate Professor FT	Intercultural Electives
Larissa Odessky	PharmD	Assistant Professor FT	MHS 608, MHS 652
Theresa Neumann	MMS, PA-C	Associate Professor FT	DMSC 714
Isabell May	PhD-Civilization	Associate Professor FT	MHS 607
Larry Magder	PhD- Biostatistics, MPH	Professor FT	MHS 615
Mike Grasso	MD/PhD-Computer Science	Assistant Professor UMB School of Medicine	DMSC 715



<b>Additional Faculty</b>			
Wei Chao Chang	PhD-Health Science, DHSc, PA-C	Adjunct Professor	MHS 608, DMSC 713, DMSC 718
Jack Goble	DMSc, PA-C	Adjunct	DMSC 720
Jen Grover	DHSc, MMS, PA-C	Adjunct	DMSC 713, DMSC 720
Patty Alvarez	PhD-College Student Personnel	Adjunct	MHS 652
Roger Ward	JD, EdD	Provost, Dean and Executive Vice President UMB Graduate School, FT	DMSC 712
Jenny Owens	ScD, MS	Associate Dean of Academic Affairs, UMB Graduate School FT	MHS 652
Emilie Ludeman	MSLIS	Adjunct	MHS 600
Sarah Archibald	PhD-Public Policy MS	Associate Professor FT	MHS 602

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

UMB has a robust process for training faculty and ensuring effective instruction. Based on Quality Matters standards, UMB developed a rubric which details the best practices for distance education; this rubric helps faculty and instructional designers create the courses; assesses the readiness of the course and ensures that the online courses are instructionally and pedagogically sound. The best practices are a synthesis of strategies, activities, design techniques, and organizational items that have been successful in higher education. The specific domains of this checklist are as follows:

- Course overview and introduction to the students
- Course organization and design
- Learning Objectives (competencies)
- Instructional Materials
- Learner Communication, Interaction and Collaboration

- Assessment and Evaluation (measurement)
- Course Technology
- Learner Support

The Learning Management Platform UMB utilizes and provides IT support for is the Blackboard Learning Management System for online and in-person course delivery. Within Blackboard is the Collaborate conferencing software that we will use for our synchronous live activities, i.e., orientation and presentation of face-to-face class sessions and recurring webinars. Additionally, the Faculty Center for Teaching and Learning which houses expert Instructional and Educational Medial Specialists, uses of a video camera to record lectures, integrates webcams, and utilizes an interactive smart board.

We also use the Camtasia software for screen lecture capture.

#### **J. Adequacy of Library Resources**

The University of Maryland, Baltimore's Health Sciences and Humans Services Library (HS/HSL) collection contain more than 30,000 electronic journals, 162 current print journals, approximately 170,000 books, and 6,000 electronic books. Students can access the electronic resources offered on the library website by logging in with their University ID number. The library serves as the regional medical library for 10 southeastern states as part of the National Library of Medicines National Network of Libraries of Medicine. In addition to the library services and collections, the building also houses computing services. Faculty librarians provide direct service to students. They use subject expertise to develop online resources and provide in-person consultations.

The HS/HSL is one of the largest health sciences libraries in the United States with a track-record of user-centered innovative services and programs. The library consists of 57 employees including 27 faculty librarians. The attractive and vibrant facility, which opened in 1998, serves as a hub for collaboration and learning with resources, programs, and tools that promote discovery, creativity, and innovation. With wireless connectivity throughout the building, the HS/HSL has 45 group study rooms, three computer classrooms, an Innovation Space which includes 3D printers; a presentation and practice studio, art gallery, and multiple technology enhanced meeting spaces. Through the HS/HSL's website ([www.hshsl.umaryland.edu](http://www.hshsl.umaryland.edu).) the UMB community has access to a full range of resources and services.

The HS/HSL supports the University's students, faculty, and staff members in the schools of dentistry, law, medicine, nursing, pharmacy, and social work; the Graduate School; the University of Maryland Medical Center; and other affiliated institutions. Research Connection, the library's suite of research services, is available for all programs on campus and includes individual research consultations, a systematic review service, research impact assessment, reference assistance, and more. For over 30 years, the HS/HSL has provided liaison services, in which faculty librarians are assigned to work with specific user communities. Faculty librarians have many years of instructional experience in the classroom, in the community, and the online environment. In FY16, faculty librarians reached 4,131 faculty, staff, and students through online, and in-person instructional sessions offered through the curriculum and in library-sponsored workshops.

In FY16, the HS/HSL licensed 116 databases, 4,524 journals, 18,018 e-books, and maintained a print collection of 360,104 volumes. One hundred percent of the current journal subscriptions are available electronically. Through its interlibrary loan and document delivery

service, library staff can acquire articles and other resources not available through the library's collections. These are secured through local, regional, and national networks including the University System of Maryland and Affiliated Institutions, the National Library of Medicine's DOCLINE service, and OCLC, among others. The HS/HSL is also home to the National Network of Libraries of Medicine/Southeastern Atlantic Region (NNLM/SEA), whose mission is to advance the progress of medicine and improve the public health by providing all U.S. health professionals with equal access to biomedical information and improve the public's access to information to enable them to make informed decisions about their health. With only eight regions in the U.S. designated as regional medical libraries under contract to the National Library of Medicine at the National Institutes of Health, the Southeastern/Atlantic Region serves ten southeastern states, Puerto Rico, the U.S. Virgin Islands, and the District of Columbia. The HS/HSL has held this competitive and prestigious designation for over 30 years.

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

UMB's 71-acre research and technology complex encompasses 67 buildings in west Baltimore near the Inner Harbor. Faculty have offices provided within their respective departments and the Graduate School has identified office space to house the Program Manager Specialist and instructional technology personnel. UMB has adequate facilities, infrastructure, and equipment to support any distance learning needs of the Doctoral Program. Students will have full access to the computing facilities at UMB. Students will be provided with UMB e-mail and library accounts and will have complete journal searching ability via PubMed. UMB possesses computing facilities that includes a networked computing environment for support of a broad range of information technology functions, including basic research, clinical research, patient information and general office management.

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

No new general funds will be required for implementation of the proposed DMSc which will be coordinated and administered fully through the Graduate School. A budget is included in Appendix A.

#### **M. Adequacy of Provisions for Evaluation of Program**

Students will have the opportunity to evaluate courses and faculty through a standard evaluation of every course. Formal assessment planning is already in place throughout UMB Schools including the Graduate School. Our approach includes ensuring that student learning is in alignment with course learning outcomes, alignment of mission at institutional and program levels, alignment of mission with learning outcomes, then program outcomes with curriculum, flowing down to course outcomes and assignments. Assessment activities emphasize analysis of results and feedback loops for continuous improvement. Additional evaluation includes tracking of student retention, grade distributions, and cost-effectiveness, and regular academic program reviews consider these factors.

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

UMB is strongly committed to cultural diversity and the recruitment and retention of underrepresented minority students. Recruitment efforts for the DMSc will include specific outreach to Historically Black Institutions to make students aware of the program and related

opportunities designed to improve their competitiveness in the job market and reach their professional goals if they are admitted and successfully complete the program.

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

The proposed DMSc is not directly related to an identified low productivity program identified by the Maryland Higher Education Commission.

#### **P. Adequacy of Distance Education Programs**

##### *Context of Online Education at UMB*

As the State's public health, law, and human services university, the mission of UMB is to excel at professional and graduate education, research, patient care, and public service, and to educate leaders in healthcare delivery, biomedical science, global health, social work, and the law. Also, UMB emphasizes interdisciplinary education in an atmosphere that explicitly values civility, diversity, collaboration, and accountability. UMB expects to achieve its mission in education excellence and to be competitive; the Graduate School has designed and offered online degree programs that respond to the following changes occurring in higher education (Allen, 2010).

1. **Education Pipeline.** The education pipeline includes future enrolled PA students in Maryland and Regionally as well as over 3000 clinically practicing PAs in Maryland as the prospective applicant pool. Prospective students are typically working adults who pursue part-time and non-residential educational opportunities, but who wish to remain in their regional geographic area, while pursuing advanced education. According to the National Center for Education Statistics, National Postsecondary Graduate Student Aid Study (NCES, NPSAS: GR; 2017), between the period of 2008 and 2017, there was a slight increase (3%) in the number of graduate students reporting full-time (FT) enrollment at a single institution. We suspect this may be partially influenced by availability of new online educational programs, where one can work, be considered enrolled FT, yet negotiate academic studies as one's lifestyle permits.
2. **Changing Demographics.** Data indicate a shift from the traditional student (the 18-22-year-old, full-time resident) to older students studying part-time. In 2015-2016, the National Center for Education Statistics (NCES, 2017) reported that 37.58% of graduate students were married and the average graduate student was 32 years old ( $SD= 9.66$ ). 9% of single/unmarried/divorced graduate students reported dependents, and nearly 60% of graduate students were female.
3. **Technology Shift.** Educational research suggests that online education achieves the same as, or better student learning outcomes, than traditional face-to-face delivery models (Tallent-Runnels, et al., 2006; Means et al., 2009). Online delivery is far outpacing traditional forms of educational delivery. Between 2002 to 2008, online enrollments grew at an annual rate of 19% vs. 1.5% versus all Higher Education. By the fall of 2008, 25% (4.6 million) of all students took at least one online course. In 2019, the top five highest reported college enrollments nationally four were online universities, offering at least some graduate programs (NCES).

4. Growth of Mobile Technologies. Mobile technologies and miniaturization are changing the computing environment and the educational delivery paradigm. Technologies like netbooks, e-Readers, iPhones, and iPads have revolutionized the delivery space and to provide anywhere, anytime learning.
5. Web 2.0 Revolution. Other technologies that are already figuring widely into the future of education are part of the Web 2.0 revolution. The use of a variety of technologies is disaggregating the educational experience into 'the cloud'. Many of the technologies for the future, like blogs, wikis, podcasts, video, social networking and social media, virtual worlds, mobile learning, and Personal Learning environments, will have profound effects on the future learning landscape.

Online education represents a strategy that can address the restrictions of traditional onsite college courses, opening up accessibility for variety of learners, for a variety of reasons and expanding access to global education opportunities and expertise, beyond the walls of the campus. Major determinants of successful online programs include 1) course design that incorporates best practices (e.g., course alignment, integration of technology and content), 2) quality faculty who can engage students in the material (e.g., provide feedback and relevant expertise), and 3) provide responsible academic oversight. All three of these determinants are present in this proposal.

Collectively, the distance learning team will provide the following services to ensure that best pedagogical practices are used to train and support the most of effective presentation of their course content.

- Guided tutorials on the online course development process, with open questions and answer session.
- Written instructions accompanied by training videos to guide faculty on how to use the learning management system.
- A manual for the faculty regarding principles of good practice and the pedagogy of distance education.
- Provide timely support to the faculty in the use of the technology and trouble shoot any problems that might arise during the course of instruction.
- Work with faculty to design and develop courses, monitor the delivery of the course, and assess and revise the course for future offerings.

### *Supporting Students in Distance Education*

Most of the courses for the Doctor of Medical Science will be online. Students enrolled in the clinical symposium and practicum courses will be attend short impact labs requiring four days of intense instruction and practice. We realize that the key to the success of the online courses is dependent on a) students knowing upfront the assumptions, requirements and responsibilities of taking an online course, 2) the ability of students to have the background, knowledge, and technical skills to undertake an online program; and 3) ~~their~~ students having access to academic and technical support services to support their online activities.

Accordingly, we will provide the following services to support the students in accessing distance learning technology:

- Communicate to students the nature of online learning, including their requirements, roles and responsibilities, and access to support services. All of our advertising, recruiting, and admissions materials shall clearly and accurately represent the program and the services available.
- Ensure that enrolled students shall have reasonable and adequate access to the range of student services to support their learning.
- Ensure that accepted students will have the background, knowledge, and technical skills needed to undertake the program.
- Make the HS/HSL (library) services available to students so that they can have access to research databases, online catalog of books and media, chat with or email a Librarian, electronic interlibrary loan, and more.

### *Evaluation and Assessment of Online Courses*

We will adhere to a quality improvement model for assuring the continuous quality of the online courses. The process will involve the following steps:

1. Assessment of course readiness as measured by our quality indicators of best practices (including assessment of faculty readiness).
2. Monitoring of course delivery as assessed by the instructional designers with use of our “course evaluation rubric.”
3. Obtainment of feedback from the faculty, students, and instructional designers.
4. Analysis of feedback as performed by the Distance Learning Committee.
5. Institute course revisions based on comments by the Distance Learning Committee.

Finally, to ensure the sustainability of the distance learning program, the Academic Affairs Office at UMB affirms the following:

- UMB Policies for faculty evaluation includes appropriate consideration of teaching and scholarly activities related to programs offered through distance learning.
- Commitment to ongoing support, both financial and technical, and to a continuation of the program for a period sufficient to enable students to complete a certificate.

<b>TABLE 1: PROGRAM EXPENDITURES:</b>					
<b>Expenditure Categories</b>	<b>Year 1</b>	<b>Year 2</b>	<b>Year 3</b>	<b>Year 4</b>	<b>Year 5</b>
1. Faculty (b + c below)	\$153,600	\$275,200	\$275,200	\$377,600	\$377,600
a. Number of FTE	1.00	1.80	1.80	2.60	2.60
b. Total Salary	\$120,000	\$215,000	\$215,000	\$295,000	\$295,000
c. Total Benefits	\$33,600	\$60,200	\$60,200	\$82,600	\$82,600
2. Admin. Staff (b + c below)	\$19,320	\$20,000	\$47,950	\$47,950	\$47,950
a. Number of FTE	0.20	0.20	0.50	0.50	0.50
b. Total Salary	\$14,000	\$14,340	\$35,000	\$35,000	\$35,000
c. Total Benefits	\$5,320	\$5,660	\$12,950	\$12,950	\$12,950
3. Support Staff (b + c below)	\$7,535	\$7,686	\$7,839	\$7,997	\$7,997
a. Number of FTE	0.10	0.10	0.10	0.10	0.10
b. Total Salary	\$5,500	\$5,610	\$5,722	\$5,837	\$5,837
c. Total Benefits	\$2,035	\$2,076	\$2,117	\$2,160	\$2,160
4. Technical Support and Equipment	\$5,000	\$12,000	\$12,000	\$12,000	\$12,000
5. Library	\$0	\$5,000	\$5,000	\$5,000	\$5,000
6. New or Renovated Space	\$0	\$0	\$0	\$0	\$0
7. Other Expenses	\$5,000	\$0	\$0	\$0	\$0
<b>TOTAL (Add 1 – 7)</b>	<b>\$190,455</b>	<b>\$319,886</b>	<b>\$347,989</b>	<b>\$450,547</b>	<b>\$450,547</b>

<b>TABLE 2: PROGRAM RESOURCES</b>					
<b>Resource Categories</b>	<b>Year 1</b>	<b>Year 2</b>	<b>Year 3</b>	<b>Year 4</b>	<b>Year 5</b>
1. Reallocated Funds	\$0	\$0	\$0	\$0	\$0
<b>2. Tuition/Fee Revenue (c + g below)</b>	<b>\$152,961</b>	<b>\$289,941</b>	<b>\$406,374</b>	<b>\$456,600</b>	<b>\$456,600</b>
a. Number of F/T Students*	0	0	0	0	0
b. Annual Tuition/Fee Rate	\$0	\$0	\$0	\$0	\$0
<b>c. Total F/T Revenue (a x b)</b>	<b>\$0</b>	<b>\$0</b>	<b>\$0</b>	<b>\$0</b>	<b>\$0</b>
d. Number of P/T Students	10	20	30	40	40
e. Credit Hour Rate	\$761	\$761	\$761	\$761	\$761
f. Annual Credit Hour Rate	20.1	19.05	17.8	15	15
<b>g. Total P/T Revenue (d x e x f)</b>	<b>\$152,961</b>	<b>\$289,941</b>	<b>\$406,374</b>	<b>\$456,600</b>	<b>\$456,600</b>
3. Grants, Contracts & Other External Sources	\$0	\$0	\$0	\$0	\$0

4. Other Sources (Graduate School Tuition)	\$37,494	\$29,945	\$0	\$0	\$0
<b>TOTAL (Add 1 – 4)</b>	<b>\$190,455</b>	<b>\$319,886</b>	<b>\$406,374</b>	<b>\$456,600</b>	<b>\$456,600</b>

#### **APPENDIX A: BUDGET**

**Expenses Narrative:** The table includes anticipated costs of hiring a faculty program director including salary and benefits as well as estimated costs for faculty and support staff to launch and develop the program. This financial analysis was built estimating approximately 30% of students enrolling in this program will be use existing PA or Health Science coursework for partial fulfillment of credits, and 70% of students enrolling in this program will take the full 60 credits. By utilizing resources shared across the Graduate School, UMB is maximizing resource to control costs. An initial \$20,000 expenditure is included to design, create and purchase degree specific promotional materials to advertise, promote, and attend recruiting events.

**Resource Narrative:** Anticipated revenue based on enrollment is projected in the resource narrative with initial shortfall for program costs being funded by Graduate School tuition funds, with anticipated ability to self-fund by year three.



**APPENDIX B: PLAN OF STUDY**  
**Part-Time Plan of Study, Fall Start (60 credits)**

Semester	Course	Credits	2023	2024	2025
<b>Year 1</b>					
<b>Fall</b>					
MHS 600	Introduction to Library Resources and Scholarly Writing	1 credit	X	X	X
MHS 615	Biostatistics for Health Professionals	3 credits	X	X	X
MHS 608	Research Seminar 1	3 credits	X		
<b>Spring</b>					
MHS 630	Epidemiology of Infectious and Chronic Disease	3 credits	X	X	X
MHS 652	Leadership and Communication	3 credits	X		
<b>Summer</b>					
MHS 602	Ethics for Healthcare Professionals	2 credits	X		
DMSC 713	Impact Lab/Clinical Symposium 1	6 credits	X		
	Credits Year 1	21 credits			
<b>Year 2</b>					
<b>Fall</b>					
DMSC 710	Healthcare System Science, Organizational Macroeconomics and Finance	3 credits		X	X
DMSC 712	Health Care Law, Policy, and Ethics	3 credits	X	X	X
<b>Spring</b>					
TBD	Elective 1	3 credits		X	X
DMSC 714	Applied Leadership and Advocacy	3 credits		X	X
<b>Summer</b>					
DMSC 718	Impact Lab/Clinical Symposium II	6 credits		X	X
	Credits Year 2	18 credits			
<b>Year 3</b>					
<b>Fall</b>					
DMSC 715	Technology Literacy, Utilization, and Integration into Practice	3 credits		X	X
DMSC 716	Life-Long Learning and Practice Reflection	3 credits		X	X
<b>Spring</b>					

DMSC 717	Evaluation, Synthesis and Critical Appraisal of Literature	3 credits			X
TBD	Elective 2	3 credits			X
<b>Summer</b>					
DMSC 719	Scholarship: Writing, Publishing and Presenting	3 credits			X
DMSC 720	Improving Quality, Equity and Outcomes	3 credits			X
	Credits Year 3	18 credits			
<b>Year 4</b>					
<b>Fall</b>					
DMSC 821	Capstone	3 credits			X
	Total	60 credits			

**Part-Time Plan of Study, Fall Start***Advanced standing example of a UMB PA/MSHS Graduate*

Semester	Course	Credits	2023	2024	2025
<b>Year 1</b>					
<b>Fall</b>					
DMSC 710	Healthcare System Science, Organizational Macroeconomics and Finance	3 credits	X	X	X
DMSC 712	Health Care Law, Policy, and Ethics	3 credits	X	X	X
<b>Spring</b>					
TBD	Elective 1	3 credits		X	X
DMSC 714	Applied Leadership and Advocacy	3 credits		X	X
<b>Summer</b>					
DMSC 713	Impact Lab/Clinical Symposium I	6 credits		X	X
	Credits Year 1	18 credits			
<b>Year 2</b>					
<b>Fall</b>					
DMSC 715	Technology Literacy, Utilization, and Integration into Practice	3 credits		X	X
DMSC 716	Life-Long Learning and Practice Reflection	3 credits		X	X
<b>Spring</b>					
DMSC 717	Evaluation, Synthesis and Critical Appraisal of Literature	3 credits			X
TBD	Elective 2	3 credits			X
<b>Summer</b>					
DMSC 718	Impact Lab/Clinical Symposium 2	6 credits			X
	Credits Year 2	18 credits			

Year 3					
<b>Fall</b>					
DMSC 719	Scholarship: Writing, Publishing and Presenting	3 credits			
DMSC 720	Improving Quality, Equity and Outcomes	3 credits			
<b>Spring</b>					
DMSC 821	Capstone	3 credits			
	Credits Year 3	9 credits			
	Credit subtotal	45 credits			
	Credits for partial fulfillment	15 credits			
	Credit total	60 credits			

**Bibliography**

American Academy of Physician Associates Salary Report (2022)  
 Physician Assistant Education Association Faculty and Directors Survey (2020)  
 Health Clinician of the Future Report March 2022 Elsevier  
 Bureau of Labor and Statistics



**BOARD OF REGENTS**  
SUMMARY OF ITEM FOR  
ACTION, INFORMATION, OR  
DISCUSSION

**TOPIC:** University of Maryland Eastern Shore Bachelor of Science in Biomedical Engineering

**COMMITTEE:** Education Policy and Student Life

**DATE OF COMMITTEE MEETING:** Tuesday, November 15, 2022

**SUMMARY:** The University of Maryland Eastern Shore (UMES) is pleased to present a proposal to create a new Bachelor of Science in Biomedical Engineering (BSBME). UMES is located in Maryland’s Somerset County, one of the poorest counties in the state according to the U. S. Census Bureau. Lack of educational opportunities and choices for minority and educationally disadvantaged students calls for development of high-quality and innovative academic programming to align academic programs with the educational needs of the region and the state of Maryland. The proposed biomedical engineering (BME) 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 to support the rural healthcare system.

With expertise spanning physiology, biology, healthcare and health informatics, mechanics, and engineering, biomedical engineers can combine their diverse skills to develop solutions to address continuing worldwide health issues, helping change how patients are treated and lowering the cost of care, two issues which prove increasingly to be important and urgent impediments for rural area healthcare systems, such as on the Eastern Shore of Maryland. Moreover, the recent Covid-19 pandemic has stimulated an unprecedented engineering response across all domains of healthcare infrastructure, logistics, personal protective equipment development, medical and digital technology, diagnostics, testing, monitoring, infrastructure, prevention, vaccine bio-processing, and therapeutics. Within this context, biomedical engineers who work at the interface of physiology, pathology, and treatment have come to the fore. They have devised new technologies, established fast routes for translation, and made demonstrably significant clinical impacts.

**ALTERNATIVE(S):** The Regents may not approve the program or may request further information.

**FISCAL IMPACT:** No additional funds are required. The programs can be supported by the projected tuition and fees revenue.

**CHANCELLOR’S RECOMMENDATION:** That the Education Policy and Student Life Committee recommend that the Board of Regents approve the proposal from University of Maryland Eastern Shore to offer the Bachelor of Science (B.S.) in Biomedical Engineering.

COMMITTEE RECOMMENDATION: DATE: November 15, 2022

BOARD ACTION: DATE:

SUBMITTED BY: Joann A. Boughman 301-445-1992 jboughman@usmd.edu



UNIVERSITY OF MARYLAND EASTERN SHORE  
*Office of the President*

October 14, 2022

Dr. Jay Perman, Chancellor  
University System of Maryland  
701 E. Pratt Street  
Baltimore, MD 21202

**RE: New Academic Program Proposal – Bachelor of Science in Biomedical Engineering**

Dear Dr. Perman:

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

**Program:** BS in Biomedical Engineering

The Department of Engineering and Aviation Sciences is proposing to offer a BS degree in Biomedical Engineering (BME). The proposed program will play a crucial role in preparing professionals to work in various positions related to the medical industry and help address the shortage of biomedical engineers and healthcare technical talents in rural areas.

The proposed biomedical engineering program will significantly strengthen and expand the capability of UMES, one of the four HBCUs in the state, to provide high-quality and unique educational experiences to students to support the rural healthcare system. With expertise spanning physiology, biology, healthcare, health informatics, mechanics, and engineering, biomedical engineers can combine their diverse skills to create solutions to continuing worldwide health issues, helping to change how patients are treated and lowering the cost of care, which becomes increasingly important and urgent for rural area healthcare system, like the eastern shore of Maryland. Moreover, the Covid-19 pandemic has stimulated an unprecedented engineering response across all domains of healthcare infrastructure, logistics, personal protective equipment, medical and digital technology, diagnostics, testing, monitoring, infrastructure, logistics, prevention, vaccine bioprocessing, and therapeutics. Within this arena, biomedical engineers who work at the interface of physiology, pathology, and treatment have come to the fore. They have devised new technologies, established fast routes for translation, and have demonstrably had a significant clinical impact.

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,

A handwritten signature in cursive script, appearing to read "Heidi M. Anderson".

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. Yuanwei Jin, Professor and Chair, Department of Engineering and Aviation Sciences

**UNIVERSITY SYSTEM OF MARYLAND INSTITUTION PROPOSAL FOR**

- New Instructional Program
- Substantial Expansion/Major Modification
- Cooperative Degree Program
- Within Existing Resources, or
- Requiring New Resources

**University of Maryland Eastern Shore**

Institution Submitting Proposal

**Bachelor of Science in Biomedical Engineering**

Title of Proposed Program

**Bachelor of Science**

Award to be Offered

**Fall 2023**

Projected Implementation Date

**090500.00**

Proposed HEGIS Code

**140501.000**

Proposed CIP Code

**Engineering and Aviation Sciences**

Department in which program will be located

**Dr. Yuanwei Jin**

Department Contact

**(410) 621-3410**

Contact Phone Number

**yjin@umes.edu**

Contact E-Mail Address



Signature of President or Designee

**October 5, 2022**

Date



**DIVISION of ACADEMIC AFFAIRS**  
**Office of the Provost & Vice President**

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**Proposal for New Undergraduate Degree Program**  
**Bachelor of Science in Biomedical Engineering (BME)**

**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 Department of Engineering and Aviation Sciences proposes to establish a Bachelor of Science degree in Biomedical Engineering within the School of Business and Technology (SBT) at UMES. Biomedical engineers play a critical role in the design of artificial organs, prostheses, instrumentation, medical information systems, health management and care delivery systems, medical devices used in various medical procedures, and imaging systems. As an emerging issue, COVID-19 is one of the most severe global health crises that humanity has ever faced. Researchers have restlessly focused on developing solutions for monitoring and tracing the viral culprit, SARS-CoV-2, as vital steps to break the chain of infection. Biomedical engineering (BME) has demonstrated its pivotal role in nurturing the maturation of COVID-19 diagnostic technologies. The proposed BME program aims to offer perspective students the educational opportunity to pursue a bachelor of science degree in biomedical engineering and take the inside track to a career that combines engineering and medical technology to find ways to improve the quality of human life.

The curriculum of the program consists of core engineering courses, supportive science and math courses, and major electives, in addition to the general education courses. The program consists of two tracks: (1) Biomechanics and Tissue Engineering track and (2) Bioelectric and Bio-computational Engineering track. This curriculum is designed to offer both a core understanding of traditional engineering disciplines, and an in-depth knowledge of the body. Our courses emphasize experimental and analytical coursework to gain a strong understanding of medical technology and complex living systems.

The institution's mission of UMES, as an 1890 HBCU land-grant institution, 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 graduation rate of the underrepresented minorities in the fields of biomedical 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://wwwcp.umes.edu/president/wp-content/uploads/sites/16/2021/05/Strategic-Plan-2020.pdf>

we identified the following two goals:

- “Goal IV: Meet the educational needs of the state of Maryland with high-quality and innovative academic programming” in order to align academic programs with the educational needs of the state of Maryland; and
- “Goal VI: Achieve and Maintain National Eminence and Global Impact” by creating signature academic programs to prepare students for careers nationally and internationally.

The proposed degree program will help the institution achieve its strategic goals listed above and position UMES to the forefront of educational innovation in health care related academic programs. The proposed biomedical engineering program, similar to the existing programs at UMES, including Kinesiology, Pharmacy, Physical Therapy, Physician Assistant and Rehabilitation Services is expected to improve the health and well-being of the community through health education and promotion. According to Bureau of Labor statistics, nationwide, employment of bioengineers and biomedical engineers is projected to grow 6 percent from 2020 to 2030, about as fast as the average for all occupations. About 1,400 openings for bioengineers and biomedical engineers are projected each year, on average, over the decade. Biomedical engineers work with a broad range of professionals ranging from other engineering specialties, to basic laboratory scientists, to physicians and nurses, which are in short supply in the rural area of Eastern Shore.

The proposed BME program is expected to enable a stronger and multi-disciplinary research collaboration across campus community, thus fueling research forward in many other different disciplines more than in applied science and engineering disciplines and creating 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 clean room, and Microwave Anechoic Chamber Lab, etc. Four (4) new faculty lines will be allocated to support this proposed BME program to develop courses and deliver instructions and labs. The new faculty lines will be funded by the HBCU settlement fund that UMES receives for the first five years of program implementation. Beginning of 2022 – 2023 academic year, it is expected that one tenure track faculty position will be funded. This process will continue for the next four years.

Two additional new teaching labs for the BME program will be developed: The Bioinstrumentation Lab and the Biomedical Engineering Lab. These two labs will enable the program to conduct measurements on living systems. The department has started acquiring measurement kits, for example, the BSL BME Teaching Package to start the development process.

- 4. Provide a description of the institution's a commitment to:**
  - a. ongoing administrative, financial, and technical support of the proposed program**

The University Administration is committed to adequately fund 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, and Department of Engineering and Aviation Sciences 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 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. Four additional new full-time tenure track faculty members with terminal degrees in the field of biomedical engineering or a closely related field will be recruited to develop and deliver courses and labs for the program. The university is fully committed to continue the proposed BME program for a sufficient period of time 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**

Bioengineers and biomedical engineers combine engineering principles with sciences to design and create equipment, devices, computer systems, and software. Bioengineers and biomedical engineers work in manufacturing, in research facilities, and for a variety of other employers.

The current pandemic has stimulated an unprecedented engineering response across all domains of healthcare infrastructure, logistics, personal protective equipment, medical and digital technology, diagnostics, testing, monitoring, infrastructure, logistics, prevention, vaccine bio-processing, and therapeutics. Within this, engineers who work as the interface of physiology, pathology and treatment have come to the fore. They have devised new technologies, established fast routes for translation, and have demonstrably had significant clinical impact. The COVID-19 pandemic has shone a light on the critical role medical technology plays in patient care. As demand for ventilators and patient monitoring equipment has surged, biomedical engineers are working around the clock to keep patients safe.

The need for the advancement and evolution of medical and healthcare technology demands academic programs such as the proposed BME program to educate and produce next generation medical researchers and engineers to handle challenges in future global infectious diseases.

**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 U. S. Census Bureau. Lack of educational opportunities and choices for minority and educationally disadvantaged students calls for development of high-quality and innovative academic programming in order to align academic programs with the educational needs of the region and the state of Maryland.

With expertise spanning physiology, biology, healthcare and health informatics, mechanics, and engineering, biomedical engineers can combine their diverse skills to create solutions to continuing worldwide health issues, helping to change how patients are treated and lowering the cost of care, which becomes increasingly important and urgent for rural area healthcare system, like the eastern shore of Maryland.

UMES currently offers the only general engineering bachelor of science degree program in the Eastern Shore of Maryland. In the past 15 years since inception of the engineering program, there has been more than 130 graduates. Among those graduates, more than a dozen former graduates are working in the Wallops Island area for NASA and its contractors. About 20 of them went on to pursue graduate degrees (master's and doctorate) in mechanical engineering, electrical engineering, and engineering science in other engineering schools, including Dartmouth College and Rensselaer Institute of Technology. The graduation and job placement data have demonstrated the success of the engineering program. The proposed biomedical engineering program is expected to further enhance UMES's position as a top choice of higher education institution for STEM education for minority and educationally disadvantaged students in the state and the surrounding regions with the ultimate goal of developing a pipeline of engineering and STEM workforce for the state.

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

The proposed BME 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. No HBIs in the state offers any biomedical engineering or bioengineering program. In fact, only two HBCUs in the nation offers biomedical engineering and bioengineering programs, that is University of the District of Columbia (UDC)'s biomedical engineering program (since 2019) and the North Carolina Agricultural and Technical State University (NCA&T)'s bioengineering program (since 2013). The proposed BME program at UMES will advance the increase of minorities BME degree grantees in the fields of health care, biomedical research and engineering. It will also strengthen and expand the research capacity of UMES to provide high quality and unique educational programs to a high level.

**2. Provide evidence that the perceived need is consistent with the [Maryland State Plan for Postsecondary Education](#).**

The proposed BME 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 BME degree program is intended to prepare highly trained scientists and engineers at the undergraduate level in biomaterials, tissue engineering, cardiovascular engineering, biomedical imaging, bioinformatics, bioinstrumentation, machine learning in biomedical engineering, which are becoming increasingly important and relevant to our society, and public health. However, the field of health care and biomedical technology is a specialized field with many barriers for students to access. The proposed BME degree program will provide equitable access and quality education to all Maryland residents, including those with disadvantaged background, in order to develop a strong biomedical engineering workforce for the state.

**Success – Promote and implement practices and policies that will ensure student success.**

The practices and policies concerning the proposed BME degree program align with the all existing policies at the University, which will ensure student success. By providing a carefully developed curriculum, sufficient 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 BME 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 new knowledge and skillsets 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.**

Biomedical engineering is a fascinating discipline, blending traditional engineering with issues of health care. As outlined by an article from the American Society of Mechanical Engineers, biomedical engineers work to help improve the lives of patients living with various conditions in a variety of ways, including through the design of new digital tools, software platforms, instruments and other devices. In essence, the practice of biomedical engineering refers to the design and creation of technologies that aid the health care process in some way. For example, commonplace medical devices that can be credited to the bioengineering field include MRI machines and dialysis machines. Innovation in this area of engineering will no doubt continue in accordance with the development of technology - improving health care and patient outcomes in the process. The proposed BME program will

produce graduates in all these technical fields, expected as entry level engineers or engineering managers.

## **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 (BLS) indicates that the number of jobs in bioengineering and biomedical engineering in 2020 is 19,300. In terms of the job outlook, it is expected to grow at the rate of 6% annual in the next ten years (2020-2030). The median pay for biomedical engineer is \$92,620 per year. Data by BLS (<https://www.bls.gov/ooh/architecture-and-engineering/biomedical-engineers.htm>) shows that about 1,400 openings for bioengineers and biomedical 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.

Industry analysis also shows that biomedical engineers will likely see greater demand for their services because of the broadness of both their profession and their training. A recent study on the job market for biomedical engineers in the US (<https://www.careerexplorer.com/careers/biomedical-engineer/job-market/>) shows that Maryland currently employs 710 biomedical engineers in the industry, ranked No. 8 among 50 states in the nation. This shows that Maryland has the potential to further increase the number of employment opportunities in biomedical engineering field.

Moreover, according to Occupational Information Network, i.e., O-Net Online, (<https://www.onetonline.org/link/summary/17-2031.00>), job titles suitable for graduates of the BME program vary, such as Biomedical Electronics Technician, Biomedical Engineer, Biomedical Engineering Technician, Biomedical Equipment Technician (BMET), Biomedical Technician, Engineer, Process Engineer, Research Engineer, Research Scientist. Among those position titles, industries with the highest levels of employment in Bioengineers and Biomedical Engineers are listed in the table below: (<https://www.bls.gov/oes/current/oes172031.htm>)

<b>Industry</b>	<b>Employment</b>	<b>Annual Mean Wage</b>
<a href="#">Medical Equipment and Supplies Manufacturing</a>	3090	\$97,800
<a href="#">Scientific Research and Development Services</a>	3090	\$104,00
<a href="#">Pharmaceutical and Medicine Manufacturing</a>	2560	\$98,610
<a href="#">Navigational, Measuring, Electromedical, and Control Instruments Manufacturing</a>	1570	\$109,220
<a href="#">General Medical and Surgical Hospitals</a>	1570	\$81,910

## **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. Data by BLS (<https://www.bls.gov/ooh/architecture-and-engineering/biomedical-engineers.htm>)

[engineering/biomedical-engineers.htm](#)) shows that about 1,400 openings for bioengineers and biomedical engineers are projected each year, on average, over the decade. These openings are to be filled by those with educational and training background in the field of biomedical engineering.

The career outlook for biomedical engineers is strong. Industry data shows ([www.recruiter.com](#)) demand for Bioengineers and Biomedical Engineers is expected to go up, with an expected 3,550 new jobs filled by 2029. This represents an annual increase of 2.11 percent over the next seven years (2022-2029).

#### 4. Provide data showing the current and projected supply of prospective graduates.

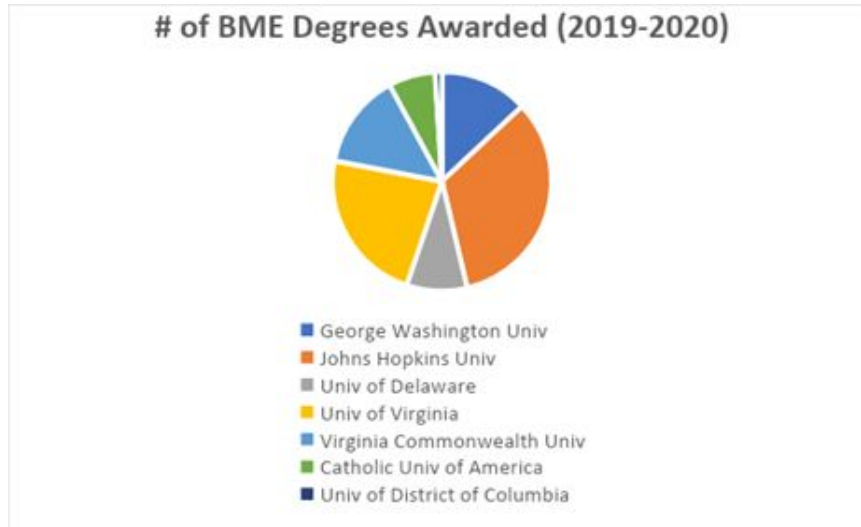
According to the ABET database of accredited programs

(<https://amspub.abet.org/aps/name-search?searchType=program&keyword=biomedical%20engineering>),

similar biomedical engineering BS programs in the DC/MD/VA/DE regions include: George Washington University, The Catholic University of America, The Johns Hopkins University, University of Delaware, University of District of Columbia (UDC), Virginia Commonwealth University, University of Virginia. Similar bioengineering BS programs include George Mason University and University of Maryland College Park. Among HBCUs in the four states, only UDC offers a BS biomedical engineering program. In fact, UDC became the first of its kind among HBCUs nationwide to receive accreditation by ABET in 2019. Based upon the data provided by [www.collegefactual.com](#), the number of BME BS degree awarded by the seven BME programs in the DC/MD/VA/DE region is summarized below:

<b>Institutions</b>	<b># of BME BS Degree Awarded in 2019 – 2020</b>
George Washington University	51
Johns Hopkins University	130
University of Delaware	35
University of Virginia	89
Catholic University of America	27
Virginia Commonwealth Univ	55
University of District of Columbia	4
<b>Total</b>	<b>391</b>

It is clear that UDC has the lowest number of BME BS degrees awarded, which amounts to 1% of the 391 degrees awarded in 2019-2020. This implies that the number of awarded BS degrees in biomedical engineering from a HBCU that is comparable to UMES in the surrounding states is very low. UMES is in a good position to address the shortage of HBCU graduates of a BME program.



It is our belief that the market demand is sufficiently high, the geographic draw of students is sufficiently distinct, the proposed BME program to be offered in the Eastern Shore of the state, along with other similar programs in the state (e.g., JHU's BME and UMD's Bioengineering) will provide valuable contributions to the Maryland workforce.

#### **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 building upon the existing faculty expertise in the general engineering program at UMES. There is no other biomedical engineering degree program in the Eastern Shore of Maryland. Although other institutions in Maryland, such as University of Maryland College Park offers bioengineering degree and the Johns Hopkins University offers a BME degree program, these institutions are located about 140 miles away from the Eastern Shore. UMES serves a different geographical area compared with other parts or regions of the state. Moreover, the proposed program offers unique curriculum with a focus in biomaterials, bioinstrumentation, tissue engineering, cardiovascular engineering, biomechanics of rehabilitation in which technical talents and workforce is lacking, especially in the rural eastern shore of the state. The proposed UMES program does not duplicate similar programs offered by other Maryland institutions.

- 2. Provide justification for the proposed program**

Healthcare workforce shortages impact healthcare access in rural communities. One measure of healthcare access is having a regular source of care, which is dependent on having an adequate healthcare workforce. A shortage of healthcare professionals in rural areas of the U.S. can restrict access to healthcare by limiting the supply of available services. Equally importantly, equipment malfunctions are a major challenge for rural, resource-poor healthcare centers, limiting the ability of medical staff to diagnose and treat patients.

The BME program we propose will enable biomedical engineering students to obtain both practical experience with medical devices and de novo design training to develop improved devices that are safe and reliable. As we can imagine, BME graduates will diagnose and repair medical equipment at local healthcare facilities, thus helping to address the barriers of healthcare access in the rural area, such as the Eastern Shore of Maryland.

#### **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.**

Engineering program with various sub-disciplinary has always been in high demands on the employment spectrum. Among of the four HBIs in the state of Maryland, no biomedical engineering or bioengineering program is offered. Only a handful of HBCUs in the nation offers biomedical engineering BS degree programs or bioengineering BS degree programs. The proposed BME program at UMES, if established, will position UMES as a center for medical technology education and research in the rural area of Eastern Shore. The program will enable UMES to produce a pipeline of high caliber workforce in biomedical engineering to support health care facilities and other industry fields in health care and human factors.

#### **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.**

UMES has established a series of strong programs in pharmacy and health professions, such as Kinesiology, Pharmacy, Physical Therapy, Physician Assistant and Rehabilitation Services. The proposed BME program at UMES, if established, will strengthen the position of UMES as a center for medical technology education and research in the rural area of Eastern Shore. The program will enable UMES to produce a pipeline of high caliber workforce in biomedical engineering to support health care facilities and other industry fields in health care and human factors.

#### **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.**

**Curriculum Design:** The proposed program was established through a rigorous review of unmet needs by the institution. It started from the faculty in the engineering program, with approval from the Departmental Curriculum Committee, School Curriculum Committee, Graduate Faculty Council, Senate Curriculum Committee, etc. The curriculum was developed by the faculty in the Department of Engineering and Aviation Sciences, with consultation with School of Pharmacy and Health Professions, and School of Agriculture and Natural Sciences.



**Faculty Oversight:** The courses of the curriculum in the proposed BME bachelor of science degree program will be taught by faculty in the Department of Engineering and Aviation Sciences, with 4 new full-time tenure-track faculty members with Ph.D. degrees in the biomedical engineering fields to be hired. The four new faculty will develop courses and labs and deliver teaching and research in the biomedical engineering field. In addition, the existing faculty in the department will also help with the BME program because 10 courses in the core and elective of the BME curriculum are the same as the courses in the existing Engineering Program curriculum. This arrangement ensures the new BME program is fully supported in terms of faculty resources. Please the detailed list of faculty background in the current engineering program below.

**Program Modality:** The program will be offered at the main campus of UMES.

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

The educational objectives of the curriculum of the proposed BME program are to enable graduates of the program to develop ability of

- Applying principles of engineering, biology, human physiology, chemistry, calculus-based physics, mathematics (through differential equations), and statistics;
- Solving bio/biomedical engineering problems, including those associated with the interaction between living and non-living systems;
- Analyzing, modeling, designing and realizing bio/biomedical engineering devices, systems, components, or processes; and
- Making measurements on and interpreting data from living systems

The learning outcomes of the program align with the learning outcomes of the ABET (1)-(7) specified by the Engineering Accreditation Commission (EAC).

- [1]. An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics;
- [2]. An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economics factors;
- [3]. An ability to communicate effectively with a range of audiences;
- [4]. An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts;
- [5]. An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives;
- [6]. An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions;
- [7]. An ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

Students will learn analytical and experimental methods that are broadly applicable in the field of biomedical engineering. They will also be given specific instruction and hands-on laboratory

experimental leaning experiences on how to apply these methods to a large range of problems in biomedical engineering.

**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.
- Assessing comprehensive senior design project report in the two tracks of the program.

**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. Assessment of learning outcomes will be conducted every six years per ABET accreditation requirements.

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

The Biomedical Engineering program consists of **125** total credit hours. The curricula include 28 credit hours of general education courses in English, arts and humanities, social and behavioral sciences, and emerging issues. An additional 12 credits in mathematics and physical sciences are required under the General Education program, which are included as a part of the requirements for the Engineering major. This makes the total credits for General Education to be 40 credit hours. The Biomedical Engineering curriculum also requires 27 credits of supportive math, physics and biology courses. Students take 43 credit hours of core biomedical engineering courses. Students choose 15 credit hours of elective courses from the two elective tracks of 1) biomechanics and tissue engineering, or 2) bioelectrics and biocomputational engineering. The program is on semester base. The total number of credits and their distribution is given as follows:

<u><i>Category</i></u>	<u><i>Distribution</i></u>
I. General Education Courses	40 credit hours
II. Supportive Math & Science Courses	27 credit hours
III. Engineering Core Courses	43 credit hours
IV. Elective Courses	15 credit hours

<b>Biomedical Engineering Core Requirement</b>		<b>43 credits needed</b>
<b><u>Course Code</u></b>	<b><u>Course Title</u></b>	<b><u>Credit Hours</u></b>
BMEN 150	Freshmen Biomedical Engineering Design	3 hrs
ENGE 260	Statics	3 hrs
BMEN 265	Biomaterials	3 hrs
ENGE 320	Statistics and Probability for Engineers	3 hrs
BMEN 242	Fluid Mechanics for Biosystems	3 hrs
BMEN 245	Bio-thermodynamics	3 hrs
BMEN 346	Transport Phenomena for Bio-systems	3 hrs
BMEN 362	Biomechanics	3 hrs
BMEN 364	Human Physiology for Engineers	3 hrs
BMEN 365	Cell Biology for Engineers	3 hrs
ENGE 370	Computational Methods in Engineering	3 hrs
BMEN 380	Bioinstrumentation	3 hrs
BMEN 383	Bioinstrumentation Lab	1 hrs
BMEN 384	Biomedical Engineering Lab	1 hrs
BMEN 475	Biomedical engineering Seminar	1 hrs
BMEN 476	Senior Design Project I	2 hrs
BMEN 477	Senior Design Project II	2 hrs

<b><u>Biomechanics and Tissue Engineering Elective Track</u></b>		<b>15 credits needed</b>
<b><u>Course Code</u></b>	<b><u>Course Title</u></b>	<b><u>Credit Hours</u></b>
BMEN 450	Bio-Solid Mechanics	3 hrs
BMEN 386	Design and Modeling in Bio-Solid Mechanics	3 hrs
BMEN 448	Cardiovascular Engineering	3 hrs
BMEN 388	Tissue Engineering	3 hrs
BMEN 390	Bio-reaction Engineering	3 hrs

BMEN 410	Nanotechnology	3 hrs
BMEN 415	Cellular Biotechnology	3 hrs
ENGE 261	Dynamics	3 hrs
ENGE 382	Control System	3 hrs
BMEN 448	Biomechanics of Human Movement	3 hrs
BMEN 449	Biomechanics of Rehabilitation	3 hrs
ENME 442	Micro-Electro-Mechanical Systems	1 hrs
BMEN 472	Selected Topics in Biomedical Engineering	1 hrs

<b>Bioelectric and Bio-computational Engineering Elective Track</b>		<b>15 credits needed</b>
<u>Course Code</u>	<u>Course Title</u>	<u>Credit Hours</u>
ENGE 240	Basic Circuit Theory	3 hrs
BMEN 340	Bioelectronics	3 hrs
BMEN 349	Neural Engineering	3 hrs
ENEE 330	Signals and Systems	3 hrs
ENEE 460	Digital Signal Processing	3 hrs
BMEN 445	Biomedical Imaging	3 hrs
BMEN 446	Bioimage Processing	3 hrs
BMEN 422	Machine Learning in Biomedical Engineering	3 hrs
BMEN 452	Artificial Intelligence in Biomedical Engineering	3 hrs
BMEN 450	Electrical Biophysics	3 hrs
BMEN 461	Bioinformatics	3 hrs
ENGE 382	Control Systems	3 hrs
ENME 442	Micro-Electro-Mechanical Systems	3 hrs
BMEN 472	Selected Topics in Biomedical Engineering	3 hrs

<b>Supportive Science &amp; Math Requirement</b>		<b>27 credits needed</b>
<u>Course Code</u>	<u>Course Title</u>	<u>Credit Hours</u>
MATH 211	Calculus II	4 hrs
MATH 212	Calculus III	4 hrs
MATH 241	Differential Equation for Engineers	3 hrs
PHYS 262	General Physics II	3 hrs
PHYS 263	Genera Physics II Lab	1 hrs
CHEM 112	Principles of Chemistry II	3 hrs
CHEM 114	Principles of Chemistry II Lab	1 hrs
BIOL 111	Principal of Biology I	3 hrs
BIOL 113	Principal of Biology I Lab	1 hrs
BIOL 222	Genetics	3 hrs
BIOL 223	Genetics Lab	1 hrs

**Note:** the following nine (9) courses are cross-listed in the existing engineering program curriculum: ENGE 260, ENGE 320, ENGE 370, ENGE 261, ENGE 382, ENGE 240, ENEE 330, ENEE 460, ENME 442. This arrangement enables the existing engineering faculty to contribute to course offering to the proposed BME program.

### **BIOMEDICAL ENGINEERING CORE AND ELECTIVE COURSE DESCRIPTIONS**

**BMEN 150 Freshman Biomedical Engineering Design: 3 credits.** An introduction to modern biomedical engineering design with emphasis on various aspects of developing a biomedical product via hands-on design approach, communication skills, and teamwork; use of product visualization and computer software such as word processing, power point, and spreadsheet; students work as teams to develop and design a working prototype.

**BMEN 265 Biomaterials: 3 credits.** Introduction to bioengineering material such as metals, ceramics, polymers, carbons, and composites as well as their applications in biomedical devices and implants. The biomedical applications of the biomaterials in several areas including tissue engineering, drug delivery, orthopedic implants, ophthalmologic devices, and cardiovascular devices.

**BMEN 242 Fluid Mechanics of Bio-systems: 3 credits.** Introduction to fundamentals of fluid mechanics as applied to biomedical systems. Topics include fluid properties, fluid statics, conservation of mass, momentum and energy as it applies to biomedical systems. Integral and differential analysis of biological flows applicable in human physiology and biotechnology.

**BMEN 245 Bio-Thermodynamics: 3 credits.** Principles of thermodynamics as applied to biomedical systems. First law and second law of thermodynamics, statistical thermodynamics, and reaction kinetics as relate to biological systems, and biomedical technologies.

**BMEN 346 Transport Phenomena for Bio-systems: 3 credits.** Fundamentals of chemical and mass transport as it relates to biomedical systems. Conservation of momentum, mass and energy as applied to cellular and organ level transport. Understanding transport phenomena applicable to design and development of modern biomedical devices and bio-artificial organs.

**BMEN 362 Biomechanics: 3 credits.** Fundamental of engineering mechanics such as dynamics and deformable body mechanics as applied to biological tissues and systems. Topics include linear and angular kinematics as well as kinetics as they apply to biomechanical systems; Apply methods of statics to biomechanical systems for deformation analysis; Principle of mechanics of materials including stress, strain, material properties, materials models of biological tissues, multi-axial deformation, torsion, bending and Mohr's circle.

**BMEN 364 Human Physiology for Engineers: 3 credits.** This course has two distinct components. The first component is to introduce the major organ systems of the body with an emphasis on regulatory processes and interactions with other systems. The second component is to implement physical and mathematical models along with engineering approaches to analyze different physiological systems quantitatively. Systems examined in these two components include cellular, musculoskeletal, cardiovascular, respiratory, endocrine, gastrointestinal, and renal.

**BMEN 365 Cell Biology for Engineers: 3 credits.** The course has two distinct components. The first component provides general contents of cell biology including cell structure and functioning. The second component implements physical and engineering models to provide quantitative and/or semiquantitative analyses to address several problems in cell biology.

**BMEN 380 Bio-instrumentation: 3 credits.** Introduction to sensing, measurement, instrumentation and data acquisition as applied to biological and biomedical systems. Topics include bioelectric signals, biomedical electronics, biomedical electrodes and sensors, instrumentation in diagnostic cardiology, extracorporeal devices, instrumentation in blood circulation, and new technologies and advances in medical instrumentation.

**BMEN 383 Bio-instrumentation Lab: 1 credit.** The lab aims to demonstrate the principles covered in Bio-instrumentation course. Experiments cover bio-signal recording (finger pulse, ECG, EEG, and EMG), muscle stimulation and fatigue, Wheatstone bridge circuit, and Op-Amp and filter circuits; Data collection, data analysis and written lab reports are expected.

**BMEN 384 Biomedical Engineering Lab: 1 credit.** The lab aims to expose students to formulating and solving problems in biomedical systems using experimental design, experimentations and subsequent data collection and data analysis. In particular, the experiments cover biomaterials, biomechanics, bio-thermal and bio-fluid mechanics topics. Written lab reports are expected.

**BMEN 450 Bio-Solid Mechanics: 3 credits.** Fundamentals of continuum mechanics and constitutive modeling relevant for biological tissues. Constitutive models including linear elasticity, nonlinear elasticity, viscoelasticity and poroelasticity. Structure-function relationships, which link tissue morphology and physiology to tissue constitutive models, are covered for skeletal, cardiovascular, pulmonary, abdominal, skin, eye and nervous tissues.

**BMEN 386 Design and Modeling in Bio-Solid Mechanics: 3 credits.** Introduce concepts, tools and methodologies to model, design and analyze a biomedical system or product. Fundamental of solid modeling and computer aided design (CAD), as well as computer aided engineering (CAE) including applied finite element analysis (FEA) are covered for the purpose of modeling, designing, analyzing, and examining the performance of a biomedical system or product.

**BMEN 447 Cardiovascular Engineering: 3 credits.** Introduction to modeling and measurement methods for the cardiovascular system, analysis of blood flow dynamics, function of the heart, and noninvasive approaches. Applications to cardiovascular instrumentation, basic cardiovascular system research, assistive and repair devices, and disease processes.

**BMEN 388 Tissue Engineering: 3 credits.** The course applies the principles of biomedical engineering to design and fabricate a wide range of functional tissues and organs. The topics include tissue components, biomaterials for tissue engineering, cell-matrix interactions, regenerative processes, engineering of specific tissues, and recent advances in tissue engineering.

**BMEN 390 Bio-reaction Engineering: 3 credits.** The course introduces engineering aspects of biological reactions as applied to biomedical systems. Topics to be covered includes enzyme kinetics, enzyme inhibition, biochemical pathway engineering, mass and energy balance, cell growth and differentiation, cell engineering, bioreactor design, and analysis of the human body, organs, tissues, and cells as bioreactors. The application of bioreaction/bioreactor principles to tissue engineering is also covered.

**BMEN 410 Nanotechnology: 3 credits.** The course covers emerging topics in nanotechnology relating to biomedical systems. Topics includes scaling laws, nanodevices, nanotools, nanoparticles, nanoscale phenomena applicable to biomedical systems. Computational models and tools as they apply to nano-biosystems are covered.

**BMEN 415 Cellular Biotechnology: 3 credits.** This course covers the engineering principles behind rapidly growing field of biotechnology. The emerging topics such as protein engineering, synthetic biology, nanomedicine, biosimilars, microtechnologies, organ-on-chip platforms, drug delivery, immunotherapies, gene editing, stem cells, tissue engineering, regenerative medicine, personalized medicine may be covered.

**BMEN 448 Biomechanics of Human Movement: 3 credits.** The course introduces musculoskeletal biomechanics and the quantitative analysis of human movement. Topics covered include rigid-body kinematics, dynamics, motion capture, external force measurement, electromyography, and mechanical properties of muscles and tendons; muscles are presented as mechanical actuators that produce movements; experimental and computational methods are implemented to evaluate the functions of muscles, bones, and joints together as a mechanical system.

**BMEN 449 Biomechanics of Rehabilitation: 3 credits.** This course covers biomechanical topics related to design and application of rehabilitation engineering and assistive technologies in a wide range of areas including wheeled mobility, seating and positioning, environmental control, computer access, augmentative communication, sensory aids, as well as emerging technologies.

**BMEN 472 Selected Topics in Biomedical Engineering: 3 credits.** Selected topics on special or current topics and issues relating to biomedical engineering structured for students in biomedical engineering and other areas.

**BMEN 340 Bio-Electronics: 3 credits.** The course covers fundamental concepts of electronics, assembly of electronic components into functional circuits, and integration of functional electronic devices and circuits into a biomedical system. Development and design of sensors, stimulators, and their medical devices for bio-integrated electronics. Materials design and fabrication of passive and active components for sensitive, multimodal, and robust wearable and implantable devices.

**BMEN 349 Neural Engineering: 3 credits.** The course introduces principles and techniques for understanding and interacting with the nervous system. Topics include quantitative models of neurons, recording and stimulation models, as well as machine learning techniques to extract information from large neural datasets.

**BMEN 445 Biomedical Imaging: 3 credits.** The course covers biomedical imaging system with an emphasis on fundamental principles and applications of each modern imaging modality including X-ray radiography, computed tomography (CT), nuclear medicine (SPECT and PET), magnetic resonance imaging (MRI), and ultrasound.

**BMEN 446 Bio-image Processing: 3 credits.** The course covers principles of signal and image processing including machine learning techniques as applicable to biomedical systems. The course covers how biomedical signals and images are analyzed and converted into helpful information for detection and diagnostic purposes.

**BMEN 422 Machine Learning in Biomedical Engineering: 3 credits.** This course introduces fundamental concepts, methods and applications of machine learning as applied to biomedical problems. Topics to be covered include parametric and non-parametric learning algorithms, support vector machines, neural networks, clustering, clustering and principal components analysis applicable to biomedical systems.

**BMEN 452 Artificial Intelligence in Biomedical Engineering: 3 credits.** The course covers Artificial Intelligence (AI) tools to problems in Biomedical Engineering. AI algorithms can learn patterns from biomedical data sets to provide actionable insights on disease diagnosis or treatment. This course will provide an overview of a wide range of AI and machine-learning tools (e.g. clustering, regression, decision trees, random forests and neural networks), biomedical data sets (imaging, omics, health records) and diseases (cancer, cardiovascular-, infectious- and brain diseases)

**BMEN 450 Electrical Biophysics: 3 credits.** Electrical biophysics of nerve and muscle; electrical conduction in excitable tissue; quantitative models for nerve and muscle including the Hodgkin Huxley equations; biopotential mapping, cardiac electrophysiology and functional electrical stimulation

**BMEN 461 Bioinformatics: 3 credits.** This course introduces theoretical background and a working knowledge of the techniques employed in bioinformatics. Emphasis is placed on biological sequence (DNA, RNA, protein) analysis and its applications.

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

Students in the biomedical engineering majors will take a total of 40 credits of General Education courses. This includes 28 credit hours of general education courses in English, arts and humanities, social and behavioral sciences, and emerging issues. An additional 12 credits in mathematics and physical sciences are required under the General Education



program, which are included as a part of the requirements for the Engineering major. The total number of GenEd credits (40) and the composition of the GenEd courses are the same as the requirement for the current Engineering majors at UMES.

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

The accreditation body of the biomedical engineering program is Engineering Accreditation Commission of ABET. Since the current general engineering program is ABET accredited, we will leverage the faculty expertise and resources to pursue ABET accreditation for the proposed BME program.

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

No other institution or non-collegiate organization is required to offer this degree program.

**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 and 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 Department of Engineering and Aviation Science website: [www.umes.edu/engavi](http://www.umes.edu/engavi). Information pertaining to the availability of academic/student support services, financial aid resources and tuition payment policies can be found on the webpages of the UMES Office of Admissions and the Office of Financial Aid.

**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.**

The program will be advertised alongside other academic graduate programs within the School of Business and Technology of UMES. Proper venues include Public Radio WESM 91.3, and social media such as UMES Facebook page, the University Key, as well as UMES alumni association, and other professional societies. The Department has a tradition of strong outreach program. For example, the Department has hosted in the past three years the “National Engineer’s Week” (in the month of February each year) celebration for high schools from the local counties, such as Wicomico County, Somerset County, etc. Faculty with different disciplines in engineering developed hands-on activities to enable high schools for have firsthand exposure to different engineering disciplines. We will continue this engagement as an effort of advertising, recruiting and promoting engineering education.

## H. Adequacy of Articulation

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

This is a new program to be established at UMES home campus. UMES has existing articulation agreements with community colleges in the state, such as Wor-Wic Community College, and high schools. We will leverage the existing partnerships to develop, when appropriate, new articulation agreements with high schools in the local counties and community colleges for the proposed BME program.

## I. Adequacy of Faculty Resources (as outlined in COMAR 13B.02.03.11).

### 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.**

Four (4) new faculty lines have been allocated to support the proposed BME degree program by the HBCU settlement fund. Furthermore, the existing faculty in the engineering program will also be able to provide needed expertise to support partially the teaching of courses when necessary. In addition, there are seven (7) full-time engineering faculty qualified to teach the ten (10) courses cross-listed in the proposed BME curriculum and the existing general engineering curriculum.

#### **Existing seven (7) faculty are listed below:**

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

**Dr. Ibibia K. Dabipi, Professor.** 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 technical staff with primary research focus in communications and networks.

**Dr. Payam Matin, Professor.** 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, and sheet metal forming, drone design, etc.

**Abhijit Nagchaudhuri, Professor.** He received 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.** 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.** He received his Ph.D. in Electrical Engineering from the University of Nevada, Las Vegas. His primary research area is in computer networks, microprocessor and microcomputers, embedded system design, etc.

**Dr. Lanju Mei, Assistant Professor.** She received her Ph.D. degree in Aerospace and Mechanical Engineering from Old Dominion University. Her primary research interests include MEMS sensor, additive manufacturing, computational fluid dynamics.

**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**
- b) The learning management system**

**(a) and (b):** Faculty support for the development and instruction of courses is provided by the Faculty Development Center of UMES. The department also supports faculty professional development for attending conferences such as ASEE (American Society of Engineering Education) for pedagogy training in engineering education, as well as ABET Symposium for continuous improvement.

- d) Evidenced-based best practices for distance education, if distance education is offered.**

Not applicable.

**J. Adequacy of Library Resources** (as outlined in COMAR 13B.02.03.12).

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

The University assures that institutional library resources meet the new program 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 Explore, the technical papers could be accessed through the Inter-Library Loan (ILL) services.

**K. Adequacy of Physical Facilities, Infrastructure and Instructional Equipment** (as outlined in COMAR 13B.02.03.13)

- 1. Provide an assurance 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, and Embedded System Lab, Communications Lab, Microwave Chamber, CAD/VLSI Lab, High Bay Area, and Multiple Computer Labs, etc.

These labs can support majority of the activities in the new courses and research activities. A complete list of engineering labs with brief descriptions is shown by the link:

<https://www.umes.edu/Engineering/DynContent/Laboratories/>

All engineering faculty and staff have individual offices that will facilitate student advising, office hours, etc. Sufficient classrooms are available also in the same building, which make it very convenient for students to take classes and conduct laboratory experiments. To support the proposed BME program, two new engineering teaching labs on UMES campus are to be developed, including acquiring educational packet, data acquisition systems for data measurement on cells and living systems, and data analysis software. The two labs are (1) Bioinstrumentation Lab, and (2) Biomedical Engineering Lab. Both labs are BSL (biosafety level) Level 1 labs. They follow basic safety procedures, called Standard Microbiological Practices and require no special equipment or design features. BSL-1 are common to biomedical engineering programs in the country. A good example of a typical biomedical engineering teaching lab is shown in the picture (for example, BME Teaching Lab at U.



Vermont).

To develop the two teaching labs for the BME program, there are two options. The first option is retrofit the existing lab space, for example, Room 2051 in the Engineering and Aviation Complex to become a Biomedical Engineering teaching lab. The second option is to share with other academic units BSL-1 level labs in other buildings on campus in the beginning of the program.

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** (as outlined in COMAR 13B.02.03.14)

- 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 <sup>1</sup>	\$26,532	\$0.00	\$0.00	\$0.00	\$0.00
2. Tuition/Fee Revenue <sup>2</sup> (c+g below)	\$139,068	\$289,080	\$411,730	\$548,064	\$684,396
a. # FT Students	15	30	45	60	75
b. # Annual Tuition/Fee Rate	\$8,724	\$8,724	\$8,724	\$8,724	\$8,724
c. Annual / Full Time Revenue (a x b)	\$130,860	\$261,720	\$392,580	\$523,440	\$654,300
d. # PT Students	3	5	7	9	11
e. Credit Hour Rate	\$228	\$228	\$228	\$228	\$228
f. Annual Credit Hours	12	12	12	12	12
g. Total Part Time Revenue (d x e x f)	\$8,208	\$13,680	\$19,150	\$24,624	\$30,096
3. Grants, Contracts & Other External Sources <sup>3</sup>	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
4. Other Sources	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
<b>TOTAL (Add 1 - 4)</b>	<b>\$165,600</b>	<b>\$289,080</b>	<b>\$411,730</b>	<b>\$548,064</b>	<b>\$684,396</b>

**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)	105,600	211,200	316,800	422,400	422,400
a. # FTE	1	2	3	4	4
b. Total Salary	80,000	160,000	240,000	320,000	320,000
c. Total Benefits	25,600	51,200	76,800	102,400	102,400
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	0	0	0	0
5. Library	0	0	0	0	0
6. New or Renovated Space	0	0	0	0	0
7. Other Expenses	10,000	10,000	10,000	10,000	0
TOTAL (Add 1 - 7)	165,600	221,200	326,800	432,400	422,400

### Narrative Rationale for Table 1: Resources

1. Reallocated Funds  
No funds will be reallocated from existing programs beyond the first year.
2. Tuition and Fee Revenue  
We assumed that tuition and fees will remain unchanged for the next five years. The annual in-state tuition rate is \$8724 for full time students. For part-time students, the credit hour rate is \$228/credit. The two values were used in calculating the revenue for full time students and 6 credits per semester (i.e., 12 credit per 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)  
**Four (4) new full-time tenure-track faculty members with terminal degree in biomedical engineering or a closely related field** are required to support the proposed Bachelor of Science in Biomedical Engineering Program. Each year, one new faculty will be hired to deliver instruction and develop labs. This process will continue for four years to recruit four new faculty members. The rate of fringe benefits is 32% per year for full time faculty.
2. Support Staff (# FTE, Salary and Benefits)  
There will be no need for additional administrative staff. The existing department and school administrative staff will be sufficient to run the program.
3. Equipment  
\$50,000 is requested for acquiring educational packet, equipment, and supplies for developing two labs (1) Biomedical Engineering Lab and (2) Bioinstrumentation Lab for the purpose of enabling data measurement on living systems.
4. Library  
Minimal funds are needed to purchase additional engineering textbook.
5. New and/or Renovated Space  
Not needed

6. Other Expenses  
\$10,000 Startup Package for each new hire at the rate of \$10,000 per person. A total of \$40,000 is requested. The startup package is to support new faculty, especially at the assistant professor level, for professional development, including developing proposals for grant and contracts, travel and supplies for specialized engineering labs.

**M. Adequacy of Provisions for Evaluation of Program** (as outlined in COMAR 13B.02.03.15).

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 portfolio 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, school wide and department service. In order to receive high evaluation, a faculty member must demonstrate effective teaching, active scholarly activities and publication, etc. There is also a provision for administration to set out an improvement plan for faculty members who have not done well in the area of teaching. Tenured faculty will undergo five-year post-tenure review.

Periodic academic program review takes place in a cycle of every five years. 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.

Program accreditation comprehensive review takes place every six years per ABET criteria. The assessment, evaluation, and continuous improvement are integral part of faculty teaching and performance evaluation.



**N. Consistency with the State’s Minority Student Achievement Goals (as outlined in COMAR 13B.02.03.05).**

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

UMES 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 student population is 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 proposed B.S. degree program in biomedical engineering.

**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 has no relationship to low productivity programs.

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

Not applicable. The proposed program is not a distance education program.



**BOARD OF REGENTS**  
 SUMMARY OF ITEM FOR ACTION,  
 INFORMATION, OR DISCUSSION

**TOPIC:** University of Maryland Eastern Shore: Bachelor of Science in Fashion Merchandising and Design

**COMMITTEE:** Education Policy and Student Life

**DATE OF COMMITTEE MEETING:** Tuesday, November 15, 2022

**SUMMARY:** The University of Maryland Eastern Shore (UMES) is pleased to present a proposal for the creation of a Bachelor of Science in Fashion Merchandising and Design (FMDS). Programs within the dynamic and highly technological field of apparel and textiles must continually improve to ensure graduates are prepared for the evolving job market locally, nationally, and globally. This new program is directly linked to the UMES mission to ensure graduates are better prepared to address challenges in a global knowledge-based economy. Creating the stand-alone FMDS program fits well with UMES’s strategic goals. The new academic program will be unique to the University of Maryland System and the Eastern Shore regions of Maryland and Virginia.

The new B.S. degree will provide professional training in FMDS, qualifying graduates for employment as entry-level fashion designers, merchandisers, and retailers. Students will be prepared for many positions that bridge fashion design, merchandising, and retailing. The proposed upgrade would bring the fashion program at UMES into synch with leading nationwide programs. It would improve student competencies necessary for employability by keeping them abreast of current trends and continually improving their research efforts. Students enrolled in the B.S. in Human Ecology with a concentration in fashion merchandising will be able to enroll in the new degree program. The new degree program will also serve prospective students who wish to pursue the same concentration.

**ALTERNATIVE(S):** The Regents may not approve the program or may request further information.

**FISCAL IMPACT:** No additional funds are required. The programs can be supported by the projected tuition and fees revenue.

**CHANCELLOR’S RECOMMENDATION:** That the Education Policy and Student Life Committee recommend that the Board of Regents approve the proposal from University of Maryland Eastern Shore to offer the Bachelor of Science (B.S.) in Fashion Merchandising and Design.

COMMITTEE RECOMMENDATION: DATE: November 15, 2022

BOARD ACTION: DATE:

SUBMITTED BY: Joann A. Boughman 301-445-1992 jboughman@usmd.edu



UNIVERSITY OF MARYLAND EASTERN SHORE  
*Office of the President*

October 14, 2022

Jay A. Perman, MD  
Chancellor, University System of Maryland  
701 E. Pratt St.  
Baltimore, MD 21202

Dear Dr. Perman,

**RE: New Program Proposal**

The University of Maryland Eastern Shore hereby submits a new program proposal to establish a B.S. in Fashion Merchandising and Design.

The Department of Human Ecology currently offers a B.S. degree in Human Ecology with several concentrations, including Fashion Merchandising. The Fashion Merchandising concentration has existed for over 40 years and has consistently had the highest enrollment in the department.

The proposed stand-alone Fashion Merchandising and Design (FMDS) B.S. degree will expand the current program's scope by establishing two concentrations: Fashion merchandising and fashion design and will bring the UMES program into synch with leading nationwide programs. It would improve student competencies necessary for employability by keeping them abreast of current trends in the fashion industry. The program will help provide a pipeline of qualified individuals to meet the continuous demand for professionals with diverse fashion-related skills and knowledge.

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

I will highly appreciate your favorable consideration of our proposal.

Sincerely,

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

Copy: Dr. Rondall Allen, Provost and Vice President for Academic Affairs  
Dr. Moses T. Kairo, Dean, School of Agricultural and Natural Sciences  
Dr. Grace Namwamba, Chair, Department of Human Ecology

**UNIVERSITY SYSTEM OF MARYLAND INSTITUTION PROPOSAL FOR**

- New Instructional Program
- Substantial Expansion/Major Modification
- Cooperative Degree Program
- Within Existing Resources, or
- Requiring New Resources

**University of Maryland Eastern Shore**

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Institution Submitting Proposal

**Fashion Merchandising and Design**

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Title of Proposed Program

**Bachelor of Science**

**Fall 2023**

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Award to be Offered

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Projected Implementation Date

1303

19.0901

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Proposed HEGIS Code

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Proposed CIP Code

Department of Human Ecology

Dr. Grace Wasike Namwamba

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Department in which program will be located

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Department Contact

410-651-6055

gnamwamba@umes.edu

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Contact Phone Number

---

Contact E-Mail Address



10-15-22

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Signature of President or Designee

---

Date



**DIVISION of ACADEMIC AFFAIRS**  
Office of the Provost & Vice President

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**Bachelor of Science (B.S.) in Fashion Merchandising and Design**

**A. Centrality to Institutional Mission 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.**

**Program Description:** Fashion Merchandising is currently offered in the Human Ecology Department as a concentration under the B.S. in Human Ecology. The current program, which has existed since the 1980s, is designed to prepare students for entry-level management positions in the broad field of fashion merchandising, with an emphasis on the retail process of products and services. This proposal seeks to establish a stand-alone Fashion Merchandising and Design (FMDS) degree, which will expand the program's scope by establishing two concentrations: fashion merchandising and fashion design. Fashion merchandising has consistently had the highest enrollment and graduation rate in the Department and has excellent potential to sustain a stand-alone degree program. The current content in the concentration has been limited to the business side of fashion. The growth of digital technologies in fashion design and the expressed desire by students to pursue more design content led to the strategic decision to expand the scope of the current program. A stand-alone program would increase the name recognition of the major and open up the program to more students wishing to pursue the creative side of fashion. The new degree program is designed to leverage existing resources, faculty expertise, and new teaching spaces available to the Department of Human Ecology.

**Relation to Institution's Approved Mission:** This new academic program will be unique to the University of Maryland System and the Eastern Shore regions of Maryland and Virginia. In addition, the launch of this new academic program will dramatically improve student learning opportunities and preparedness for work in the global fashion industry, both nationally and internationally. This new program is directly linked to the University of Maryland Eastern Shore (UMES) mission to ensure graduates are better prepared to address challenges in a global knowledge-based economy.

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

The creation of this stand-alone FMDS program fits well with UMES's strategic goals. The new academic program will be unique to the University of Maryland System and the Eastern Shore regions of Maryland and Virginia. In addition, the launch of this new

academic program will dramatically improve student learning opportunities and preparedness for work in the global fashion industry, both nationally and internationally.

This proposal is directly linked to the University of Maryland Eastern Shore (UMES) 2020 Strategic Goals for meeting the educational needs of the State of Maryland with high-quality and innovative programming. The proposal of this new program supports the following sub-goals:

- 3.1 Increase innovation in academic programs and delivery methods
- 3.2 Align academic programs, educational centers, enterprises, and co-curricular activities with workforce development needs
- 6.1 Create signature academic programs to prepare students for careers nationally and internationally

Hence, the new FMDS program aligns with university goals by enhancing and strengthening an academic unit by creating a new degree program. Creating a stand-alone FMDS program fits well with UMES's strategic goals.

**3. Provide a brief narrative of how the proposed program will be adequately funded for at least the first five years of the program implementation.**

UMES will provide the proposed program with adequate resources, facilities, and faculty, in the same manner, it currently has for its academic programs in the Department of Human Ecology. We have already been approved to hire an additional fashion faculty member. In addition, Fashion Merchandising faculty members have submitted a USDA Capacity Building grant to provide additional financial resources to support the proposed program.

**4. Provide description of the institution's commitment to:**

- a) Ongoing administrative, financial, and technical support of the proposed program**
- b) Continuation of the program for a period of time sufficient to allow enrolled students to complete the program.**

UMES is committed to supporting this program with sufficient time for enrolled students to complete the Bachelor's degree in Fashion Merchandising and Design. The program was proposed after a lengthy strategic process by the entire Department and with support from the Dean and Provost. The University has provided the needed resources to hire needed tenure-track faculty to teach in 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**

The dynamic and highly technological field of apparel and textiles must continually improve programs to ensure graduates are prepared for the job market locally, nationally, and globally. Thus, the new degree program seeks to expand the fashion program offered in the Human Ecology Department by establishing a new Bachelor's degree in Fashion Merchandising and Design (FMDS).

Developing the FMDS degree program with current, industry-relevant hands-on, computer-aided design and product development applications will provide students with experience in creating solutions to real-world business problems. This new B.S. degree will provide professional training in FMDS, qualifying graduates for employment as entry-level fashion designers, merchandisers, and retailers. Thus, the new degree addresses the continuous demand from the fashion industry for well-trained employees and the demand of students to acquire diverse fashion-related skill sets. In addition, this proposed degree curriculum will expose students to modern fashion design software and equipment, which they will utilize to create original designs and fashion portfolios during their coursework. Students will be prepared for many positions that bridge fashion design, merchandising, and retailing.

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

The proposed project addresses a severe need facing the Human Ecology Department at UMES. Program enhancement is necessary to bring the Fashion program at UMES to parallel with leading programs in the nation. Major concerns include the need to improve competencies necessary for employability and to enhance enrollment. These factors make it imperative for UMES to keep abreast of current trends and continually improve educational programs and research efforts. In-house, state-of-the-art equipment is essential to provide an experience pertinent to current industry best practices. Further, the new program will advance educational equity because more African Americans will be trained to take management positions in the textiles, apparel, and retail industries. In addition, the proposed program will provide qualified workers and leaders in many textiles, apparel, and retailing sectors and contribute to economic development.

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

The new Fashion Merchandising and Design (FMDS) Program will assist UMES in retaining and better preparing students for work in the creative economy, which comprises the apparel industry and retailing. It will also help us attract returning students for career changes and stimulate new students to seek degrees in FMDS. The students will be taught standard industry use of fashion design equipment, software, hardware, and product development methods. In addition to regular classroom instruction, students will have an opportunity to develop original fashion designs, test their products, and simulate real-life business scenarios. Students graduating with a B.S. in Fashion Merchandising and Design will be better prepared to work in various fashion apparel and retailing industries in design, merchandising, product development, sourcing, and management. Establishing the new Bachelor's degree in FMDS will have far-reaching positive impacts on the academic and research program. The new program will significantly enhance the Department's capacity to attract and retain students.

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

The proposed FMDS degree program aligns well 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 FMDS degree program is designed to prepare highly trained graduates to work in fashion design and merchandising companies. The proposed FMDS degree program will provide equitable access and quality education to all Maryland residents, including those with disadvantaged backgrounds, to develop vibrant and stable textiles, fashion merchandising, and design workforce.

**Success – Promote and implement practices and policies that will ensure student success.**

The practices and policies concerning the proposed FMDS degree program align with all existing policies at the University, ensuring student success. The proposed degree program provides a focused and efficient pathway to degree completion by providing a carefully developed curriculum. The Department of Human Ecology has a well-established academic advising system that helps students progress through the degree program on time. The course offering sequence is planned to promote timely degree completion. An adequate number of faculty is available to support advising and teaching to ensure student graduation and successful job placement.

Career readiness is integral in the proposed degree program. The Department takes advantage of the full range of services offered by the University Career & Professional Development Center, such as resume writing seminars, career assessments, and employability skills training.



The curriculum is designed to promote career readiness. Students will take several core courses to help them acquire and use knowledge and skills to increase their individual and professional capacity. Students will engage in portfolio development, self-assessment, research proposal development, and other experiential learning activities that will make them more competitive in their careers.

Faculty are engaged in mentoring and assisting students in locating job opportunities. All students in the new program will be required to complete a 200-hour internship in the fashion industry. Established partnerships with industry will further facilitate the placement of students. The G.A.P. Corporation funded a career mentoring program for majors in the fashion merchandising concentration, which has led to the placement of five graduates in management trainee programs of major corporations. These partnerships will continue to support the stand-alone degree program in fashion merchandising and design.

Faculty support for professional development is available. Examples of recent professional development of faculty include travel to conferences and training on new software and hardware to keep up with the trends in the fashion industry.

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

Specifically, the proposed FMDS 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 "Economic Growth and Vitality" goal, which is centered on supporting a knowledge-based economy through increased education and training. It ensures that Historically Black Institutions are "competitive, both in terms of program and infrastructure", with Maryland's other state institutions.

The proposed FMDS degree program will help enhance and expand current partnerships with the fashion industry. The current fashion merchandising concentration has partnerships with several companies, such as Lectra Systems, which provides support through textile and design software donations. The G.A.P. Corporation funds a career mentorship program. TC2 donates 3D Body Scanning software for the CAD lab.

The new FMDS degree will offer an innovative curriculum supported by state-of-the-art laboratories. These include a Computer-Aided-Design lab equipped with industry-standard software, a 3D body scanner, digital textile printing equipment, and a textile testing laboratory.

The proposed degree program will ultimately prepare highly qualified textile scientists, apparel designers, interior designers, retail apparel managers, merchandisers, and extension specialists. These professionals will contribute to Maryland's economic growth and vitality by providing them with new knowledge and skillsets in emerging technologies to 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: midlevel management) for graduates of the proposed program.**

The new FMDS program will help undergraduate students gain competency in fashion merchandising, design, and apparel product development and management. In addition, they will be trained using the latest computer technologies and relevant textiles and apparel industry applications. The educational preparation will ensure that graduates will be capable global fashion industry employees, managers, and entrepreneurs. Graduates from the proposed FMDS program will contribute to the economy in many employment sectors, including textile scientists, interior designers, apparel retail managers, merchandisers, and extension specialists.

**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 Occupational Outlook Handbook, published by the U.S. Department of Labor Statistics, indicates that fashion buying, and fashion design jobs open at a rate of approximately 66,000 per year. In addition, no category specifically addressed retail or apparel manufacturing sales and management. However, Linked-in showed 166,000 retail management jobs and 586,000 merchandising jobs currently available in the U.S.

**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 five years.**

According to the Occupational Outlook Handbook, about 2,500 openings for fashion designers are projected each year, on average, over the decade. The median annual wage for fashion designers was \$75,810 in May 2020. The Maryland Department of Labor provides data for the Maryland Occupational Projections – 2016-2026

<https://www.dlir.state.md.us/lmi/wages/page0018.htm>

**4. Provide data showing the current and projected supply of prospective graduates.**

	Undergraduate Applicants to UMES	Total Undergraduates Admitted to UMES	Enrolled in Human Ecology - fashion merchandising concentration	Graduated in Human Ecology - fashion merchandising concentration
2014-2015	4807	3045	93	15
2015-2016	7735	3944	101	17
2016-2017	11215	4366	92	16
2017-2018	8415	3304	65	14
2018-2019	5387	2954	56	6
2019-2020	4284	2784	53	20
2020-2021	8775	5466	41	8

**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.**

While there are universities in Maryland that have either fashion merchandising or fashion design programs, there is no university in Maryland that offers a combined fashion merchandising and design Bachelor's degree. The following table illustrates the similarities and differences between the proposed program and the other programs in Maryland:

	Similarities	Differences
Stevenson University		<ul style="list-style-type: none"> <li>Not located on the Eastern Shore of Maryland</li> <li>Not an HBCU</li> <li>Offers two separate Bachelor's degrees, one in Fashion Design and another in a Fashion Merchandising</li> </ul>
Bowie State University	HBCU	<ul style="list-style-type: none"> <li>Not located on the Eastern Shore of Maryland</li> <li>Offers a Bachelors in Fashion Design with no Merchandising program</li> </ul>
Morgan State University	HBCU	<ul style="list-style-type: none"> <li>Not located on the Eastern Shore of Maryland</li> <li>Offers a Bachelors in Family and Consumer Sciences with a concentration in Fashion Merchandising with no Design program</li> </ul>
Howard University	HBCU	<ul style="list-style-type: none"> <li>Not located on the Eastern Shore of Maryland. Only</li> <li>Offers a Bachelors of Fine Arts in Design with a concentration in Fashion Design with no Merchandising program</li> </ul>

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

FMDS careers provide good starting pay and have good career growth prospects. According to the Occupational Outlook Handbook (U.S. Dept. of Labor, 2020), the median annual wage for fashion designers was \$75,810 and \$66,690 for buyers and purchasing agents in May 2020. In addition, no other program in Maryland offers a Fashion Merchandising and Design degree. This rigorous curriculum, which focuses on fashion business, design, and product development, prepares students for a greater variety of professional opportunities than a degree focusing exclusively on design.

### **E. Relevance to High-demand Programs at Historically Black Institutions (H.B.I.'s):**

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

UMES is a Historically Black Institution and would benefit from having a new undergraduate major such as fashion merchandising and design. Unfortunately, there is no H.B.I.'s in Maryland with this program and degree.

### **F. Relevance to the identity of Historically Black Institutions (H.B.I.'s):**

#### **1. Discuss the program's potential impact on the uniqueness and institutional identities and missions of H.B.I.'s.**

There is no H.B.I.'s in Maryland with this program and degree. This program will be offered here on the Eastern Shore and contribute to the uniqueness and the mission of H.B.I.'s.

### **G. Adequacy of Curriculum Design, Program Modality, and Related Learning Outcomes:**

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

The strategic component of implementing the stand-alone degree in FMDS has been completed. Human Ecology faculty approved this process during the January 2021 annual retreat. Review of Fashion Merchandising Curriculum and program of study to determine the new program's structure. Three Fashion Merchandising faculty members worked together to determine the program's course content. The faculty who will oversee the program include:

**Dr. Grace Wasike Namwamba**, Professor and Chair of the Department of Human Ecology at UMES. She has a Ph.D. in Family and Consumer Sciences Education. She researches digital textile printing and 3D prototyping of garments and has experience with various design software packages.

**Dr. John Jacob**, Associate Professor in the Department of Human Ecology. Dr. Jacob has a background in art, fashion design, and fashion merchandising. He teaches fashion merchandising and textiles courses in the Department. In addition, Dr. Jacob has expertise in computer-aided design and related technologies and will propose two new courses in fashion design.

**Dr. Bridgett Clinton-Scott**, Associate Professor in the Department of Human Ecology at UMES. She teaches a wide range of fashion merchandising, emphasizing visual merchandising and product development.

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

This new degree in fashion merchandising and design aims to graduate well-prepared individuals to assume employment and leadership positions and possibly pursue entrepreneurship in fashion retailing, design, and related fields.

**Program Outcomes for the Proposed Major:**

- Demonstrate foundation knowledge in Fashion Retailing, Merchandising, and Design
- Demonstrate problem-solving, critical thinking, oral and written communication, and leadership skills.
- Integrate theory, discovery, and technology into practice.

**Merchandising Concentration Learning Outcomes:**

- Technology Competency: Students will use fashion design equipment, hardware, and software services to manage and deliver information and products.
- Critical analysis and reasoning: Students will demonstrate in writing and speaking to use of logic and balanced thinking; formulations of solutions to problems by objective consideration of all possible alternatives; demonstrate recognition of the importance of profitability, ethics, social justice, and sustainability.
- Information Literacy: Students will identify, retrieve, evaluate, and use information effectively and efficiently (including social, legal, and economic issues; students acquire skills necessary to succeed in academic and professional areas).

**Design Concentration Learning Outcomes:**

- Demonstrate ability to engage in, and document the creative problem-solving processes associated with fashion design for target markets.
- Ability to clearly communicate design ideas both visually and verbally
- Ability to translate 2-D sketches into 3-D Garments
- Demonstrate competency in computer-aided and hands-on fashion drawing and patternmaking modalities
- Demonstrate skill in garment construction techniques
- Create a senior capsule collection suitable for portfolio inclusion
- Construct a professional portfolio in hard-copy and digital formats that demonstrates ability in fashion sketching, patternmaking modalities, and garment construction.

**3. Explain how the institution will: a) provide assessment of student achievement of learning outcomes in the program; b) document student achievement of learning outcomes in the program**

Currently, faculty assess student-learning outcomes annually. The assessment process will continue with the transition to the FMDS program. Particular emphasis is placed on internship and capstone courses to determine how well the academic program has prepared students for entry-level positions in the fashion industry. Additionally, periodic program review ensures that the program meets current standards.

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

This program will be offered as an undergraduate degree consisting of 120 credits, with 41 general education credits, 8 Human Ecology credits, 62 program core credits, and nine supportive area credits. Most of these core courses are three credits in the 300-400 level. The courses and course descriptions are listed below for the 62 program core credits offered in the new program.

**Course Descriptions**

**HUEC 101 Principles of Art & Design**

This course is designed to introduce students to the basic principles and elements of art and design through the application of principles and elements in a variety of studio projects. Two lecture hours and one lab session.

**HUEC 399 Pre-internship Seminar**

Pre-internship Seminar is designed to prepare students for internships in the field of family and consumer sciences/human ecology. This course consists of one lecture hour. Prerequisite: Junior Level Standing. OPEN TO MAJORS ONLY.

**HUEC 400 Internship**

Internship is a supervised work experience in an approved work setting planned cooperatively with business establishments, agencies, or centers. Two hundred clock hours of field experience are required. Prerequisite: HUEC 399. OPEN TO MAJORS ONLY

**HUEC 409 Post-internship Seminar**

Post-Internship Seminar provides the opportunity for students to reflect upon and present an overview of their work experience in their discipline. The course is one hour. Prerequisites: Senior Level Standing, HUEC 400, or permission of the instructor. OPEN TO MAJORS ONLY.

**HUEC 490 Consumer Motivation**

This course offers an interdisciplinary approach to the study of consumer motivation and behavior in the marketplace, with emphasis on the functioning of the market system and models of consumer behavior. Prerequisites: SOCI 101, PSYC 200. OPEN TO MAJORS AND MINORS ONLY.

### **FMCT 141 – Introduction to the Fashion Industry**

Introduction to the Fashion Industry provides an overview of the fashion industry, including the organization and operation of the numerous facets of the textile, apparel, home furnishings, and cosmetics industries, product development, the impact of technology, and career opportunities. Forty clock hours of work experience in a retail or related setting is also required. This course consists of three hours of lecture

### **FMCT 203 – Introduction to Fashion Forecasting**

This course will introduce students to trend research, presentation, and forecasting principles needed to work in the merchandising environment to be examined through influences on the acceptance and rejection of apparel and textile products. Students will develop the basic technological skills needed to forecast and work in the merchandising environment. Prerequisites: FMCT 141.

### **FMCT 205 Fashion Styling & Coordination**

This course will engage students in developing the skills and knowledge necessary for a career in fashion styling. Students will gain an understanding of print styling for magazines, wardrobe styling for film and television, personal styling, and other areas of styling that will enhance students' professional skill set. In addition, students will establish their own styling portfolio. This course consists of three hours of combined lecture and laboratory.

Prerequisite: FMCT 203

### **FMCT 300 Historic Costumes**

This course is the study of historic costumes and design reflecting the social, economic, and political environment of the past and fashion cycles relating historic costume/designs to current fashions. The course consists of three hours of combined lecture and laboratory.

### **FMCT 307 Computer-Aided Design for Fashion Merchandising & Design**

This course will introduce students to various software packages and operation of computer-related equipment for applications in all areas of apparel and textiles. Students will develop color stories and textile prints for design merchandising presentations, including digital presentation and portfolio development. Prerequisites: FMCT 203, Open to Majors and Minors only.

### **FMCT 321 Fashion Design & Illustration**

Fashion Design and Illustration provides an introduction to drawing fashion figures, rendering various textiles, and illustrating apparel and accessories utilizing an array of media. The course consists of three hours of combined lecture and laboratory.

### **FMCT 341 Fashion Buying & Merchandising**

This course provides practical application of buying practices and procedures, merchandise planning, controlling, budgeting, merchandise assortment planning, and managing inventory. Prerequisite: FMCT 141, MATH 102 or higher. Co-requisite: MKTG 308. OPEN TO MAJORS AND MINORS ONLY.

### **FMCT 342 Advertising & Promotion**

Advertising & Promotion introduces students to both the theoretical and practical aspects of the principles and techniques used in promoting fashion goods and services to the consumer. Promotional strategies and creative concepts for promotional campaigns are developed by the students for local businesses. The course consists of three hours of combined lecture and laboratory. Prerequisites: FMCT 141. Junior Standing. OPEN TO MAJORS AND MINORS ONLY.

### **FMCT 361 Apparel Construction & Evaluation**

The main focus of this course is to provide an introduction to various sewing techniques and to demonstrate the use of commercial patterns. A variety of garment components, including alterations, is identified and classified. An evaluation of ready-to-wear apparel will be fully conducted. One lecture and two laboratories. Advertising & Promotion introduces students to both the theoretical and practical aspects of the principles and techniques used in promoting fashion goods and services to the consumer. Promotional strategies and creative concepts for promotional campaigns are developed by the students for local businesses. The course consists of three hours of combined lecture and laboratory. Prerequisites: FMCT 141. Junior Standing. OPEN TO MAJORS AND MINORS ONLY.

### **FMCT 381 Textiles**

This is a fundamental course that covers information on fibers, yarns, fabric construction, dyeing, printing, and finishing of textiles: two lectures and one laboratory. Advertising & Promotion introduces students to both the theoretical and practical aspects of the principles and techniques used in promoting fashion goods and services to the consumer. Promotional strategies and creative concepts for promotional campaigns are developed by the students for local businesses. The course consists of three hours of combined lecture and laboratory. Prerequisites: FMCT 141. Junior Standing. OPEN TO MAJORS AND MINORS ONLY.

### **FMCT 382 Textiles II**

This course requires an understanding of basic textiles principles. Students enrolled in this course are required to measure the physical properties of fabrics, compile and analyze data, and relate the results to the performance of fabrics and garments. One lecture and two laboratories. Prerequisite: FMCT 381, MATH102 or higher. OPEN TO MAJORS AND MINORS ONLY.

### **FMCT 407 Advanced Computer-Aided Design for Fashion Merchandising & Design**

This course will focus on modern digital technologies in fashion, textiles, and design. Students will be exposed to advanced computer applications such as computer-aided patternmaking, 3D body scanning, 3D virtual prototyping of apparel, and advanced digital textile printing. Students will engage in advanced product development and mass customization of apparel and textile products. Prerequisite: FMCT 307. OPEN TO MAJORS AND MINORS ONLY

### **FMCT 422 Apparel Design: Pattern Drafting & Draping**

Apparel design: pattern drafting, and draping introduces students to basic principles of flat pattern design and draping through the development of the master pattern and its use in



the design and production of marketable apparel. The course consists of one hour of lecture and two hours of laboratory. Prerequisite: FMCT 361.

**FMCT 423 - Advanced Apparel Design and Construction (3 Credits):** This course emphasizes garment design and fit considerations along with advanced garment construction techniques required for successful realization of complexly cut and sewn fashion apparel. Some garments that will be included in the Senior Capsule Collection are produced in this course for those who will take FMCT 425. Prerequisites: FMCT 361

**FMCT 425 – Fashion Design Senior Capstone (3 Credits):** This course is the culmination of the fashion design program of study. Students produce final garments and put final touches on their Fashion Design Capsule Collection. Required portfolio products include an interview-ready printed copy of the fashion design portfolio and a web-based portfolio. Prerequisites: FMCT 423

#### **FMCT 441 Visual Merchandising**

Visual Merchandising is the study of principles and practices of designing and evaluating the various aspects of visual displays. The course involves the creation of window and interior promotional displays and the development of a visual portfolio. The course consists of three hours of combined lecture and laboratory. Prerequisite: FMCT 342. Advertising & Promotion introduces students to both the theoretical and practical aspects of the principles and techniques used in promoting fashion goods and services to the consumer. Promotional strategies and creative concepts for promotional campaigns are developed by the students for local businesses. The course consists of three hours of combined lecture and laboratory. Prerequisites: FMCT 141. OPEN TO MAJORS AND MINORS ONLY.

#### **FMCT 490 Product Development**

Product Development introduces both theoretical and practical aspects of the principles and techniques used in the creation, production, marketing, and distribution of fashion-related products that meet customer needs in the microeconomic and/or global marketplace. Actual prototypes will be created. The course consists of three hours of combined lecture and laboratory.

### **B.S. in FASHION MERCHANDISING AND DESIGN PROGRAM SEQUENCES**

#### **Fashion Merchandising Concentration**

The current fashion merchandising concentration and the Fashion Institute of Technology option currently offered as part of the B.S. in Human Ecology will be unchanged.

#### **Fashion Design Concentration**

Eleven existing courses from Human Ecology's current fashion merchandising program will remain as requirements. Five existing design courses will be added (highlighted in blue), and two new courses will be developed (highlighted in red). The table below indicates the course sequence students will follow to fulfill the academic requirements for the Fashion Design Concentration.

Freshman Year						
First Semester				Second Semester		
Course	Course Title/Area	Credits		Course	Course Title/Area	Credits
ENGL 101	English Composition I	3		ENGL 102	English Composition II	3
FMCT 141	Introduction to the Fashion Industry	3		EXSC 111	Personal Health & Fitness	3
ENVS 101	Environmental Science (AREA III)	3		MATH 109	College Algebra	3
HUEC 100	First-Year Experience	1		BIOL 101	Biology (AREA III)	3
SOCI 101	Intro. To Sociology	3		BIOL 103	Biology Lab (AREA III)	1
PSYC 100	Intro. To Psychology	3		HUEC 101	Principles of Art & Design	3
<b>Total</b>		16		<b>Total</b>		16
Sophomore Year						
First Semester				Second Semester		
Course	Course Title/Area	Credits		Course	Course Title/Area	Credits
ENGL 203	Contemporary Speech	3		HUEC 230	Multicultural Perspectives on Families	3
ACCT 200	College Accounting	3		FMCT 361	Apparel Construction & Evaluation	3
FMCT 203	Intro. To Fashion Forecasting	3		FMCT 300	Historic Costumes	3
FMCT 321	Fashion Design & Illustration	3		FMCT 205	Fashion Styling & Coordination	3
ECON 202	Principles of Economics	3		Literature/Foreign Language	Literature or Foreign Language (AREA I)	3
<b>Total</b>		15		<b>Total</b>		15
Junior Year						
First Semester				Second Semester		
Course	Course Title/Area	Credits		Course	Course Title/Area	Credits
FMCT 341	Fashion Buying & Merchandising	3		FMCT 342	Advertising & Promotion	3
FMCT 381	Textiles	3		MKTG 308	Principles of Marketing	3
FMCT 307	Computer-Aided Design for Fashion Merchandising & Design	3		FMCT 382	Textiles II	3
FMCT 422	Pattern Drafting & Draping	3		HUEC 490	Consumer Motivation	3
				HUEC 399	Pre-internship Seminar	1
HUEC 370	Professional Development	2		ENGL 305	Technical Writing	3
<b>Total</b>		14		<b>Total</b>		16
Summer						
Course	Course Title/Area	Credits				

HUEC 400	Internship	3				
<b>Total</b>		3				
<b>Senior Year</b>						
Course	Course Title/Area	Credits		Course	Course Title/Area	Credits
FMCT 423	Advanced Sewing	3		FMCT 407	Advanced Computer-Aided Design for Fashion Merchandising & Design	3
FMCT 441	Visual Merchandising	3		HUEC 463	Food, Clothing, & Culture	3
HUEC 409	Post-internship Seminar	1		FMCT 425	Senior Capstone: Portfolio & Design	3
MUSI/HIST	Music -or- History (AREA I)	3		FMCT 490	Product Development	3
HUEC 474	Research Methodology	2		<b>Total</b>		12
HUEC 495	Senior Seminar	1				
<b>Total</b>		13		<b>Total Required Credits for Degree: 120</b>		

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

General Education requirements will be met in conjunction with the program requirements and will meet COMAR and UMES policies. Students are required to take a minimum of 40 credits in the General Education sequence, including those in the Arts and Humanities, Social and Behavioral Sciences, Biological and Physical Sciences, Mathematics, English Composition, and Emerging Issues. A semester-by-semester sequence will be provided in the course catalog.

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

There are no required certifications or accreditations for the new fashion merchandising and design degree program.

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

There will be no contracting with other entities.

**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 systems, availability of academic support services and financial aid resources, and costs and payment policies.**

The proposed degree program's curriculum and course-specific information will be posted on the Department of Human Ecology website: [www.umes.edu/he](http://www.umes.edu/he). Information about the availability of academic/student support services, financial aid resources, and tuition payment policies can be found on the UMES Office of Admissions and Recruitment website and the Financial Aid Office of UMES.

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

The University of Maryland Eastern Shore has established an office of Admissions and Recruitment to ensure a supply of students to the University. The Office of Admissions and Recruitment will support the Department and provide linkages to prospective students. The School of Agriculture and Natural has dedicated recruitment and retention staff who works with departments to ensure recruitment and retention. The School also provides funding and personnel for developing promotional materials and online outreach, including social media. The Department of Human Ecology will collaborate to revise its advertising, recruiting, and administration materials to clearly and accurately represent this new degree in Fashion Merchandising and Design. Dr. Jacob is the Chair of the Department's Recruitment Committee and will assume a leadership role in ensuring that these imperatives are realized. In addition, he has the support of his Chair, Dr. Grace Namwamba, and his colleague in Fashion Merchandising and Design, Dr. Bridgett Clinton Scott.

**H. Adequacy of Articulation:**

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

The proposed program does not have articulation partners currently at the Bachelor's level. UMES aims to work with partner institutions to provide a pathway for community college students interested in fashion merchandising and design to a bachelor's degree.

**I. Adequacy of Faculty Resources (as outlined in COMAR 13B.02.03.11): 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 will teach in the proposed program.**

The Department of Human Ecology is in the process of hiring one additional tenure-track faculty member to teach and advise students in the major. Currently, the Human Ecology Department has two full-time faculty members in fashion merchandising and two adjunct faculty with specific expertise in retailing, design, and merchandising. The department chair is also a fashion merchandising faculty member. Department has enough faculty with the required expertise to teach all the courses proposed in the B.S. in fashion merchandising and design program.

**The existing three (3) faculty members are listed below:**

**Dr. Bridgett Clinton-Scott, Associate Professor in Fashion Merchandising.** She received her Doctorate of Management from the University of Maryland Global Campus. She has a Master's in Merchandise Management from Michigan State University. Her primary research area is fashion sustainability, consumer behavior, and creative scholarship in fashion design. She will teach Merchandising and Design Content.

**Dr. John Jacob, Associate Professor in Fashion Merchandising.** He received his Master of Science and a Ph.D. in Clothing and Textiles from Virginia Tech. His research interests include clothing and the social construction of gender, aesthetic movements in fashion history, sustainability, the social construction of ideal body types and body image, and creative scholarship in fashion design. He will teach Merchandising and Design content.

**Dr. Grace Namwamba, Chair and Professor of Fashion Merchandising.** She holds a Master of Education in Home Economics Education from the University of North Carolina Greensboro and a Ph.D. in Family and Consumer Sciences Education from Iowa State University. She is currently Chair of the Department of Human Ecology at UMES. She teaches courses in Apparel & Textiles and Family and Consumer Sciences. Her focus has been digital textile printing and 3D virtual prototyping for apparel products. She will teach courses in textiles.

**New Faculty Member:** The Department will hire a faculty member who will complement and expand the existing faculty expertise to deliver the Fashion Merchandising and Design Program.

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

**a) pedagogy that meets the needs of students and b) the learning management system**

The University of Maryland Eastern Shore Center for Teaching Excellence provides faculty support for the development and instruction of courses.

**c) evidenced-based best practices for distance education if distance education is offered**

Although the proposed program is in-person, faculty use online tools to enhance in-class learning. The Center for Instructional Technology and Online Learning (CITOL) supports

development and instruction. All the faculty members in the fashion merchandising program are certified by CITOL to teach online.

**J. Adequacy of Library Resources: (as outlined in COMAR 13B.02.03.12)**

**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 centrally located in the Academic Oval. It is primarily the intellectual nucleus of the University that houses supportive and supplemental acquisitions in various formats that connect all academic disciplines.

The Family and Consumer Sciences collections are a part of the Library's core collection. In addition, the Family and Consumer Science electronic collection has access to over 70 online databases and over 96,500 eBooks to meet the needs of the students and faculty.

Library instruction sessions are an integral component of the Frederick Douglass Library's agenda to support the research needs of the University's curriculum, its students, faculty, staff, and the Eastern Shore. To support these research needs, library instruction offers classes to provide instruction in information literacy, library orientation, and utilization of digital resources both on and off-campus. A library instruction session can range from an overview of the Library to advanced or subject-specific research assistance.

When the Library does not have the needed resource, Inter-Library Loan and Inter-Campus Loan services are available to process requests from students, faculty, and staff who request to borrow resources the Frederick Douglass Library does not have available in the Library. Inter-Library Loan service allows you to take advantage of the millions of items available at other libraries for use in research. Inter-Campus Loan allows you to request items from other University of Maryland System Libraries.

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

**1. Provide an assurance 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 Department of Human Ecology has the necessary resources to initiate and support the proposed B.S. in Fashion Merchandising and Design. In the past three years, the Department of Human Ecology has made several upgrades to classrooms and laboratories using a combination of State General Funds and grant dollars. The apparel construction lab was upgraded using State funds in 2016, whereby ten industrial sewing machines were purchased to replace home-sewing machines. Through an 1890 Capacity Building grant, the Center was established. The same funds were used to purchase a 3D body scanner and a digital textile printer.

We also used State funds to upgrade scanning equipment to enhance our document digitization process in the main office. In addition, the I.T. department upgraded multi-media presentation equipment in two classrooms as part of a University-wide effort.

Our Department was recently approved for funding from the U.S. Department of Agriculture 1890 Facilities Grant Program for \$687,200. These funds will be used to implement our technology plan, which involves upgrading classrooms and laboratories across the Department.

The Center of Fashion Merchandising and Design Technology (CFMDT) provides students with hands-on experience with industry-standard software such as the Lectra System and the latest in CAD hardware. In addition, students have access to textile testing equipment and an apparel production lab. The Department also has a historic costume collection that features costumes and accessories from the early 1900s to the present day.

The Department has been given additional space in Kiah Hall. The space will be used to establish laboratories and additional faculty offices.

**2. Provide assurance and appropriate evidence that the institution will ensure students are 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.**

Although the proposed program is in-person, faculty and students will have access to resources as follows:

- a) Students enrolled, and faculty will be assigned University emails for communication. The system also provides video conferencing via Google Meets.
- b) Students enrolled and faculty will have access to Canvas, the official Learning Management System. The Center for Instructional Technology and Online Learning (CITOL) provides faculty support for course development and instruction. The Academic Computing Unit will also provide support.

**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 these funds.**

<b>TABLE 1: PROGRAM RESOURCES</b>					
<b>Resource Categories</b>	<b>Year 1</b>	<b>Year 2</b>	<b>Year 3</b>	<b>Year 4</b>	<b>Year 5</b>
1. Reallocated Funds					
2. Tuition/Fee Revenue (c + g below)	294435	333700	374385	416580	531150
a. Number of F/T Students	45	50	55	60	75
b. Annual Tuition/Fee Rate	6543	6674	6807	6943	7082
c. Total F/T Revenue (a x b)	294435	333700	374385	416580	531150
d. Number of P/T Students	0	0	0	0	0
e. Credit Hour Rate	328	328	328	328	328
f. Annual Credit Hour Rate	0	0	0	0	0
g. Total P/T Revenue (d x e x f)	0	0	0	0	0
3. Grants, Contracts & Other External Sources	0	0	0	0	0
4. Other Sources	0	0	0	0	0
<b>TOTAL (Add 1 – 4)</b>	294435	333700	374385	416580	531150

**Resources and Narrative Rationale**

1. Funds will be reallocated from the existing B.S. in Human Ecology – Fashion Merchandising Concentration to fund faculty salaries in the new B.S. in Fashion Merchandising and Design.
2. Tuition/Fee Revenue: Additional funds will be generated from tuition and fees. It is estimated that the initial enrollment of full-time students will be 45 (based on the current enrollment), with a projected increment of five students for years 2 – 5. This projection is consistent with current enrollment trends in the program and the anticipated effects of program awareness. We have also accounted for a modest increase in tuition and fees over the years.
3. Grants, Contracts & Other External Sources: At this point, none is anticipated.
4. Other Sources: No other sources of funding are anticipated at this point.



**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.**

<b>TABLE 2: PROGRAM EXPENDITURES</b>					
<b>Expenditure Categories</b>	<b>Year</b>	<b>Year</b>	<b>Year</b>	<b>Year</b>	<b>Year</b>
	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
1. Faculty (b + c below)	283500	283500	283500	283500	283500
a. Number of FTE	3	3	3	3	3
b. Total Salary	210000	210000	210000	210000	210000
c. Total Benefits	73500	73500	73500	73500	73500
2. Admin. Staff (b + c below)	0	0	0	0	0
a. Number of FTE	0	0	0	0	0
b. Total Salary	0	0	0	0	0
c. Total Benefits	0	0	0	0	0
3. Support Staff (b + c below)	0	0	0	0	0
a. Number of FTE	0	0	0	0	0
b. Total Salary	0	0	0	0	0
c. Total Benefits					
4. Technical Support and Equipment	5000	5000	5000	5000	5000
5. Library	0	0	0	0	0
6. New or Renovated Space	0	0	0	0	0
7. Other Expenses	5000	5000	5000	5000	5000
<b>TOTAL (Add 1 – 7)</b>	<b>293500</b>	<b>293500</b>	<b>293500</b>	<b>293500</b>	<b>293500</b>

**Program Expenditures and Narrative Rationale**

1. Faculty expenses: Three full-time tenure track faculty members will be paid to teach and support the program. The University already funds the three positions under the B.S. in Human Ecology – Fashion Merchandising concentration. Two faculty members are already on staff, and the third is being hired. Additionally, two adjunct faculty members will continue to teach in the new degree program.
2. Administrative Staff: No additional funds will be spent on administrative staff because the current level of support is enough to support the new program.
3. Support Staff: There is no need for support staff for this program.
4. Technical Support and Equipment: Funds for supplies, equipment/technology will be reallocated from the existing Fashion Merchandising concentration.
5. Library: No funds for the Library are requested because the UMES library can support the new program with current resources.
6. New or Renovated Space: The new program does not require new space.
7. Other Expenses: Not other expenses are anticipated for this program.

**M. Adequacy of Provisions of Evaluation of Program: (as outlined by COMAR 13B.02.03.15)**

**1. Discuss procedures for evaluating courses, faculty, and student learning outcomes.**

**Evaluation of Courses:**

The Department of Human Ecology holds annual retreats to set the year's agenda and review the curriculum. During these sessions, faculty from each concentration will review the curriculum and determine if they need to revise, update, change, or add new courses. The departmental curriculum committee will review and take action on the proposed changes, which will be transmitted to the Department Chair and higher levels.

**Evaluation of Faculty:**

At the University of Maryland Eastern Shore, all faculty members are expected to meet their professional and institutional commitments, including teaching, academic advising, and engaging in research and service. Because student involvement in teaching evaluation is considered important, students conduct faculty evaluations at the end of each semester, and the rating and comments are one factor in the final performance rating of the faculty member. The Chair also conducts classroom visits to observe teaching. Factors such as the quality of the syllabus and teaching materials are considered in determining the effectiveness of an instructor.

The Chair conducts faculty evaluation, an annual process that begins with submitting. Following a review of the goals during a meeting with the faculty and Chair, the goals are modified and accepted as deemed appropriate. A final report of the accomplishments of the goals is due in March of each year. Mid-year reviews with faculty are encouraged to ascertain faculty progress or concerns. A final review meeting takes place in April.

**Evaluation of Student Learning Outcomes.**

The Department of Human Ecology uses assessment data to make informed curriculum decisions regarding improving teaching and learning processes. The Department is strongly engaged in the assessment of Student Learning Outcomes. A well-developed assessment plan gathers data to improve student learning at the undergraduate level. The plan will be updated to include the new graduate program. The process will start with the collaborative determination of program learning outcomes (P.L.O.). Then, student learning outcomes will be developed from the P.L.Os.

**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.**

**Assessment of Student Learning Outcomes:**

The Department of Human Ecology at the University of Maryland Eastern Shore is accredited by the American Association of Family and Consumer Sciences. It has

undergone a rigorous review of its processes of assessing student learning outcomes. The Department conducts an assessment of student learning outcomes and faculty evaluations annually. The Department has developed and implemented a comprehensive assessment plan that contains all the components required for this intent. All faculty members in the Department participate in the student learning outcomes assessment process and the faculty evaluation process.

The Department of Human Ecology has identified 3 Program-level Learning Outcomes. The Outcomes were reviewed and agreed upon by all faculty in the Department. The Program Learning Outcomes are:

1. Students will demonstrate foundation knowledge and skills in their program areas (concentrations).
2. Students will demonstrate problem-solving, critical thinking, oral and written communication, and leadership skills.
3. Students will integrate theory, discovery, and technology into practice.

The Department of Human Ecology uses assessment data to make informed curriculum decisions regarding improving teaching and learning processes. The Department is strongly engaged in the assessment of Student Learning Outcomes. We have a well-developed assessment plan and use the data to improve student learning.

#### **Student Retention:**

The University of Maryland Eastern Shore is committed to student retention. The Center for Access and Academic Success (CAAS) provides dedicated advisors for first-year students and works with the Department to ensure adequate academic advising. CAAS also provides support to students at all levels of enrollment. The Department of Human Ecology has a well-established advising process and has developed an advising handbook for faculty advisors. Another important aspect of student retention is ensuring the high quality of the program. Excellent programs will be attained through hiring highly qualified and experienced faculty members. The curriculum will be regularly updated to ensure relevance to current and future trends. The learning environment will be positive and supportive of students. The Department will ensure that all the resources needed are provided in a timely fashion. Student engagement activities will be conducted to increase cohesion and pride in belonging to the program.

#### **Student and Faculty Satisfaction:**

Student satisfaction will be measured using course evaluation and exit interview surveys.

Faculty satisfaction will be measured through the annual evaluation process, including a planning and goal-setting session in the fall, a mid-year review in February, and a final evaluation session at the end of the spring semester. A Campus climate survey will also help in assessing faculty satisfaction. Additionally, informal feedback from faculty will be used to determine faculty and student satisfaction, and adjustments will be made accordingly.

### **Cost-Effectiveness**

The BS in Fashion Merchandising and Design is based on the existing B.S. in Human Ecology, Fashion Merchandising concentration. All the resources needed to implement the program are already in place. The visibility of the new program and the addition of the design component will attract more students and ensure sustainability and cost-effectiveness. Based on current enrollment data from the B.S. in Human Ecology – Fashion Merchandising concentration, the new degree will produce enough revenue to self-sustain.

### **N. Consistency with the State's Minority Achievement Goals: (as outlined by COMAR 13B.02.03.05).**

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

Our programs attract a diverse set of students, with the majority of the student population being African American, multiethnic, and multicultural. Diversity is one of the core values of the University of Maryland Eastern Shore (UMES), and it is reflected in its policies, creating an educational environment that leverages the diverse characteristics of faculty, students, and staff. Thus, the UMES mission supports the Maryland State plan to develop a highly qualified workforce for the economic growth and vitality of the State (<https://wwwcp.umes.edu/about/mission/>).

### **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.**

N/A

### **P. Adequacy of Distance Education Programs: (as outlined by COMAR 13B.02.03.22)**

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

At this point, the intention is to offer this program face-to-face.

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

N/A



**BOARD OF REGENTS**  
 SUMMARY OF ITEM FOR ACTION,  
 INFORMATION, OR DISCUSSION

**TOPIC:** University of Maryland Eastern Shore: Master of Science in Human Ecology

**COMMITTEE:** Education Policy and Student Life

**DATE OF COMMITTEE MEETING:** Tuesday, November 15, 2022

**SUMMARY:** The University of Maryland Eastern Shore (UMES) is pleased to present a proposal for a new Master of Science degree in Human Ecology (MSHE). This new program supports the UMES mission by ensuring the degree programs meet the workforce needs of the Eastern Shore, the state, and nation by leveraging the existing Human Ecology faculty expertise in the various concentration areas. Maryland is currently experiencing a shortage of early childhood education teachers ready to fill positions opened by the planned expansion of public preschool programs and new dietician requirements. In addition, beginning in January 2024, dietetic interns will be required to hold Master’s degrees before sitting for their registration examinations—a situation this proposal would also address. In the light of these and other regulatory and budgetary changes, the proposed new Program will ensure the Department of Human Ecology is positioned to meet workforce demands for future professionals in Human Ecology professions.

The MSHE will provide new opportunities to first-generation college graduates from UMES and other institutions across Maryland. We anticipate that prospective students will come from graduates from the concentration areas of the BS in Human Ecology. In addition to the undergraduate students, the Dietetic Internship is fully subscribed, with the six available slots filled each year. Therefore, we project that all six interns will be enrolled in the program and that past DI graduates will also be potential future MS students.

**ALTERNATIVE(S):** The Regents may not approve the program or may request further information.

**FISCAL IMPACT:** No additional funds are required. The programs can be supported by the projected tuition and fees revenue.

**CHANCELLOR’S RECOMMENDATION:** That the Education Policy and Student Life Committee recommend that the Board of Regents approve the proposal from the University of Maryland Eastern Shore to offer the Master of Science (M.S.) in Human Ecology.

COMMITTEE RECOMMENDATION:

DATE:

BOARD ACTION:

DATE:

SUBMITTED BY: Joann A. Boughman 301-445-1992

[jboughman@usmd.edu](mailto:jboughman@usmd.edu)



UNIVERSITY OF MARYLAND EASTERN SHORE  
*Office of the President*

October 14, 2022

Jay A. Perman, MD  
Chancellor, University System of Maryland  
701 E. Pratt St.  
Baltimore, MD 21202

Dear Dr. Perman,

**RE: New Program Proposal**

The University of Maryland Eastern Shore hereby submits a new program proposal to establish an MS in Human Ecology. The proposed program will have concentrations in Nutrition and Dietetics, Family and Consumer Sciences, Child Development, and Fashion Merchandising.

The degree will help fill a need for our graduates to earn a master's degree in their areas of specialization and ensure that the Department of Human Ecology is positioned to meet workforce demands for future professionals in Human Ecology professions. The proposed degree is crucial for the University to meet requirements for accreditation in keeping with changes in the health professions. The Academy of Nutrition and Dietetics will require a Masters degree for students in the Dietetic Internship in 2024. The proposed MS degree will help us restructure, streamline, and grow the successful Dietetic Internship.

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

I will highly appreciate your favorable consideration of our proposal.

Sincerely,

A handwritten signature in cursive script, appearing to read "Heidi M. Anderson".

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

Copy: Dr. Rondall Allen, Provost and Vice President for Academic Affairs  
Dr. Moses T. Kairo, Dean, School of Agricultural and Natural Sciences  
Dr. Grace Namwamba, Chair, Department of Human Ecology

**UNIVERSITY SYSTEM OF MARYLAND INSTITUTION PROPOSAL FOR**

- New Instructional Program
- Substantial Expansion/Major Modification
- Cooperative Degree Program
- Within Existing Resources, or
- Requiring New Resources

**University of Maryland Eastern Shore**

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Institution Submitting Proposal

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**Human Ecology**

Title of Proposed Program

**Master of Science**

**Fall 2023**

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Award to be Offered

130100.00

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Projected Implementation Date

1901011.00

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Proposed HEGIS Code

Department of Human Ecology

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Proposed CIP Code

Dr. Grace Wasike Namwamba

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Department in which program will be located

410-651-6055

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Department Contact

gnamwamba@umes.edu

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Contact Phone Number




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Signature of President or Designee

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Contact Email Address

10-15-22

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Date



**DIVISION of ACADEMIC AFFAIRS**  
**Office of the Provost & Vice President**

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**Master of Science (M.S.) in Human Ecology**  
**with Concentrations in Child Development, Nutrition and Dietetics, Family & Consumer Sciences, and Fashion Merchandising**

**A. Centrality to Institutional Mission 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.**

**Program Description:** The Human Ecology Department proposes a Master of Science degree in Human Ecology. The proposed Master of Science in Human Ecology will cover content aligned with the Family and Consumer Sciences Body of Knowledge. The degree is designed to provide the student with an interdisciplinary life span perspective necessary for professional work with families and consumers. The degree will have four areas of concentration: Child Development, Nutrition and Dietetics (clinical and non-clinical track), Family and Consumer Sciences, and Fashion Merchandising. The degree will be offered online except for the Nutrition and Dietetics clinical track, which requires an in-person Dietetic Internship. The proposed graduate degree requires students to complete 30 credits, with nine (9) core credits in Human Ecology and the remaining 21 credits in the specific concentration area of choice. The degree offers a thesis and a non-thesis option. For the thesis option, students must take three core courses (9 credits), a minimum of six concentration area (18 credits) graduate-level courses, and three thesis credits. For the non-thesis option, students are required to take three core courses (9 credits) and a minimum of six concentration area (18 credits) graduate-level courses, and three (3) credits of a non-thesis project.

**Relation to Institution's Approved Mission:** The proposed degree will assist the Department of Human Ecology in meeting the University's land-grant mission. In addition, it will be in keeping with the future trends in undergraduate programs offered in the Department. A Master's degree in Human Ecology will help fill a need for our graduates to earn a Master's degree in their areas of specialization. Master's degree will be critical for maintaining our Dietetic Internship (DI). Starting in January 2024, Dietetic Interns must have a Master's degree before sitting for their registration examination. The new Master's degree would help the Department restructure and streamline the current DI program. Similarly, most schools require a Master's degree rather than a bachelor's degree for Family and Consumer Science Education teachers. This program would also benefit Child Development and Fashion Merchandising majors.



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

This new program supports the UMES mission by ensuring that the degree programs “meet the workforce needs of the Eastern Shore, the state, and the nation.” In addition, this new Master’s degree in Human Ecology will allow the Department to provide new opportunities to first-generation college students at UMES and supply much-needed qualified preschool teachers, dietitians, and professionals in the fields of fashion merchandising, Nutrition, and family & consumer sciences.

The proposed graduate program supports the following institutional strategic goals:

- Goal III: become a leading U.S.M. partner in research, innovation, and economic competitiveness by increasing innovation in academic programs and delivery methods (goal 3.1) and increasing student-faculty and faculty research efforts to promote innovative partnerships in the region of impact and service areas (goal 3.3)
- Goal IV: meet the educational needs of the State of Maryland with high-quality and innovative academic programming from other research universities to strengthen research and development enterprise by Align academic programs with the educational needs of the State of Maryland (goal 4.1)

UMES Strategic Plan 2018-2020, (<https://www.wcp.umes.edu/president/wp-content/uploads/sites/16/2021/05/Strategic-Plan-2020.pdf>)

**3. Provide a brief narrative of how the proposed program will be adequately funded for at least the first five years of the program implementation.**

UMES will provide the proposed program with adequate resources, facilities, and faculty, in the same manner, it currently has for its academic programs in the Department of Human Ecology. The University will provide these resources to support the success of the program.

**4. Provide description of the institution's commitment to:**

**a) Ongoing administrative, financial, and technical support of the proposed program**

The internal approval procedure for new programs at UMES indicates the University’s commitment to the ongoing administrative, financial, and technical support of the Department of Human Ecology and its current undergraduate major. The Human Ecology program has the fifth largest undergraduate enrollment. The proposed program has been approved for further development by the Provost and Vice President for Academic Affairs and the President of the University, President Anderson.

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

UMES is committed to supporting this program with sufficient time for enrolled students to complete the Master's Degree in Human Ecology. Our goal to pursue this major is driven by the strategic goals listed previously and to increase offerings to our students. To accomplish these strategic goals and maintain the quality of the Department, support of this program and its students through graduation is essential to the University's mission and goals.

**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

The mission of Family and Consumer Sciences / Human Ecology is to provide leadership and support for professionals whose work assists individuals, families, and communities in making informed decisions about their well-being, relationships, and resources to achieve optimal quality of life. Family well-being is key to thriving communities and national well-being. A graduate degree in Human Ecology will contribute to the body of knowledge that will assist families to thrive in a rapidly changing society. This contribution will have far-reaching impacts on the future.

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

Offering a graduate degree in Human Ecology at UMES will expand the educational opportunities and choices for minority and educationally disadvantaged students at higher education institutions.

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

There are no HBCUs in Maryland with Master's programs in Human Ecology. Therefore, this proposed program supports the mission of UMES to offer unique educational programs to the eastern shore of Maryland and its rural, minority, and educationally disadvantaged residents. This graduate degree will ensure that individuals seeking credentialing in Dietetics and Family & Consumer Sciences Education can secure the degree required to fulfill their credentialing requirements.

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

The proposed MSHE degree program aligns well 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 MS in Human Ecology degree program is designed to prepare highly trained graduates to work in all areas taught in the Human Ecology undergraduate program. The proposed MSHE degree program will provide equitable access and quality education to all Maryland residents, including those with disadvantaged backgrounds. The degree will enable Maryland residents, many of whom may have graduated from the undergraduate program to pursue a Masters degree. Many of the graduates of the undergraduate programs are from disadvantaged backgrounds. The graduate degree will position them to improve their lives, contribute positively to the economy, and increase diversity in the workforce.

The degree will be offered online for all concentrations except for the Clinical option Dietetic concentration, which will require students to be on campus to complete the Dietetic Internship. Online course offerings will provide access to many individuals who may otherwise not have the opportunity to attain a graduate degree.

**Success – Promote and implement practices and policies that will ensure student success.**

The practices and policies concerning the proposed MSHE degree program align with all existing policies at the University, ensuring student success. By providing a carefully developed curriculum, sufficient laboratory facilities, equipment, and adequate faculty members for advising and teaching, the proposed degree program will help ensure student graduation and successful job placement.

The Department of Human Ecology has a well-established academic advising system that helps students progress through the degree program on time. Academic advising for students in the new MS in Human Ecology will follow the same rigorous process. Course offering sequence and scheduling are planned to promote timely degree completion. The Department will create degree completion plans for non-traditional students wishing to complete the program part-time to optimize the efficient use of resources and timely completion of the degree program. An adequate number of faculty will support advising and teaching to ensure student graduation and successful job placement. Faculty will be supported to engage in professional development, which is in line with the goals of the Department of Human Ecology.

Career readiness is integral in the proposed degree program. The Department takes advantage of the full range of services offered by the University Career & Professional Development Center, such as resume writing seminars, career assessments, and employability skills training.

The curriculum is designed to promote career readiness. All students in the program will take several core courses to help them acquire and use knowledge and skills to increase their individual and professional capacity, making them more competitive in their careers. Faculty are engaged in mentoring and assisting students in locating job opportunities. Established partnerships with industry, public agencies, hospitals, and health agencies will further facilitate the placement of students.

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

Specifically, the proposed MSHE 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 "Economic Growth and Vitality" goal, which is centered on supporting a knowledge-based economy through increased education and training. It ensures 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 human sciences professionals in child development, family and human development, textiles, fashion, and health professions in Nutrition and dietetics. These individuals will contribute to Maryland's economic growth and vitality because of the new knowledge and skillsets they will acquire, leading to success in the workforce.

The new MS in Human Ecology will offer an innovative curriculum supported by state-of-the-art laboratories that will be used to create simulations suitable for online teaching and in-person instruction (Dietetics concentration). The simulations will provide valuable experiential learning and prepare the graduates for career success.

The MS in Human Ecology will be critical for maintaining our Dietetic Internship (DI). Starting in January 2024, Dietetic Interns must have a Masters degree before sitting for their registration examination. There is a shortage of Registered Dietitians, and UMES helps meet the need for qualified health practitioners. The MS in Human Ecology will help the Department restructure and streamline the current DI program. The new degree will provide highly qualified professionals in the Human Sciences who will serve to strengthen individuals, families, and communities.

**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: midlevel management) for graduates of the proposed program.

There is a high demand for highly qualified professionals in Family and Consumer Sciences. The Department of Human Ecology is among the highest producers of B.S.

degrees at the University of Maryland Eastern Shore. Most of these students are employed in the fashion industry, childcare settings, the school system, and family services. To advance in their careers, they need to attain a graduate degree. Many of our graduates have been requesting the implementation of a Master's degree, and there is a demand for it. Implementing a Master's degree in Family and Consumer Sciences will increase the number of highly qualified minorities (primarily African Americans) in the workforce and thus increase diversity. There is a current shortage of early childhood education teachers in Maryland due to the planned expansion of public preschool programs. Fashion merchandising students would also benefit significantly from a Master's program.

In addition, beginning in January 2024, Dietetic Interns will be required to have a Master's degree before sitting for their registration examination. The new Master's degree would help the Department restructure and streamline the current DI program.

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 career outlook for students graduating with a degree in Human Ecology is generally positive, but it varies according to the concentration.

Child Development: Individuals with training in child development can work in various fields. Well-paying careers relevant to the field and in family, social, and community services, with a high job growth rate of 15%.

Dietitian jobs are growing at the highest rate of all concentrations (11 %). Starting in 2024, individuals will require a Master's degree before being allowed to do the registration examination to become Registered Dietitians.

Family and Consumer Sciences (F.C.S.) Education jobs are growing at 4%. However, it is essential to note that there is a shortage of F.C.S. teachers nationwide. Although our program is not a teacher preparation program, F.C.S. graduates can pursue alternative certification and attain teaching licensure. B.L.S. data shows that 32% of F.C.S. professionals are employed in the field requiring an advanced degree.

Fashion Merchandising: Fashion merchandisers are part of the larger field of buyers and purchasing agents. According to the B.L.S., the median national annual salary for buyers and purchasing agents in 2020 is \$72,270. Actual salaries may vary greatly based on specialization within the field, location, years of experience, and various other factors. The growth rate of jobs for advertising, promotion, and marketing managers is 9%.

## **Sources**

*Advocacy.* Advocacy - American Association of Family and Consumer Sciences. (n.d.). Retrieved February 22, 2022, from <https://www.aafcs.org/resources/advocacy>

Bureau of Labor Statistics, U.S. Department of Labor, *Occupational Outlook Handbook*, Dietitians and Nutritionists, at <https://www.bls.gov/ooh/healthcare/dietitians-and-nutritionists.htm> (visited February 22, 2022).

Bureau of Labor Statistics, U.S. Department of Labor, *Occupational Outlook Handbook*, Social and Community Service Managers, at <https://www.bls.gov/ooh/management/social-and-community-service-managers.htm> (visited February 22, 2022).

Bureau of Labor Statistics, U.S. Department of Labor, *Occupational Outlook Handbook*, Field of degree: Family and consumer sciences, at <https://www.bls.gov/ooh/field-of-degree/family-and-consumer-sciences/family-and-consumer-sciences-field-of-degree.htm> (visited February 01, 2022).

*Graduate Program Directory*. Graduate Program Directory - American Association of Family and Consumer Sciences. (n.d.). Retrieved February 22, 2022, from <https://www.aafcs.org/network/all-directories/graduate-program-directory>

Nechak, P. (2021, September 16). *What's The Outlook for Fashion Merchandising Careers*. All Art Schools. Retrieved February 22, 2022, from <https://www.allartschools.com/fashion-design/fashion-merchandising-career-outlook/>

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.

Human Ecology is a well-established field, and there are many sources of reliable data to support projection vacancies. The Bureau of Labor of Statistics has published surveys concerning the proposed M.S areas of concentration. In Human Ecology. Additionally, the American Association of Family and Consumer Sciences has developed advocacy resources that provide a wide range of reliable data, scholarly articles, and public policy information to show educational training needs and job demand trends.

4. Provide data showing the current and projected supply of prospective graduates.

The number of graduates from the current Bachelor of Science in Human Ecology degree is below:

2021 Fall	2020-2021	2019-2020	2018-2019	2017-2018	2016-2017
6	21	36	29	30	34

The projected supply of prospective graduates focuses on the concentration areas of Human Ecology (child development, Nutrition and dietetics, family & consumer sciences, and fashion merchandising) is about ten in the first two years based on the number of graduates of the B.S. program at UMES. In addition to the undergraduate degrees shown in the table above, the Dietetic Internship is fully subscribed, with the six available slots filled each year. Therefore, we project that all six interns will be enrolled in the program and past DI graduates are potential students.

#### **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 Human Ecology Department at UMES. There are no other Family and Consumer Sciences degree programs on the Eastern Shore of Maryland. Although other institutions in Maryland, such as the University of Maryland College Park and Towson University, offer advanced degrees in family studies, the proposed UMES program does not duplicate similar programs. These institutions are located about 140 miles away from the Eastern Shore.

In addition, we serve a different geographical areas and academic program degree-level.

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

By leveraging the existing Human Ecology faculty expertise in the various concentration areas, we are positioned, in a unique way, to address challenges in the job sectors by supplying much-needed qualified preschool teachers, dieticians, and professionals in the fields of fashion merchandising, dietetics & Nutrition, and Family & Consumer Sciences to the workforce. For example, there is a current shortage of early childhood education teachers in the State of Maryland due to the planned expansion of public preschool programs and new qualification requirements for Dieticians. In addition, dietetic Interns will be required to have a Master's degree before sitting for their registration examination beginning in January 2024. Thus, the proposed new program will ensure that the Department of Human Ecology is positioned to meet workforce demands for future professionals in Human Ecology professions.

#### **E. Relevance to High-demand Programs at Historically Black Institutions (H.B.I.s):**

1. Discuss the program's potential impact on the implementation or maintenance of high-demand programs at H.B.I.s.

UMES is a Historically Black Institution and would benefit from having a new graduate degree program in Human Ecology as there are no H.B.I. s in Maryland with this program and degree.

## **F. Relevance to the identity of Historically Black Institutions (H.B.I.s):**

1. Discuss the program's potential impact on the uniqueness and institutional identities and missions of H.B.I.s.

No H.B.I.'s in Maryland offers a Master's degree in Human Ecology. While there are Family Science programs at College Park and Towson University, their Master's degrees focus on Couple and Family Therapy and Family Collaboration with a focus on Jewish communities and families. The mission of UMES is to provide opportunities for minorities and first-generation college students, allowing many individuals who might not otherwise have a chance to earn a graduate degree in Human Ecology. The establishment of the proposed Master's 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 Child Development, Dietetics and Nutrition, Family and Consumers Sciences, and Fashion Merchandising are severely lacking.

## **G. Adequacy of Curriculum Design, Program Modality, and Related Learning Outcomes:**

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 the University's unmet needs. Implementation of the new program has received approval from the administration, and four new faculty lines have also been dedicated to the new program. The courses in the proposed Master's degree program will be taught by faculty in the Department of Human Ecology, with four additional faculty members to be hired to balance the teaching load. Adjunct faculty members will also be hired to teach in the program.

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

The educational objectives and learning outcomes of this Master's degree will equip students to:

1. Demonstrate ongoing synthesis and application of relevant literature, current trends, and emerging issues related to their professional area of interest in Human Ecology.
2. Design a research study/creative project investigating topics within their professional area of interest, including diverse populations.
3. Apply sound evidence-based practices and applications within their professional area of interest in Human Ecology.



3. Explain how the institution will: a) provide assessment of student achievement of learning outcomes in the program; b) document 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.
- Assessing comprehensive examination, thesis, or research project report.

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

This program will offer a graduate degree consisting of 30 credits, with 9 core credits in Human Ecology and the remaining 21 credits in the specific concentration area of either child development, Nutrition and dietetics, family & consumer sciences, or fashion merchandising. The courses and course descriptions are listed below for the 30 credits offered in the new program.

Students in the Master of Science in Human Ecology (Child Development, Dietetics and Nutrition, Family and Consumer Sciences, and Fashion Merchandising concentrations) will take thirty (30) credit hours with the Thesis and Non-thesis options. Students can enroll in program 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. The UMES Graduate School must approve any exception to the time limit.

**Thesis option:** students are required to take three core courses (9 credits), a minimum of six concentration area (18 credits) graduate-level courses, and three credits of Thesis (CHDE 600 / NUDT 661 / HUEC 600 / FMCT 600). The thesis must be supervised by a faculty member as a thesis advisor. 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. In addition, a student is required to submit at least one journal/conference paper from their thesis work before the defense.

**Non-thesis option:** students are required to take three core (9 credits) and a minimum of six concentration area (18 credits) graduate-level courses and three (3) credits of Thesis (CHDE 600/NUDT 600/HUEC 600/ FMCT 600). The non-thesis project must be approved by the project advisor. In addition, a copy of the resulting scholarly paper (if any) must be

submitted to the Department.

All M.S. students must choose either the thesis or non-thesis option. Students choosing a non-thesis option will fulfill the comprehensive examination requirement by completing and passing a proctored essay examination. Students must be enrolled in the term in which the comprehensive examination is taken.

Students choosing the thesis option will fulfill the comprehensive examination requirement through the successful oral thesis defense and acceptance of the thesis by the Graduate School. Students must be enrolled in the term in which the oral thesis defense is given.

Admission to the Master's program will be determined primarily based on the applicant's undergraduate grade-point average (G.P.A.). In addition, students admitted to the Master of Science in Human Ecology should possess a bachelor's degree with a major specialization in one of the following areas: fashion merchandising and design, food, and Nutrition, business, family studies, health and wellness, elementary education, or child psychology.

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 a letter grade of C will be accepted. A minimum grade point average (G.P.A.) of 3.0 is required to remain in good standing and to graduate. A maximum of two graduate-level course units may be transferred from another institution. UMES approval of transfer credit may also be required.

Transferred courses must logically fit into the student's graduate program. All courses outside the Human Ecology Master's Program must be graduate-level courses. Prior approval of both student's advisor and the graduate program director is required for all external courses.

### **Human Ecology Program Core Courses**

<b><u>Course Title</u></b>	<b><u>Course Credits</u></b>
HUEC 508 Research Methods	3 credits
AGSC 605 Statistics in Agricultural Research	3 credits
HUEC 509 Program Leadership & Grantsmanship in Human Ecology	3 credits

### **Human Ecology Program -Child Development Concentration Courses**

<b><u>Course Title</u></b>	<b><u>Course Credits</u></b>
CHDE 500 Trauma Informed Best Practices for Young Children	3 credits
CHDE 510 Family Advocacy	3 credits
CHDE 520 Theories of Human Development: Neurological Implications	3 credits
CHDE 530 Early Childhood Program Development	3 credits
CHDE 540 Coaching and Mentoring Child Development Professionals	3 credits
CHDE 550 Diversity and Social Justice in Early Learning Settings	3 credits
CHDE 600 Non-thesis Project/Thesis Research/Examination Thesis	3 credit

### **Human Ecology Program -Dietetics and Nutrition (Clinical Track) Concentration Courses**

<b><u>Course Title</u></b>	<b><u>Course Credits</u></b>
NUTD 600 Pre-professional AP-4 Practice Program (Dietetic Internship)	3 credits
NUDT 601 Integrated Nutrition Metabolism	3 credits
NUDT 605 Therapeutic Cooking for Disease Management	3 credits
NUDT 610 Applied Nutrition Education/Counseling for the Dietetics Profession	3 credits
NUDT 630 Advanced Medical Nutrition Therapy and Assessment	3 credits
NUDT 650 Contemporary Issues in Nutrition	3 credits
NUDT 660 - World Culture Food and Nutrition	3 credits

### **Human Ecology Program -Dietetics and Nutrition Concentration (Non-Clinical Track) Courses**

<b><u>Course Title</u></b>	<b><u>Course Credits</u></b>
NUDT 602 Nutrition and Wellness across the Lifecycle	3 credits
NUDT 605 Therapeutic Cooking for Disease Management	3 credits
NUDT 611 Food and Nutrition Communication	3 credits
NUDT 631 Food and Nutrition Policy	3 credits
NUDT 650 Contemporary Issues in Nutrition	3 credits
NUDT 660 - World Culture Food and Nutrition	3 credits
NUDT 661 Non-thesis Project/Thesis Research/Examination Thesis	3 credits

### **Human Ecology Program -Family and Consumer Sciences Concentration Courses**

<b><u>Course Title</u></b>	<b><u>Course Credits</u></b>
HUEC 500 Theories and Contemporary Issues in Family and Consumer Sciences	3 credits
HUEC 510 Disparities and Family Development	3 credits
HUEC 520 Foundations of Family Development	3 credits
HUEC 530 Program Planning and Evaluation	3 credits
HUEC 540 Family and Consumer Public Policy	3 credits
HUEC 550 Family Resource Management and Capacity Building	3 credits
HUEC 600 Non-thesis Project/Thesis Research/Examination	3 credits

### **Human Ecology Program -Fashion Merchandising Concentration Courses**

<b><u>Course Title</u></b>	<b><u>Course Credits</u></b>
FMCT 500 Global Retail and Merchandising	3 credits
FMCT 510 Brand Management	3 credits
FMCT 520 Customer Relationship Management	3 credits
FMCT 530 Sustainability in Retail and Merchandising	3 credits
FMCT 540 Retail and Merchandising Analytics & Technologies	3 credits
FMCT 550 Capstone in Retail and Merchandising	3 credits
FMCT 600 Non-thesis Project/Thesis Research/Examination Thesis	3 credits

**HUMAN ECOLOGY MASTER'S PROGRAM COURSE SEQUENCES****Child Development Concentration**

<b>First Term</b>		
Course	Course Title/Area	Credits
CHDE 500	Trauma-Informed Best Practices for Young Children	3
HUEC 508	Research Methods	3
CHDE 510	Family Advocacy	3
<b>Total:</b>		9
<b>Second Term</b>		
Course	Course Title/Area	Credits
CHDE 520	Theories of Human Development: Neurological Implications	3
CHDE 540	Coaching and Mentoring Child Development Professionals	3
AGSC 605	Statistics in Agricultural Research	3
<b>Total:</b>		9
<b>Third Term</b>		
CHDE 530	Early Childhood Program Development	3
HUEC 509	Program Leadership & Grantsmanship in Human Sciences/ Human Ecology	3
CHDE 550	Diversity and Social Justice in Early Learning Settings	3
<b>Total:</b>		9
<b>Fourth Term</b>		
CHDE 600	Non-thesis Project/Thesis Research/Examination	3
<b>Total:</b>		3
<b>Total Required Credits for Degree: 30</b>		

**Nutrition and Dietetics Concentration – Clinical Track**

<b>First Term</b>		
Course	Course Title/Area	Credits
HUEC 508	Research Methodology	3
NUDT 602	Nutrition and Wellness Across the Lifecycle	3
HUEC 509	Human Ecology Leadership and Grant Writing	3
<b>Total:</b>		9
<b>Second Term</b>		
Course	Course Title/Area	Credits
NUDT 660	World Culture Food and Nutrition	3
AGSC 605	Statistics in Agricultural Research	3
NUDT 631	Food and Nutrition Policy	3
<b>Total:</b>		9
<b>Third Term</b>		
NUDT 605	Therapeutic Cooking for Disease Management	3
NUDT 611	Food and Nutrition Communication	3
NUDT 650	Contemporary Issues in Nutrition	3
<b>Total:</b>		9
<b>Fourth Term</b>		
Course	Course Title/Area	Credits
NUTD 600	Pre-professional AP-4 Practice Program	3
<b>Total:</b>		3
<b>Total Required Credits for Degree: 30</b>		

**Nutrition and Dietetics Concentration – Non-Clinical Track**

<b>First Term</b>		
Course	Course Title/Area	Credits
HUEC 508	Research Methodology	3
NUDT 602	Nutrition and Wellness Across the Lifecycle	3
HUEC 509	Human Ecology Leadership and Grant Writing	3
<b>Total:</b>		9
<b>Second Term</b>		
Course	Course Title/Area	Credits
NUDT 660	World Culture Food and Nutrition	3
AGSC 605	Statistics in Agricultural Research	3
NUDT 631	Food and Nutrition Policy	3
<b>Total:</b>		9
<b>Third Term</b>		
NUDT 605	Therapeutic Cooking for Disease Management	3
NUDT 650	Contemporary Issues in Nutrition	3
<b>Total:</b>		6
<b>Fourth Term</b>		
Course	Course Title/Area	Credits
NUDT 661	Non-thesis Project/Thesis Research/Examination	3
NUDT 611	Food and Nutrition Communication	3
<b>Total:</b>		6
<b>Total Required Credits for Degree: 30</b>		

**Family and Consumer Sciences Concentration**

<b>First Term</b>		
Course	Course Title/Area	Credits
HUEC 500	Theories and Contemporary Issues in Family and Consumer Sciences	3
HUEC 508	Research Methods	3
HUEC 509	Program Leadership & Grantsmanship in Human Sciences/ Human Ecology	3
<b>Total:</b>		9
<b>Second Term</b>		
Course	Course Title/Area	Credits
HUEC 510	Disparities and Family Development	3
HUEC 520	Foundations of Family Development	3
AGSC 605	Statistics in Agricultural Research	
<b>Total:</b>		9
<b>Third Term</b>		
HUEC 530	Program Planning and Evaluation	3
HUEC 540	Family and Consumer Public Policy	3
HUEC 550	Family Resource Management and Capacity Building	3
<b>Total:</b>		9
<b>Fourth Term</b>		
HUEC 600	Non-thesis Project/Thesis Research/Examination	3
<b>Total:</b>		3
<b>Total Required Credits for Degree: 30</b>		

**Fashion Merchandising Concentration**

<b>First Term</b>		
Course	Course Title/Area	Credits
FMCT 500	Global Retail and Merchandising	3
HUEC 508	Research Methods	3
FMCT 510	Brand Management	3
<b>Total:</b>		9
<b>Second Term</b>		
Course	Course Title/Area	Credits
FMCT 520	Customer Relationship Management	3
HUEC 509	Program Leadership & Grantsmanship in Human Sciences/ Human Ecology	3
AGSC 605	Statistics in Agricultural Research	3
<b>Total:</b>		9
<b>Third Term</b>		
FMCT 530	Sustainability in Retail & Merchandising	3
FMCT 540	Retail and Merchandising Analytics & Technologies	3
FMCT 550	Capstone in Retail and Merchandising	3
<b>Total:</b>		9
<b>Fourth Term</b>		
Course	Course Title/Area	Credits
FMCT 600	Non-thesis Project/Thesis Research /Examination	3
<b>Total:</b>		3
<b>Total Required Credits for Degree: 30</b>		



## **HUMAN ECOLOGY MASTER'S PROGRAM COURSE DESCRIPTIONS**

### **AGSC 605 Statistics in Agricultural Research**

**3 credits**

Emphasis is placed on techniques and application of statistical and experimental design, data acquisition, analysis, interpretation, and presentation as applied to Agricultural Sciences.

### **CHDE 500 Trauma-Informed Best Practices for Young Children 3 credits**

Students will explore research-based methods to invigorate wellness among families, communities, and individuals, prepare to become impactful child advocates, evaluate resources, examine resiliency and support the emergence of protective factors and strategies.

### **CHDE 510 Family Advocacy 3 credits**

This course will explore and support minority cultures and languages in a pluralistic society and determine effective methods for accessing advocacy, translation services, and resources.

### **CHDE 520 Theories of Human Development: Neurological Implications 3 credits**

Using theoretical models and the evaluation of theory-based research, this course closely scrutinizes the architecture of the brain, sensory pathways; the influence of nature and nurture on the developing brain and discusses early intervention techniques with children experiencing toxic stress.

### **CHDE 530 Early Childhood Program Development 3 credits**

To prepare the child development specialist for roles in early learning program administration, this course will delineate specific ways to develop business plans, locate funding sources, understand federal funding regulations and guidelines and write and submit grant proposals.

### **CHDE 540 Coaching and Mentoring Child Development Professionals 3 credits**

Child development leaders serve a vital role of supporting individualized and ongoing staff growth within their programs. This action-based course models transformative coaching and mentoring methods with a focus on developing soft skills, problem-solving, using observation as a springboard for communication, critical interpretation, and genuine and collaborative counseling opportunities. Proven best practices in adult learning theories are modeled and demonstrated throughout the course. (3 hrs.)

### **CHDE 550 Diversity and Social Justice in Early Learning Settings 3 credits**

The vital pillars of equity, access, participation, and rights are foremost considerations for all early learning professionals. Students will examine historical and contemporary examples of academic freedom and First Amendment Rights in early learning settings, develop program standards uniquely shaped to fit children's needs to ensure all are physically and psychologically safe and secure, and research ways to promote a sense of security and belonging to influence public policy throughout their professional careers.

### **CHDE 600 Non-thesis Project/Thesis Research/Examination Thesis 3 credits**

Students will work towards completing their thesis proposal, research project, or comprehensive examination. Prerequisite: HUEC 508 Research Methods

\*This course must be completed within the last nine (9) credits of the program

### **FMCT 500 Global Retail and Merchandising 3 credits**

This course examines the global landscape of retail and merchandising, highlighting economic and social conditions influencing apparel trade and retailing consumption; students will explore the role of government, industry, and consumers in the production, sourcing, distribution, and consumption of apparel in the global economy.

### **FMCT 510 Brand Management 3 credits**

Students will develop branding strategies for the major selling channels, including brick-and-mortar retailers, online and other direct marketing outlets. Students will research and experience fashion retail brands in today's multichannel fashion context. The course will also explore social and cultural issues impacting the methods that consumers use to purchase merchandise, as well as how retailers use multichannel methods to communicate, represent and translate their product's position in the fashion market.

### **FMCT 520 Customer Relationship Management 3 credits**

This course will cover the history of customer relationship management (CRM), the evolution of CRM, CRM as it relates to customer experience, effective CRM strategy, and CRM tools and technologies. The course includes case studies, and students will create a CRM strategy for a retailer.

### **FMCT 530 Sustainability in Retail and Merchandising 3 credits**

This course introduces students to the concept, history, and science of sustainability and its relationship within the apparel, textiles, and fashion industries. Course topics include understanding human-induced climate change in the environment and the local and global effects fashion and industry have on the Earth and its peoples. Past, present, and future apparel supply chains, practices, and technologies will be examined and

taught through class discussions and readings, hands-on learning, and case studies. Students will gain knowledge of sustainability practices and skills for fashion and related businesses.

### **FMCT 540 Retail and Merchandising Analytics & Technologies 3 credits**

This course will introduce students to various research methodologies within consumer, apparel, and retailing. Special emphasis will be placed on identification and creation of research problems, the development of research designs, and analysis procedures to address those research problems. Fashion retail analysis will be necessary to complete this course. Students will be expected to closely examine actual multi-national retail companies and identify areas of new assortment opportunity, assess the market feasibility for global expansion, evaluate technology and operational challenges, and create a course of action. Prerequisite: HUEC 508 Research Methods

### **FMCT 550 Capstone in Retail and Merchandising 3 credits**

The capstone course requires the application, analysis, and synthesis of the fashion retail and merchandising curriculum to assess the students' level of comprehension. Students will follow standard industry processes in the research and analysis of the consumer, retail business sectors, product development, assortment planning, global strategies, and select technologies. Drawing upon coursework, industry knowledge, and work experience, students collaborate on a group project to conceive a line of merchandise as a new wholesaler in a specific product category that will be sellable to prospective target retailers (primary customers) and their target consumers (the secondary customer). The capstone project concludes with a comprehensive written report and an oral presentation.

### **FMCT 600 Non-thesis Project/Thesis Research/Examination Thesis 3 credits**

Students will work towards completing their thesis proposal, research project, or comprehensive examination. Prerequisite: HUEC 508 Research Methods

\*This course must be completed within the last nine (9) credits of the program

### **HUEC 500 Theories and Contemporary Issues in Family and Consumer Sciences 3 credits**

Theories used in Family and Consumer Sciences and related fields. Students will apply the Family and Consumer Sciences integrative body of knowledge framework to propose solutions to local, national, and global issues impacting families.

### **HUEC 510 Disparities and Family Development 3 credits**

An analysis of the impact of racial/ethnic disparities on family development over the life cycle and in generations. An examination of the historical, psychosocial, economic, and political factors influencing the structure and functioning with an emphasis on

ethnic/minority families.

**HUEC 520 Foundations of Family Development 3 credits**

Human development, including cognitive, social-emotional, motor, language, and moral domains from both lifespan and bio-ecological perspectives. The course focuses on major development theories and current research on the micro-macro relationship.

**HUEC 530 Program Planning and Evaluation**

An overview of the program development process and outcome evaluation of community, children, and family programs. Students develop knowledge through participating in a community-based project involving the practical application of program design and evaluation methods.

**HUEC 540 Family and Consumer Public Policy 3 credits**

Development and analysis of public policies affecting the well-being of children, youth, and families, with an emphasis on low-income and ethnic minority populations. Examination of social, economic, and political dynamics that influence family policies and the delivery of services.

**HUEC 550 Family Resource Management and Capacity Building**

The effective management of resources to help families build their capacity to meet life needs and thrive. Resources include personal and family finance, community networks, time, money, energy, material assets, space, and the environment.

**HUEC 600 Non-thesis Project/Thesis Research/Examination 3 credits**

Students will work towards completing their thesis proposal, research project, or comprehensive examination. Prerequisite: HUEC 508 Research Methods

\*This course must be completed within the last nine (9) credits of the program

**NUTD 600 Pre-professional AP-4 Practice Program 3 credits**

Pre-professional practice – the dietetic internship is a performance-based generalist program designed to bridge the gap between the didactic education and entry-level professional dietetic practice. Approved by the Accreditation Council for Education in Nutrition and Dietetics for the Academy of Nutrition and Dietetics, the program requires a minimum of 1200 clock hours of supervised practice in foodservice systems management, clinical Nutrition, diabetes outpatient services, and community nutrition with a concentration in Diabetes Education and Counseling. This internship has a concentration in diabetes.

**NUDT 601 Integrated Nutrition Metabolism 3 credits**

Integration of biochemical, physiological, and hormonal processes involved in nutrient metabolism and function in maintaining human health.

**NUDT 602 Nutrition and Wellness Across the Lifecycle 3 credits**

This is an advanced course that focuses on the nutritional needs across the lifespan. Students will research the best nutrition practices for each life stage and use case literature to examine how these practices improve health. Projects will examine how life events influence eating habits and ways dietary guidance can be used to improve overall well-being.

**NUDT 605 Therapeutic Cooking for Disease Management 3 credits**

The focus of this course is on food and diets that claim to aid people in recovery from special conditions or illnesses, or that support the management of chronic disease. Students evaluate the evidence regarding the diet's validity and learn how to design, adapt, and prepare dishes, meals, and remedies that are thought to be health-supportive for individuals or groups and that adhere to particular recovery-type diet protocols.

**NUDT 611 Food and Nutrition Communication 3 credits**

This course will explore the various forms and styles of communication used to convey information about food and Nutrition. Students will gain knowledge about cultural influences on foodways and how this shapes the way information about food is communicated. Practical experience using evidence-based strategies to create food and nutrition messages, and techniques to assess their effectiveness, will be provided throughout the course.

**NUDT 631 Food and Nutrition Policy 3 credits**

This course will provide an overview of the history of food and nutrition policies. It will include an examination of the institutions, stakeholders, and current issues influencing national and international food and Nutrition policy development. Food and nutrition regulations will be discussed in the context of how they influence private and public sector food access. Students will explore the influence of economics and climate change on food and nutrition policy and examine the gaps in current policies. They will also be given opportunities to be directly involved in food and nutrition advocacy.

**NUDT 650 Contemporary Issues in Nutrition 3 credits**

Advanced study of a variety of current, new, and/or controversial topics in the field of foods, Nutrition, and dietetics. Exploration of current issues impacting food and Nutrition and interactions between food choice and ecology, including such areas as food technology, the impact of climate change on food systems, water use and sustainable

agriculture, nutrigenomics, and food security, are discussed.

**NUDT 660 World Culture Food and Nutrition**

**3 credits**

This course explores traditional cultural foods from around the world to increase cultural competency and effective communication with clients and community members. Foodways include but are not limited to how food is selected, prepared, presented, and consumed. Flavor profiles and commonly used ingredients and dishes will be explored to understand how and to what extent traditional foodways impact societies and cultural norms. Additionally, fusion cuisine will be explored to understand how one cultural cuisine can impact another and, in turn, be impacted by others in areas where people groups meet or as a result of global migration. Finally, students will examine their own food culture, biases, and how these impact personal and professional interactions with others. Food tastings and sensory experiences will expose students to a variety of global cuisines allowing students to compare and contrast flavors. Food security and world hunger are included.

**NUDT 661 Non-Thesis Project/Thesis Research/Examination Thesis 3 credits**

Students will work towards completing their thesis proposal, research project, or comprehensive examination. Prerequisite: HUEC 508 Research Methods

\*This course must be completed within the last nine (9) credits of the program

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

As this is a Master's degree program, all the courses will be focused on specialized areas related to the Human Ecology disciplines, with no general education courses required for the degree program.

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

Those students seeking a Master's degree in the nutrition and dietetics clinical track will be enrolled in the accredited Dietetic Internship.

There are no required certifications or accreditations for all other concentration areas (child development, family & consumer sciences, fashion merchandising, Nutrition, and Dietetics - non-clinical track).

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

There will be no contracting with other entities.

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 systems, availability of academic support services and 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 Department of Human Ecology website: [www.umes.edu/he](http://www.umes.edu/he).

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 and the Financial Aid Office of UMES.

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

The program will be advertised alongside other academic graduate programs at UMES School of Agricultural and Natural Sciences. Additionally, UMES Public Relations Office will share news of the program through university forums such as the UMES Facebook page, the University Key, and the UMES alumni association.

## **H. Adequacy of Articulation:**

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

The proposed program does not have articulation partners currently at the Master's Degree program level. UMES aims to work with partner institutions to provide a pathway for many students interested in Human Ecology related fields to obtain a Master's degree.

- I. Adequacy of Faculty Resources (as outlined in COMAR 13B.02.03.11): 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 will teach in the proposed program.

The proposed program will need to hire additional faculty to teach and advise students in the major. The Human Ecology Department currently has eight full-time faculty members and four adjunct faculty members. Four additional faculty members will be hired to support the new M.S. in Human Ecology.

**The existing seven (8) faculty are listed below:**

Mr. Michael Kirtsos, RD, CSSD, L.D.N., Lecturer and Dietetic Internship Director. He received his Master's in Applied Health Physiology from Salisbury University. His primary research area is in sports nutrition.

Dr. Malinda Cecil, R.D.N., L.D.N., Visiting Lecturer, and D.P.D. Director, she received her PhD. in Organizational Leadership in Health and Human Services from the University of Maryland Eastern Shore. Her Master's degree is in Food and Nutrition, with a Public Health Traineeship from Virginia Tech. Her research interests are recruitment and retention in dietetic education and community nutrition.

Dr. Donna Satterlee, Associate Professor in Child Development. She received her Doctorate in Educational Leadership and Change from Fielding Graduate University. In addition, she has a Master's in Special Education from Old Dominion University. Her primary research areas are early education curriculum development and child, family, and community collaboration.

Dr. Donna Long is, Associate Professor in Child Development and Director of the Child and Family Development Center. She received her Doctorate of Education in Innovation and Leadership from Wilmington University. In addition, she has a Master's in Educational Leadership from Trevecca Nazarene University. Her primary research area is in childcare administration.

Dr. Li Zhou, Assistant Professor in Child Development. She received her Doctorate of Education in Curriculum and Instruction from Indiana University of Pennsylvania. She has a Master's in TESOL/Applied Linguistics from Indiana University of Pennsylvania. Her primary research area is in early education curriculum development.

Dr. Bridgett Clinton-Scott, Associate Professor in Fashion Merchandising. She received her Doctorate of Management from the University of Maryland Global Campus. She has a Master's in Merchandise Management from Michigan State University. Her primary research area is fashion sustainability, consumer behavior, and creative scholarship in fashion design.

Dr. John Jacob, Associate Professor in Fashion Merchandising. He received his Master of Science and a Ph.D., in Clothing and Textiles, from Virginia Tech. His research interests include clothing and the social construction of gender, aesthetic movements in fashion history, sustainability, the social construction of ideal body types and body image, and creative scholarship in fashion design.

Dr. Grace Namwamba, Chair and Professor of Fashion Merchandising. She holds a Master of Education in Home Economics Education from the University of North Carolina Greensboro and a Ph.D. in Family and Consumer Sciences Education from Iowa State University. She is currently Chair of the Department of Human Ecology at UMES. She teaches courses in Apparel & Textiles and Family and Consumer Sciences. Her focus has been digital textile printing and 3D virtual prototyping for apparel products.



Four (4) new faculty are needed to support curriculum development and instruction of the new Master's program. One new faculty member will be hired to support delivery in the concentration areas of Child Development, Nutrition and Dietetics, Fashion Merchandising, and Family and Consumer Sciences.

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

a) pedagogy that meets the needs of students

b) the learning management system

(a) and (b): Faculty support for the development and instruction of courses is

provided by the Faculty Development Center and Center of Instructional Technology and Online Learning at UMES.

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

All distance education courses in the Department of Human Ecology must meet the same standards in terms of rigor as all face-to-face courses. The University has an instructional technology unit that provides training and support for online classes. 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).

Online instruction is delivered through the Canvas Learning Management System, and additional online platforms are available to support the process. These include Echo360, Google Workspace, Respondus 4.0, and Respondus LockDown Browser. The University uses Quality Matters rubrics to assess the quality of online classes and mandates a uniform template for all courses, which is based on Quality Matters standards.

The Department has qualified faculty members to teach online classes. All new faculty must complete UMES online teaching certification to teach online. The certification is provided through the Center of Instructional Technology and Online Learning (CITOL) which provides continued support throughout the semester.

Student learning is assessed similarly to face-to-face classes. Students enrolled in online classes evaluate the effectiveness of instruction using the same course assessment survey used for traditional classes. Instructors and the Chair use students' feedback to make improvements. The Department Chair is also provided access to online classes to assess teaching effectiveness.

Students enrolled and faculty are assigned University emails for communication. The system also provides video conferencing via Google Meets.

**J. Adequacy of Library Resources: (as outlined in COMAR 13B.02.03.12)**

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

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. Any resources not currently available in the UMES library can be accessed through the Inter-Library Loan (ILL) services.

The Frederick Douglass Library is centrally located in the Academic Oval. It is primarily the intellectual nucleus of the University that houses supportive and supplemental acquisitions in various formats that connect all academic disciplines.

The Family and Consumer Sciences collections are a part of the Library's core collection. In addition, the Family and Consumer Science electronic collection has access to over 70 online databases and over 96,500 eBooks to meet the needs of the students and faculty.

Library instruction sessions are an integral component of the Frederick Douglass Library's agenda to support the research needs of the University's curriculum, its students, faculty, staff, and the Eastern Shore. To support these research needs, library instruction offers classes to provide instruction in information literacy, library orientation, and utilization of digital resources both on and off-campus. A library instruction session can range from an overview of the Library to advanced or subject-specific research assistance.

When the Library does not have the needed resource, Inter-Library Loan and Inter-Campus Loan services are available to process requests from students, faculty, and staff who request to borrow resources the Frederick Douglass Library does not have available in the Library. Inter-Library Loan service allows you to take advantage of the millions of items available at other libraries for use in research. Inter-Campus Loan allows you to request items from other University of Maryland System Libraries.

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

1. Provide an assurance 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 Department of Human Ecology has the necessary resources to initiate and support the proposed M.S. degree. In the past three years, the Department of Human Ecology has made several upgrades to classrooms and laboratories using a combination of State General Funds and grant dollars. The apparel construction lab was upgraded using State funds in 2016, whereby ten industrial sewing machines

were purchased to replace home-sewing machines. Through an 1890 Capacity Building grant, the Center was established. The same funds were used to purchase a 3D body scanner and a digital textile printer.

We also used State funds to upgrade scanning equipment to enhance our document digitization process in the main office. In addition, the I.T. department upgraded multi-media presentation equipment in two classrooms as part of a University-wide effort.

Our Department was recently approved for funding from the U.S. Department of Agriculture 1890 Facilities Grant Program for \$687,200. These funds will be used to implement our technology plan, which involves upgrading classrooms and laboratories across the Department.

The students will have access to the following: The UMES Child and Family Development Center (CFDC) is a Maryland-licensed laboratory school environment for sixty-three children ages infancy through twelve.

The Foods and Nutrition Laboratory consists of three kitchen units with a variety of food preparation equipment designed to provide students with an opportunity to explore the scientific principles of food preparation. Additional Nutrition lab space is available in the Food Sciences building.

The Center of Fashion Merchandising and Design Technology (CFMDT) provides students with hands-on experience with industry-standard software such as the Lectra System and the latest in CAD hardware. In addition, students have access to textile testing equipment and an apparel production lab. The Department also has a historic costume collection that features costumes and accessories from the early 1900s to the present day.

The Department has been given additional space in Kiah Hall. The space will be used to establish laboratories and additional faculty offices.

2. Provide assurance and any appropriate evidence that the institution will ensure students are 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) Students enrolled and faculty will be assigned University emails for communication. The system also provides video conferencing via Google Meets.
  - b) Students enrolled and faculty will have access to Canvas, the official Learning Management System. The Center for Instructional Technology and Online Learning (CITOL) provides faculty support for development and instruction. The Academic Computing Unit will also provide support.

**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 these funds.

<b>TABLE 1: PROGRAM RESOURCES</b>					
<b>Resource Categories</b>	<b>Year 1</b>	<b>Year 2</b>	<b>Year 3</b>	<b>Year 4</b>	<b>Year 5</b>
1. Reallocated Funds	178900	131720	89975	141150	55880
2. Tuition/Fee Revenue (c + g below)	111600	151780	193525	236850	322120
a. Number of F/T Students	15	20	25	30	40
b. Annual Tuition/Fee Rate	7440	7589	7741	7895	8053
c. Total F/T Revenue (a x b)	111600	151780	193525	236850	322120
d. Number of P/T Students	0	0	0	0	0
e. Credit Hour Rate	436	436	436	436	436
f. Annual Credit Hour Rate	0	0	0	0	0
g. Total P/T Revenue (d x e x f)	0	0	0	0	0
3. Grants, Contracts & Other External Sources	0	0	0	0	0
4. Other Sources (MHEC Vs. Coalition lawsuit)					
<b>TOTAL (Add 1 – 4)</b>	<b>290500</b>	<b>283500</b>	<b>283500</b>	<b>378000</b>	<b>378000</b>

**Resources and Narrative Rationale**

1. Reallocated Funds: Funds required to be reallocated will come from the HBCU Settlement Fund.
2. Tuition/Fee Revenue: Additional funds will be generated from tuition and fees. It is estimated that the initial enrollment of full-time students will be 15, with a projected increment of five students for years 2 – 4. Due to program awareness, we project that the increase in year five will be higher and that ten (10) additional students will enroll in the program. We have also accounted for a modest increase in tuition and fees over the years.

3. Grants, Contracts & Other External Sources: We are not anticipating grants, contracts, or other external sources to fund this program.

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.

<b>TABLE 2: PROGRAM EXPENDITURES:</b>					
<b>Expenditure Categories</b>	<b>Year 1</b>	<b>Year 2</b>	<b>Year 3</b>	<b>Year 4</b>	<b>Year 5</b>
1. Faculty (b + c below)	283500	283500	283500	378000	378000
a. Number of FTE	3	3	3	4	4
b. Total Salary	210000	210000	210000	280000	280000
c. Total Benefits	73500	73500	73500	98000	98000
2. Admin. Staff (b + c below)	0	0	0	0	0
a. Number of FTE	0	0	0	0	0
b. Total Salary	0	0	0	0	0
c. Total Benefits	0	0	0	0	0
3. Support Staff (b + c below)	0	0	0	0	0
a. Number of FTE	0	0	0	0	0
b. Total Salary	0	0	0	0	0
c. Total Benefits	0	0	0	0	0
4. Technical Support and Equipment	7000	0	0	0	0
5. Library	0	0	0	0	0
6. New or Renovated Space	0	0	0	0	0
7. Other Expenses	0	0	0	0	0
<b>TOTAL (Add 1 – 7)</b>	<b>290500</b>	<b>283500</b>	<b>283500</b>	<b>378000</b>	<b>378000</b>

## **Program Expenditures and Narrative Rationale**

1. Faculty expenses: Four full-time tenure track faculty members will be hired to support the program. The funding will be made available from the HBCU Vs. MHEC lawsuit settlement. Details of the additional faculty are as follows:

The four FTEs will be distributed as follows: Child and Family Studies, 1 FTE; Family, and Consumer Sciences, 1 FTE; Fashion Merchandising, 1 FTE; Food and Nutrition, 1 FTE.

Additionally, four adjunct faculty members will be hired to support the four areas of concentration indicated above.

2. Administrative Staff: No additional funds will be spent on administrative staff because the current level of support is enough to support the new program.
3. Support Staff: There is no need for support staff for this program.
4. Technical Support and Equipment: \$7,000 will be used to purchase computers and office equipment for the new faculty members. This allocation is only for the first year and is not needed for subsequent years.
5. Library: No funds for the Library are requested because the UMES library can support the new program with current resources.
6. New or Renovated Space: The new program does not require new space.
7. Other Expenses: Not other expenses are anticipated for this program.

## **M. Adequacy of Provisions of Evaluation of Program: (as outlined by COMAR 13B.02.03.15)**

1. Discuss procedures for evaluating courses, faculty, and student learning outcomes.

### **Evaluation of Courses:**

The Department of Human Ecology holds annual retreats to set the year's agenda and review the curriculum. During these sessions, faculty from each concentration will review the curriculum and determine if they need to revise, update, change, or add new courses. The departmental curriculum committee will review and take action on the proposed changes, which will be transmitted to the Department Chair and higher levels.

### **Evaluation of Faculty:**

At the University of Maryland Eastern Shore, all faculty members are expected to meet their professional and institution commitments, including teaching, academic advising, and engaging in research and service. Because student involvement in teaching evaluation is considered important, students conduct faculty evaluations at the end of each semester, and the rating and comments are one factor in the final performance

rating of the faculty member. The Chair also conducts classroom visits to observe teaching. Factors such as the quality of the syllabus and teaching materials are considered in determining the effectiveness of an instructor.

The Chair conducts faculty evaluation, an annual process that begins with submitting. Following a review of the goals during a meeting with the faculty and Chair, the goals are modified and accepted as deemed appropriate. A final report of the accomplishments of the goals is due in March of each year. Mid-year reviews with faculty are encouraged to ascertain faculty progress or concerns. A final review meeting takes place in April.

### **Evaluation of Student Learning Outcomes.**

The Department of Human Ecology uses assessment data to make informed curriculum decisions regarding improving teaching and learning processes. The Department is strongly engaged in the assessment of Student Learning Outcomes. A well-developed assessment plan is used to gather data to improve student learning at the undergraduate level. The plan will be updated to include the new graduate program.

The process will start with the collaborative determination of program learning outcomes (P.L.O.). Then, student learning outcomes will be developed from the P.L.O.s.

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.

### **Assessment of Student Learning Outcomes:**

The new program includes a core curriculum for all concentrations. In addition, a formalized and thorough, and systematic assessment process will be put in place as follows:

- Program learning outcomes will be established with input from all faculty members.
- Each concentration will establish its learning outcomes (derived from the program learning outcomes).
- Key assessments will be developed to assess the program's core courses.
- Each concentration will develop key assessments to assess the areas of concentration.
- All courses will have course learning outcomes that map to the concentration and program learning outcomes.
- Learning outcomes results will be submitted to the Assessment Committee, and a report will be compiled.
- Faculty members will review the assessment reports and close the loop as needed.

### **Student Retention:**

The most important aspect of student retention is ensuring the high quality of the program. This will be attained through hiring highly qualified and experienced faculty members. The curriculum will be regularly updated to ensure relevance to current and future trends. The learning environment will be positive and supportive of students. The Department will ensure that all the resources needed are provided in a timely fashion.

Student engagement activities will be conducted to increase cohesion and pride in belonging to the program.

### **Student and Faculty Satisfaction:**

Student satisfaction will be measured using course evaluation and exit interview surveys.

Faculty satisfaction will be measured through the annual evaluation process, including a planning and goals-setting session in the fall, a mid-year review in February, and a final evaluation session at the end of the spring semester. A Campus climate survey will also help in assessing faculty satisfaction. Additionally, informal feedback from faculty will be used to determine faculty and student satisfaction, and adjustments will be made accordingly.

### **Cost Effectiveness**

The MS in Human Ecology will be an online program except for the Dietetics concentration, which will be hybrid. There are few physical resources needed to implement the program. The main input is faculty salaries, and funds have been allocated to support four full-time positions and several adjunct positions. The faculty members in the Department will also have an opportunity to contribute by teaching courses in the new program. Because of the remote nature of the program, it will be easy to attract a highly qualified and stable adjunct faculty base to assist in teaching courses at a cheaper rate. Based on current graduation data from the undergraduate program, the degree will produce enough revenue to self-sustain within a few years.

### **N. Consistency with the State's Minority Achievement Goals: (as outlined by COMAR 13B.02.03.05).**

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

The proposed program would be unique in Maryland and attractive to students from racial groups not highly represented at UMES. Our Dietetic Internship program has attracted white students from Maryland and across the United States. The impact of



the DI program will be significantly increased with the implementation of this degree in terms of increasing the diversity of the UMES student body.

**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.

N/A

**P. Adequacy of Distance Education Programs: (as outlined by COMAR 13B.02.03.22)**

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

As outlined by the Distance Education Maryland Code of Regulations (<http://mdrules.elaws.us/comar/13b.02.03.22>), UMES meets all the requirements to engage in distance education and offer an online program. At UMES, we are committed to improving our online courses and 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 distance education quality, 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 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 Human Ecology. The proposed program will be offered online except for the clinical track in Nutrition and dietetics, which will require students to participate in an in-person Dietetic Internship. The faculty members in this new program will be required to complete the UMES online teaching certification successfully.

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, and 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 digital teaching and learning aspects concerning pedagogy and technology. This includes using 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 Department of Human Ecology, School of Agricultural and Natural Sciences, and the Center for Instructional Technology and Online Learning will assure the degree program adheres to C-RAC Guidelines for the Evaluation of Distance Education.



**BOARD OF REGENTS**  
SUMMARY OF ITEM FOR ACTION,  
INFORMATION, OR DISCUSSION

**TOPIC:** University of Maryland Eastern Shore Master of Science in Data Science and Analytics Engineering

**COMMITTEE:** Education Policy and Student Life

**DATE OF COMMITTEE MEETING:** Tuesday, November 15, 2022

**SUMMARY:** The University of Maryland Eastern Shore (UMES) is pleased to present a proposal to create a Master of Science in Data Science and Analytics Engineering (MSDSAE). UMES, with the financial and technical assistance of the Microsoft Corporation, has been working toward the development of a MSDSAE. This new program complements the University’s undergraduate programs in Computer Science, Engineering, and Business.

The proposed degree program will substantially help position UMES at the forefront of emerging research in critical areas of precision agriculture, natural sciences, and pharmaceutical science. The existing undergraduate engineering program at UMES has continuously supplied undergraduate researchers to assist in research projects conducted by faculty members in agriculture, physics, and pharmaceutical science with their skills and knowledge in the engineering discipline. The proposed MSDSAE program is expected to enable stronger and multi-disciplinary research collaboration across the campus community, thus fueling research in many disciplines in addition to engineering and creating a much broader impact on the campus community. The mission of the proposed program is to provide students and working professionals with advanced training in the disciplines of data science and analytics engineering; to promote innovation and technology development in the emerging fields of aviation safety, machine learning, spatial technology, and financial engineering. It will contribute to the economic development in the state of Maryland, especially in the Eastern Shore region where learning opportunities in advanced engineering disciplines is severely limited.

**ALTERNATIVE(S):** The Regents may not approve the program or may request further information.

**FISCAL IMPACT:** No additional funds are required. The programs can be supported by the projected tuition and fees revenue.

**CHANCELLOR’S RECOMMENDATION:** That the Education Policy and Student Life Committee recommend that the Board of Regents approve the proposal from University of Maryland Eastern Shore to offer the Master of Science (M.S.) in Data Science and Analytics Engineering.

COMMITTEE RECOMMENDATION: DATE: November 15, 2022

BOARD ACTION: DATE:

SUBMITTED BY: Joann A. Boughman 301-445-1992 jboughman@usmd.edu



UNIVERSITY OF MARYLAND EASTERN SHORE  
*Office of the President*

October 14, 2022

Dr. Jay Perman, Chancellor  
University System of Maryland  
701 E. Pratt Street  
Baltimore, MD 21202

**RE: New Academic Program Proposal – Master of Science in Data Science and Analytics Engineering**

Dear Dr. Perman:

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

**Program:** MS in Data Science and Analytics Engineering

The School of Business and Technology proposed to offer an MS degree in Data Science and Analytics Engineering (DSAE). The proposed program will play a crucial role in preparing professionals to work in various positions related to the data science industry.

Consistent with its mission, UMES seeks to expand its capacity to offer unique and/or critical certificate and degree programs. The University has been working towards, with the financial and technical assistance of the Microsoft Corporation, the development of a Master of Science in Data Science and Analytics Engineering. This will complement the undergraduate programs in Computer Science and Engineering with specializations in Electrical, Computer, and Business. The Business programs offer Bachelor's Degrees in Accounting, Business Administration, Finance, and Marketing with elements of data analytics embedded throughout their curricula.

The proposed degree program will substantially help the institution achieve its strategic goals and position UMES at the forefront of emerging research in critical areas of precision agriculture, natural sciences, and pharmaceutical science. The existing undergraduate engineering program at UMES has continuously supplied undergraduate researchers to assist in research projects conducted by faculty members in agriculture, physics, and pharmaceutical science with their skills and knowledge in the engineering discipline. The proposed MSDSAE program will enable stronger and multi-disciplinary research collaboration across the campus community, thus fueling research in many other disciplines and creating a much broader impact on the entire campus community.

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

I greatly appreciate your consideration.

Sincerely,

A handwritten signature in cursive script, appearing to read "Heidi M. Anderson".

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

**UNIVERSITY SYSTEM OF MARYLAND INSTITUTION PROPOSAL FOR**

- New Instructional Program
- Substantial Expansion/Major Modification
- Cooperative Degree Program
- Within Existing Resources, or
- Requiring New Resources

**University of Maryland Eastern Shore**

Institution Submitting Proposal

**Master of Science in Data Science and Analytics Engineering**

Title of Proposed Program

**Master of Science**

Award to be Offered

**Fall 2023**

Projected Implementation Date

**0799.00**

Proposed HEGIS Code

**52.1302**

Proposed CIP Code

**School of Business and Technology**

Department in which program will be located

**Dr. Derrek Dunn**

Department Contact

**(410) 621-6348**

Contact Phone Number

**ddunn@umes.edu**

Contact E-Mail Address



Signature of President or Designee

**October 5, 2022**

Date



**DIVISION of ACADEMIC AFFAIRS**  
**Office of the Provost & Vice President**

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**Master of Science in Data Science and Analytics Engineering (MSDSAE)**

**Proposal Executive Summary**

The School of Business and Technology at the University of Maryland Eastern Shore (UMES) proposes to establish a **Master of Science in Data Science and Analytics Engineering (MSDSAE)** degree at the University of Maryland Eastern Shore (UMES). The MSDSAE aims to offer prospective students a graduate program with strong foundations in theory and practice to meet the needs of technical professionals including those in the Eastern Shore of Maryland with more advanced learning in a specialized discipline of data science and analytics. The program, if approved, will help students develop new technologies in the emerging fields of data science for a wide range of applications including agriculture, automotive, aerospace, clean energy systems, construction, finance, health care, and hospitality management. It will also prepare them, especially those with disadvantaged backgrounds, with the knowledge and tools necessary to take on engineering leadership roles to shape the future of technology advancement.

The MSDSAE program will be interdisciplinary in nature and involve faculty from the following departments:

- Business, Management, and Accounting (BMA),
- Computer Science and Engineering Technology (CSET),
- Engineering and Aviation Sciences (EAVS),
- Hospitality and Tourism Management (HTM), and
- the Built Environment (BE).

A council of faculty selected from BMA, CSET, HTM, BE, and EAVS will oversee the program's operation, curriculum, and admissions.

**A. Centrality to Institutional Mission 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 Master of Science in Data Science and Analytics Engineering (MSDSAE) degree program consists of a thesis option (30 credits), a project option (33 credits), and a coursework-only option (36 credits). The mission of the MSDSAE program is to provide students or working professionals with an advanced leaning in the discipline of data science and analytics engineering: to promote innovation and technology development in the emerging field of accounting analytics, aviation safety, machine learning, spatial technology, financial engineering, for UMES research enterprise; and to contribute to the economic development in the State of Maryland, especially in the Eastern Shore region where learning opportunities in advanced engineering disciplines is severely lacking.

The objective of the proposed degree program aligns with the mission of UMES. The UMES's mission statement states "University of Maryland Eastern Shore (UMES), the State's Historically Black 1890 Land-Grant institution, emphasizes baccalaureate and graduate programs in the liberal arts ... In keeping with its land-grant mandate, the University's purpose and uniqueness are grounded in distinctive learning, discovery, and engagement opportunities in agriculture, marine and environmental sciences, technology, engineering, and aviation sciences, health professions, and hospitality management. Degrees are offered at the bachelors, masters and doctoral levels." The establishment of the MSDSAE program at UMES will aid it in fulfilling the mission of UMES as a historically black, 1890 land-grant institution and serves to support the university goal of maintaining its Carnegie Research University classification.

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

Consistent with its mission, UMES seeks to expand its capacity to offer unique and/or critical certificate and degree programs. As such, the University has been working towards the development of a master's program in Data Science and Analytics Engineering to complement its undergraduate programs in Hospitality and Tourism Management, Engineering Technology with a concentration in Electrical/Electronic Engineering Technology, Computer Science, Engineering with specializations in Electrical and Computer, and a Business program which offers Bachelor's Degrees in Accounting, Business Administration, Finance, and Marketing, with elements of data analytics embedded throughout their curricula.

The proposed graduate program supports the institution's strategic goals. According to the UMES Strategic Plan (<https://www.wcp.umes.edu/president/strategic-plan/>), the proposed graduate program will support the following goals:

- *Goal III: Become a leading USM partner in research, innovation, and economic competitiveness*, Sub-Goal 3.1 Increase innovation in academic programs and delivery methods and 3.2 Align academic programs, educational centers, and enterprises, and co-curricular activities with workforce development needs;
- *Goal IV: Meet the educational needs of the state of Maryland with high-quality and innovative academic programming*, Sub-Goal 4.1 Align academic programs with the educational needs of the state of Maryland; and
- *Goal VI: Achieve and Maintain National Eminence and Global Impact*, Sub-Goal 6.1 Create signature academic programs to prepare students for careers nationally and internationally and 6.5 Compete for national recognition of academic programs.

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 of precision agriculture, construction, and computer science. In the past years, the existing undergraduate engineering program at UMES has continuously supplied undergraduate researchers to assist in research projects conducted by faculty members in agriculture, physics, and pharmaceutical science with their skills and knowledge in the engineering discipline. The proposed MSDSAE program is expected to enable stronger and multi-disciplinary research collaboration across the campus community, thus fueling research forward in many other different disciplines beyond engineering, and creating a much broader impact on the entire campus 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.)**

On April 2, 2021, Microsoft Corporation awarded UMES a \$100,000 cash donation to assist with the development and implementation of the MSDSA program. Additionally on March 2, 2022, Microsoft awarded UMES another cash gift of \$75,000 for which some of those funds will be supporting the development of aviation and cybersecurity related courses for the MSDSA program.

The previously mentioned funds will be used to support faculty development and the teaching of the MSDSA courses. In addition, the School of Business and Technology will reallocate one current full-time faculty position to also support the proposed program. After the expenditure of the Microsoft funds, the program is expected to be self-sustaining going forward beyond the first five years of the program's existence. Lastly, as an interdisciplinary program, it will draw faculty as needed from the following departments: Business, Management and Accounting (BMA), Computer Science and Engineering Technology (CSET), Engineering and Aviation Sciences (EAVS), Hospitality and Tourism Management (HTM), and the Built Environment (BE).

**4. Provide a description of the institution's commitment to:**

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

This degree program is created by leveraging, in part, the existing faculty and staff in the Department of Business, Management and Accounting, Department of Computer Science and Engineering Technology, Department of Engineering and Aviation Sciences, Department of Hospitality and Tourism Management, and Department of the Built Environment at UMES. The internal approval procedure for programmatic modification is indicative of UMES' commitment to ongoing administrative, financial, and technical support of the proposed program. The proposed master's program in Data Science and Analytics Engineering has been vetted by the faculty in the School of Business and Technology, the school Dean, Faculty Assembly Curriculum Committee, UMES Faculty Assembly (institution-wide shared governance body), the Provost and Vice President for Academic Affairs, as well as UMES President - indicating that the proposed program has been affirmed by the institution. Technical support from UMES Information Technology has been ongoing for several decades and no change is expected in the established processes for the proposed academic programs needing IT support.

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

UMES is committed to support the program with sufficient time for enrolled students to complete the Master of Science in Data Science and Analytics Engineering degree. To satisfactorily achieve strategic goals and maintain quality and excellence, the continuous support of the Data Science and Analytics Engineering program (e.g., students and candidates) through graduation, is essential to the UMES mission and goals.

**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***

The field of data science has existed for over thirty (30) years, but due to advances in technology and large data sets being generated due to advances in computational power of computing devices, the field of data science has gained increased importance to human society. Data science as a field is interdisciplinary in nature and can be applied to many applications in such fields as construction, image analysis, data processing, geoprocessing and tracking, predictive systems, mobile technology, finance, and health care to name a few.

One recent example of the application of data science in the healthcare field is in the development of the COVID-19 vaccines. According to Kose (2021), the application of data science to access information being generated by the modeling of test vaccines (i.e., the COVID-19 virus before and post-human trials) was key to the quick development of the eventual COVID-19 vaccines, which are now in use around the world.

**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 United States Census Bureau (<https://www.census.gov/quickfacts/somersetcountymaryland>). UMES offers the only undergraduate engineering degree program on the Eastern Shore of Maryland and there is a strong demand for a graduate education in engineering in the region. As such, offering the proposed master’s degree program is critical to the needs of the local economy.

The need for a graduate program in Data Science and Analytics Engineering on the Eastern Shore region will allow students in STEM majors at other regional institutions to enroll in the graduate program and hence serve the societal and economic needs of the Eastern Shore of Maryland in particular and the State of Maryland in general.

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

UMES offers the only engineering bachelor’s degree program on the Eastern Shore of Maryland. The proposed master’s program in Data Science and Analytics Engineering 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.

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

The proposed master’s 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 master's degree program is intended to prepare highly trained data scientists and analytic engineers at the graduate level in the areas of construction, image analysis and data processing, geoprocessing, and tracking, predictive systems, mobile technology, finance, and healthcare, which are becoming increasingly important and relevant to our society. However, graduate education can present barriers for students to 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 data scientist and analytic engineering workforce for the state.

**Success – Promote and implement practices and policies that will ensure student success.**

The practices and policies concerning the proposed master's degree program align with all existing policies at the University, which will ensure student success. By providing a carefully developed curriculum, sufficient 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 master's 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. The proposed approach is to ensure that Historically Black Institutions (HBIs) are *competitive, both in terms of programs and infrastructure*, with Maryland's other state institutions. Ultimately, the proposed degree program will prepare highly qualified data 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.**

It is anticipated that corporations such as Lockheed Martin, Boeing, Northrop Grumman Corporation, as well as government sectors such as NASA, US Navy, US Army would have a strong interest in hiring graduates of the proposed program. By leveraging UMES School of Business and Technology affiliation with the Advancing Minorities' Interest in Engineering (AMIE) and its corporate partners, it is expected that graduates of the proposed master's degree program will secure mid-level technical and management jobs in industry and the government sectors, where data science and engineering workforce is highly sought.

Our current graduates of the academic programs in the School of Business and Technology are working for various companies from small to large, including Microsoft, General Electric, Amazon, to name a few. Some are working for government sectors such as NASA, and the Department of Defense. Graduates with bachelor's degrees normally start with entry-level positions, while graduates with master's degrees normally start with mid-level positions.

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.**

<b>Job Title</b>	<b># of Maryland Positions (2018)</b>	<b># of Maryland Positions (2028)</b>	<b>Percentage Growth</b>
Computer and Mathematical Occupations	113,209	130,011	14.84%
Database Administrators	2,913	3,312	13.7%

Source: <http://www.dllr.state.md.us/lmi/iandoproj/maryland.shtml> (accessed February 22, 2022).

<b>Job Title</b>	<b># of Positions (2020)</b>	<b># of Positions (2030)</b>	<b>Percentage Growth</b>
Data Processing Systems Analysts	607,800	650,600	7%

Source: <https://www.bls.gov/ooh/computer-and-information-technology/computer-and-information-research-scientists.htm> (accessed February 22, 2022).

**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 Maryland Department of Labor Licensing and Regulation (DLLR) website does not have a specific job category for data science and analytics engineering. However, there is an umbrella category of Computer and Information Research Scientists which is representative of the field. 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, i.e. graduate degree, to fill positions related to Computer and Information Research Scientist.

<b>Job Title</b>	<b># of Maryland Positions (2018)</b>	<b># of Maryland Positions (2028)</b>	<b>Percentage Growth</b>
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).

Also, the United States Bureau of Labor Statistics (USBLS) website does not have a specific job category for data science and analytics engineering. However, there is an umbrella category of Computer and Information Research Scientists which is representative of the field. Therefore, according to the United States Bureau of Labor Statistics (USBLS) website, there is a current need for 33,000 positions nationally for persons with an education background, i.e. graduate degree, to fill positions related to Computer and Information Research Science. The median salary for an individual who is properly credentialed in the field is estimated to be \$126,830 according to the USBLS.

<b>Job Title</b>	<b># of Positions (2020)</b>	<b># of Positions (2030)</b>	<b>Percentage Growth</b>
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).

#### ***4. Provide data showing the current and projected supply of prospective graduates.***

The number of graduates from the current Bachelor of Science in Accounting (BSA), Bachelor of Science in Business Administration (BSBA), Bachelor of Science in Computer Science (BSCS), Bachelor of Science in Engineering (BSE), Bachelor of Science in Hos, Bachelor of Science in Finance (BSF), Bachelor of Science in Marketing (BSM), at UMES is summarized as follows:

<b>Program</b>	<b>2014-2015</b>	<b>2015-2016</b>	<b>2016-2017</b>	<b>2017-2018</b>	<b>2018-2019</b>	<b>2019-2020*</b>
BSA	15	15	15	15	15	14
BSBA	46	38	27	27	20	20
BSCS	17	15	11	18	23	22
BSE	14	11	11	7	22	19
BSHTM	34	39	33	44	22	26
BSF	2	2	8	5	4	8
BSM	-	-	2	8	7	14
<b>Total</b>	<b>128</b>	<b>120</b>	<b>107</b>	<b>124</b>	<b>113</b>	<b>123</b>

Based on the above number of graduates who will be eligible to enroll in the proposed master's degree, the projected supply of prospective graduates from UMES feeder programs are estimated to be ten (10) in the first year with a projection of ten (10) new students per year for the initial five years of the program's operation.

In addition to the United States Bureau of Labor Statistics, a project led effort with the University of Maryland Eastern Shore's faculty and students was considered to determine the implementation of learning techniques in the School of Business and Technology, Department of Engineering and Aviation Sciences as it relates to data analytics. The Institutional Review Board (IRB) at UMES had approved research protocols for studies that involved student-led research with faculty about student effectiveness using data analytics techniques for further advancement in STEM education and program development regarding interdisciplinary study. The IRB protocol number (11-2019-EXEMPT-007) review by the institution allowed the survey to be rendered about how the use of data analytics and methods to specific practices (e.g., safety management systems) can be examined to improve engineering and aviation sciences. From the course findings, learners were able to determine that data analytics concepts regarding safety management systems in engineering and aviation education. The learners had determined that the overall satisfaction and effectiveness using data analytics concepts as undergraduate students had allowed them to promote engineering and aviation practices using proposed industry features for database management and statistical evaluation. The figures below are used to highlight how the implementation and new programs associated with specific data analytics concepts can potentially advance student interest from an interdisciplinary approach in engineering and aviation education.

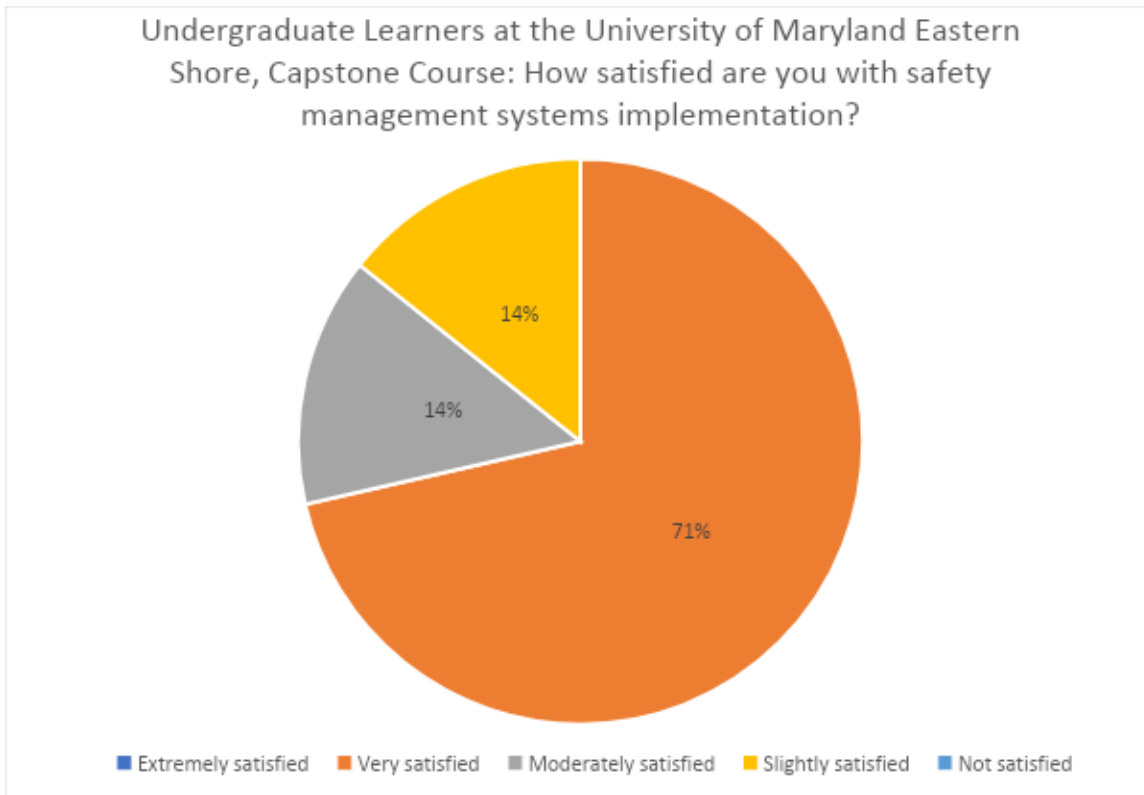


Figure 1. IRB approved case study from an interdisciplinary approach to determine undergraduate students' perspective about data analytics related concepts in engineering and aviation education using safety management systems and the overall implementation satisfaction.

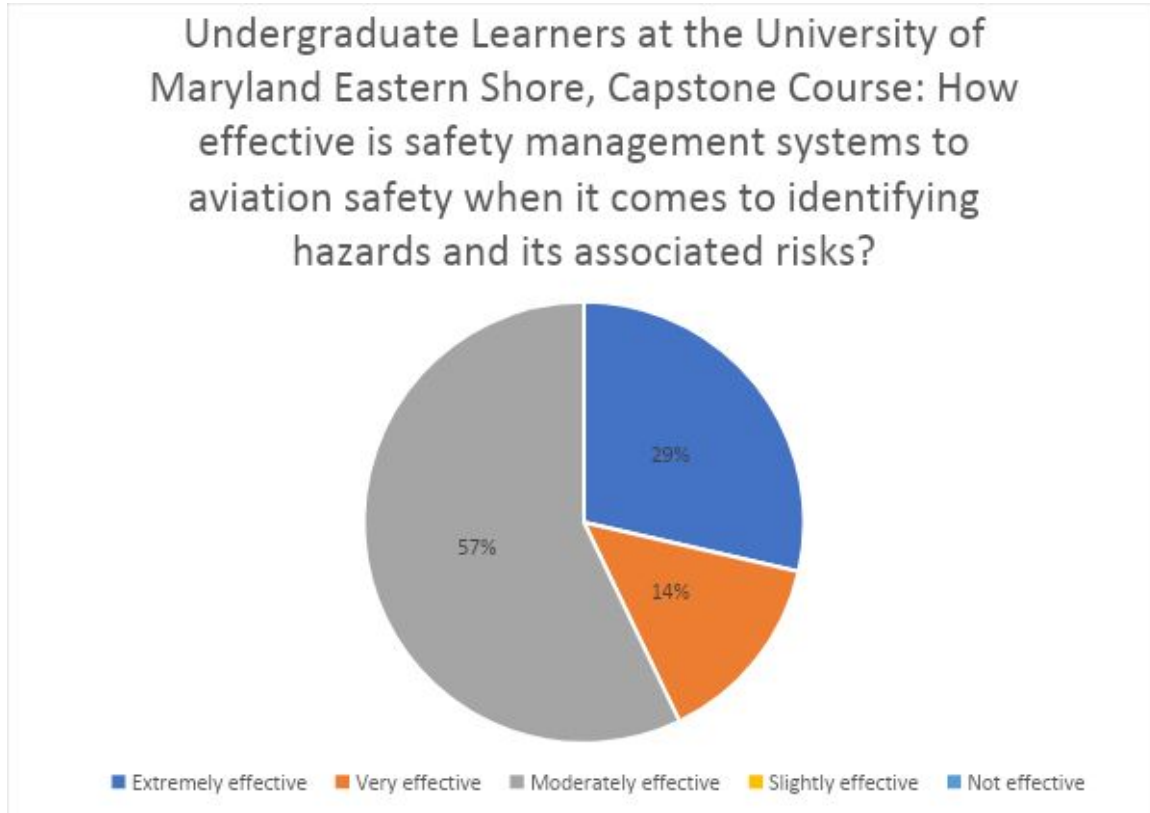


Figure 2. IRB approved case study from an interdisciplinary approach to determine undergraduate students' perspective about data analytics in engineering and aviation education using safety management systems and the overall effectiveness to learn and to identify key concepts in the field of practice.

This case study applies to undergraduate students as the findings mentioned the user experiences from an interdisciplinary perspective with the ability to promote data analytics according to industry practices, which positively had benefited learners in their fields. A majority of the learners believed that data analytics modeling such as safety management systems will be effective, and were overall satisfied with both the implementation of study and key techniques for advancement. Brown et al. (2018) explored the integration of data analytics with students and their ability to assess the potential research and practices in higher education. This engagement with the learners had explored the details of the market analysis proposed as a benefit to the industry, community impact, and higher education by adopting data analytics techniques (e.g., safety management systems) into an interdisciplinary approach (Brown et al., 2019).

#### **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.***

From our research, we are aware of several universities in the State of Maryland that are currently offering and/or have proposed similar programs with data science, analytics, and engineering-focused. Hereby, the University of Maryland Eastern Shore's offering of an interdisciplinary graduate program approach is proposed as a Master of Science in Data Science and Analytics

Engineering. The differences between this proposed program and others is the degree to be awarded by the School of Business and Technology at the University of Maryland Eastern Shore will present interdisciplinary concept specific to its departmental and program offerings. The table below captures the current institutional name with program title, description, and geographical area as discussed in the requirements.

<b>Institution</b>	<b>Program Title</b>	<b>Description</b>	<b>Geographical Area (w/Delivery Method Assessment)</b>
University of Maryland Global Campus (UMGC)	Master of Science Data Analytics	The Master of Science in data analytics program at the University of Maryland Global Campus is designed to meet the rising need for highly skilled professionals who can transform the growing amount of institutional data into valuable assets.	The delivery method is online; however, the campus location is not in the same geographical area in reference to Largo, Maryland.
University of Maryland College Park	Master of Professional Studies in Data Science and Analytics	The MPS in Data Science and Analytics is a 30-credit graduate program designed for working professionals and can be completed in less than two years. Instruction is provided by UMD faculty and experts in the field.	The program campus location offering is at College Park, Maryland and according to the instructional delivery methods, the course instruction is face-to-face on the UMD College Park campus with at least one online course. From these findings: The campus location is not in the same geographical area.
Capitol Technology University	Technical Master of Business Administration in Business Analytics & Data Science	The Technical Master of Business Administration in Business Analytics and Data Science allows students to integrate business and analytical decision-making skills in a technologically complex business environment.	The program offers a 100% online option located in Laurel, Maryland. Hence, the program offering has an online component, the campus location is not in the same geographical area to service our community.



<p>University of Maryland Baltimore County (UMBC)</p>	<p>Master of Professional Studies in Data Science</p>	<p>UMBC’s Master of Professional Studies (MPS) in Data Science program prepares students from a wide range of disciplinary backgrounds for careers in data science.</p>	<p>The program offers a pathway in the delivery method at UMBC’s main campus and Shady Grove campus location. The geographical area of the main campus is Baltimore, Maryland and the Shady Grove campus is Rockville, Maryland. Neither location is a part of the same geographical area as Princess Anne, Maryland. UMES has an off-site location at Shady Grove; hereby, the course offering plans to host the degree offerings at the Princess Anne campus location.</p>
<p>John Hopkins University</p>	<p>Master of Science in Data Analytics and Policy</p>	<p>This cutting-edge program empowers students to tackle meaningful policy challenges using analytics. Students graduate with the expertise to be data-driven decision makers and policy leaders in both the public and private sectors.</p>	<p>Both programs (MS in Data Analytics and Policy; and MS in Data Science) are either offered and listed as a delivery method of study with an online study or a hybrid study. From the previous findings with an online delivery method approach, the campus does not serve the same geographical area as UMES, as the institution's current campus location region is Baltimore, Maryland.</p>
	<p>Master of Science in Data Science</p>	<p>Enhance your career as a leader in a data-driven world and get a master’s in data science online—no GRE required. Courses in Computer Science and Applied Mathematics provide a foundation for launching our masters in data science graduates into a variety of specialized careers, including data pipeline and storage and statistical analysis.</p>	

<p>McDaniel College</p>	<p>Master of Science in Data Analytics</p>	<p>You'll notice right from the start that the Professional Masters in Data Analytics at McDaniel College is uniquely designed to prepare you for professional success. Every course in the curriculum integrates skills more typically found in arts and humanities courses that prepare the student to think more critically and through a more peripherally focused lens.</p>	<p>The delivery method with McDaniel College consists of a hybrid format with features on a full weekend per semester of an in-person class. This also includes an online experience with a hybrid format. With this approach, the demographic area that UMES services does not yield the flexibility to course interest in the Princess Anne location or the Eastern Shore community. McDaniel College's campus location is Westminster, Maryland.</p>
<p>Loyola University</p>	<p>Master of Data Science</p>	<p>Take your career to the next level with the online Master of Science in Data Science from Loyola University Maryland. This master's program provides the skills you need to become a data scientist. Students graduate ready for a career in the growing and in-demand field of data science.</p>	<p>The program offers an online delivery method option located in Baltimore, Maryland. As such, the Loyola University campus is not located in the same geographical area as the University of Maryland Eastern campus and service community.</p>
<p>Notre Dame University of Maryland</p>	<p>Master of Science in Analytics</p>	<p>The online Master of Science in Analytics prepares professionals to manage the architecture of knowledge from traditional- and online-based resources. The curriculum focuses on multidisciplinary competencies in knowledge management technologies, qualitative processes, and economic principles of change risk management.</p>	<p>The delivery method options include an online approach located in Baltimore, Maryland. As previously mentioned, our institutions with similar offerings of online in nearby regions do not service the location community here near the Eastern Shore region (e.g. Maryland, Virginia, and Delaware areas).</p>

<p>Maryland Institute College of Art</p>	<p>Master of Professional Studies in Data Analytics and Visualization</p>	<p>Maryland Institute College of Art (MICA) developed the Master of Professional Studies (M.P.S.) in Data Analytics and Visualization program to teach professionals how to represent information and data in a visual and impactful way with the use of graphics, images, and dynamic interactive features. In this program, you will develop design expertise and analytical skills that are in increasing demand in our data-driven world.</p>	<p>The delivery method is mentioned according to the residency overview as a 3-day in-person residency as presented to experience the Maryland Institute College of Art campus. In addition, the class delivery discusses flexible and adaptive web-based tools, software, and resources to support the learning experience. The Maryland Institute College of Art campus is located in Baltimore, Maryland, and will not be in the same geographical area as the University of Maryland Eastern Shore.</p>
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**2. Provide justification for the proposed program.**

In the proposed program justification, out of the nine (9) institutions with 10 different program offerings in the State listed at a master’s level, there were no master’s degree programs offered in the same geographical area or with an engineering focus (i.e., data science and analytic engineering). Through the methods of experiential learning that have been emphasized, the graduate-level program at the University of Maryland Eastern Shore will be the campus’s first interdisciplinary graduate program in the School of Business and Technology. The offerings will serve the Eastern Shore community, the state, and the nation as the geographical area location welcomes the opportunity to promote interdisciplinary teachings, research, and service. Henceforth, as the only current classified R2: Doctoral Universities – high research activity, as of January 2022, in the Eastern Shore region of Maryland, this will support any emerging studies in the same geographical area for advancement through the graduate level offerings.

**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.**

The uniqueness of the proposed high-demand program at the University of Maryland Eastern Shore is from the standpoint of the first academic program, within the School of Business and Technology, to have an interdisciplinary approach which directly impacts the effectiveness of academic program operational efficiency to advance innovation involving HBIs. Hereby, the interdisciplinary approach to implement and maintain current offerings reveals the need to explore such efforts at underrepresented minority institutions. The program offerings of interdisciplinary efforts at HBIs are not usually considered in previous developments; hence, the challenge in STEM practices encourages learners to be diverse in education and research concept. According to the table above that identifies the reasonableness of program duplication with other HBCUs, our findings do not present a master level program with the offering of keywords titles within the State of Maryland. These keywords in

the program title include data analytics, data visualization, data science, and data engineering. This is vital to the education trend in assessing and implementing maintenance of high-demand programs at HBIs.

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

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

The relevance of the University of Maryland Eastern Shore as a Historically Black 1890 land-grant institution serves a distinctive identity for HBIs in the State of Maryland. As such, the University of Maryland Eastern Shore is the State of Maryland's only Historically 1890 Land-grant with programs unique to the State as a four-year serving institution. The University of Maryland Eastern Shore references the mission of a student-centered, doctoral research degree-granting university known for its nationally accredited undergraduate and graduate programs, applied research, and highly valued graduates. To prepare 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. The proposed program is vital to the development of anticipated higher education demands that benefit the University of Maryland Eastern Shore through the promotion of research, teaching, and service.

## **G. Adequacy of Curriculum Design, Program Modality, and Related Learning Outcomes**

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

#### **How Was the Proposed Program Established?**

The decision to develop an academic proposal for a graduate program in Data Science and Analytics Engineering was made possible by a \$100,000 cash donation from the Microsoft Corporation. Receiving the funding award from the Microsoft Corporation help accelerate UMES' ability to develop and implement a cutting edge interdisciplinary graduate degree in Data Science and Analytics Engineering which can draw students not only from the fields of Engineering and Computer Science but also from Accounting, Business Administration, Construction, Finance, Hospitality and Tourism, Management and Marketing, where data analytics is becoming a key aspect to the knowledge business students are expected to demonstrate in current and future corporate America.

#### **Describe the Faculty Who Will Oversee the Program**

The proposed program will be overseen and supported by full-time and part-time faculty from the Department of Engineering and Aviation Sciences, Department of Computer Science and Engineering Technology, Department of Hospitality and Tourism Management, Department of the Built Environment, and the Department of Business, Management, and Accounting. Details of the contributions of the School of Business and Technology faculty who can make such contributions to the program development and implementation are discussed in a later section of this document.

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

In terms of educational objectives, it is the goal of the proposed program to:

1. Develop independent judgment and sound ethical values in expediting a project without jeopardizing its effectiveness, or cost;

2. Demonstrate effective communication of ideas utilizing spoken and written language;
3. Improve the professional technical practice of the Data Analytics field through continuing education and community service; and
4. Demonstrate humanistic values and responsibilities that promote active participation as productive citizens.

In terms of learning outcomes, the proposed program will build upon the Accreditation Board for Engineering and Technology, Inc. (ABET) 2022-2023 Criteria for Accrediting Computing programs. Graduates of the program will have the ability to:

1. Analyze a complex computing problem and apply principles of computing and other relevant disciplines to identify solutions;
2. Design, implement, and evaluate a computing-based solution to meet a given set of computing requirements in the context of the program's discipline;
3. Communicate effectively in a variety of professional contexts;
4. Recognize professional responsibilities and make informed judgments in computing practice, based on legal and ethical principles;
5. Function effectively as a member or leader of a team engaged in activities appropriate to the program's discipline; and
6. Apply theory, techniques, and tools throughout the data science lifecycle and employ the resulting knowledge to satisfy stakeholders' needs.

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

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

Periodic assessment of the impact of the proposed program will be monitored as part of the institutional assessment process and include an evaluation program operation against budget and enrollment projects with primary benchmarks dictated by the parameters of the semester and academic year. Data on the program's operation (enrollment, student-credit-hour production, expenses, and revenue) includes an annual assessment report to be used to improve the quality and relevance of educational opportunities offered by the School of Business and Technology at UMES.

Assessment methods for student achievement of learning outcomes will be based on established school and departmental standards and will include the following:

1. Assess written and oral student presentations, written assignments, and research projects;
2. Evaluate student performance on exams, quizzes, and assignments in required major courses; and
3. Assess comprehensive theses or research project reports by presenting at regional and national conferences.

The Student Learning Outcomes Assessment Process (SLOAP) is the degree program's procedures to determine if the program's mission, objectives and learning outcomes are being met. It explains the required assessment data to be collected, the frequency and evaluation methods to be used to examine whether the performance criteria, which have been discussed previously and below, are being met.

#### ***b) document student achievement of learning outcomes in the program***

The proposed program will document student achievement of the learning outcomes in the program in the same fashion as other currently accredited programs in the School of Business and Technology.

Assessment Methods based on previously established educational objectives and learning outcomes for the proposed program would include the following:

1. assess written and oral student presentations, written assignments, and research projects;
2. evaluate student performance in exams, quizzes, and assignments in required courses of the program; and
3. Evaluate students through a comprehensive exam and course-based projects.

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

**Admission Criteria**

Students admitted into the proposed graduate program will be required to meet the following requirements for unconditional admission:

1. Applicants are required to have a four-year bachelor's degree from a regionally accredited institution in the United States or its equivalent from a foreign institution as determined by an evaluation service accepted by UMES. Students must have a strong background in business, computer science, engineering, mathematics, statistics, science, or technology.
2. A minimum undergraduate cumulative GPA of 3.0 on a 4.0 scale,
3. Two (2) semesters of Calculus,
4. One (1) semester of Linear Algebra,
5. One (1) semester of Statistics, and
6. Two (2) semesters of a programming/scripting language or demonstrated experience with software data analysis tools.

Note: a prospective student can be admitted into the proposed graduate program conditionally at the discretion of the proposed graduate program admission committee.

**Admission Application Packet Contents**

A complete admission dossier should include:

- A. A complete Graduate School Application;
- B. Application processing fee;
- C. A 500 to 750-word statement of purpose outlining the rationale for seeking admission in the program and personal and professional goals with a focus on obtaining a graduate degree in the data science field;
- D. Transcripts of all post-secondary academic work;
- E. Two letters of recommendation from individuals acquainted with the applicant's academic and/or professional experience and his/her potential to complete a graduate program;
- F. Proof of prerequisites;
- G. A one-page resume or vita; and
- H. International applicants, whose primary language is not English, must take the TOEFL exam and obtain a satisfactory score.

**Courses and General Requirements for Degree**

All students in the proposed Masters of Science in Data Science and Analytics Engineering program will take thirty (30) credit hours with the Thesis option, thirty-three (33) credit hours with the project option, or thirty-six (36) credit hours for the course-work only option of graduate-level courses to

graduate from the program, not including any provisional admission course requirements, over four semesters. Student must obtain a minimum grade of B for all courses counted towards graduation.

**Thesis option:** the student must take three core (9 credits), a minimum of five elective (15 credits) graduate-level courses, and six credits of thesis. The thesis must be supervised by a faculty member, as a thesis advisor. The initial thesis proposal must be defended with an oral presentation 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 occur after completing the thesis. A student is required to submit at least one conference paper from his/her thesis work before the defense.

**Non-thesis option:** the student must take three core (9 credits) and a minimum of seven engineering electives (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 needs to perform a scholarly activity as part of his/her project work.

**Course-work only option:** the student will be required to take three core (9 credits) and a minimum of nine elective (27 credits) graduate-level courses.

#### Suggested Program Structure

	<u>Thesis Option</u>	<u>Project Option</u>	<u>Coursework Only Option</u>
<b>Core</b>	9	9	9
<b>Electives</b>	15	21	27
<b>Project</b>	N/A	3	N/A
<b>Thesis</b>	6	N/A	N/A
<b>Total</b>	<b>30</b>	<b>33</b>	<b>36</b>

#### Proposed Course Assigned Program Structure

##### Core:

- DSEN 600 Statistical inference with Business Applications 3 credits
- DSEN 610 Data Analysis 3 credits
- DSEN 615 Applied Statistics for Analytics 3 credits

##### Electives:

- DSEN 620 Cyber Analytics and Intelligence 3 credits
- DSEN 625 Spatial Technology and Data Analytics 3 credits
- DSEN 630 Financial Engineering, Management, and Modeling 3 credits
- DSEN 635 Analytical CRM (Customer Relationship Management) 3 credits
- DSEN 640 Accounting Analytics and Data Visualization 3 credits
- DSEN 645 Text Analysis for Business Application 3 credits
- DSEN 650 Machining Learning 3 credits
- DSEN 655 Predictive Analytics in Engineering and Aviation Systems 3 credits
- DSEN 668 Robotics. cross-listed with ENME/ENEE/ENCE 468 3 credits
- DSEN 665 AI and Big Data Analytics in Construction 3 credits
- DSEN 670 Data Analytics for Hospitality and Tourism Industry 3 credits

**Project Option:**

- DSEN 690 Data Analytics Master's Project. 1-3 credits

**Thesis Option:**

- DSEN 695 Data Analytics Master's Thesis. 1-6 credits

Proposal Course Rotation: Data Science in Data Science and Analytics Engineering									
	Fall 2023	Winter 2024	Spring 2024	Summer 2024	Fall 2024	Winter 2025	Spring 2025	Summer 2025	
DSEN 600	X								Core Courses
DSEN 610			X						Elective Courses
DSEN 615				✕					Project/Thesis Course
DSEN 620					X				
DSEN 625							X		
DSEN 630								✕	
DSEN 635	X								
DSEN 640			X						
DSEN 645				✕					
DSEN 650					X				
DSEN 655							X		
DSEN 668								✕	
DSEN 665	X								
DSEN 670			X						
DSEN 690	X	X	X	X	X	X	X	X	
DSEN 695	X	X	X	X	X	X	X	X	

**Proposed Course Descriptions****Course Master: Wei-Wei Zhu-Stone – Data Analytics****DSEN 610 Data Analysis****3 credits**

The course will cover the scientific decision-making process, understanding and visualizing data, and using predictive data analysis to study complex data sets. Graduate Standing and permission of the instructor. Instructional Delivery Method: On-line

**Course Master: Isaac Marcelin – Financial Analytics****DSEN 630 Financial Engineering, Management, and Modeling****3 credits**

Financial engineering, management, and modeling aim to provide engineers and data professionals the tools to create products using math and statistics to measure risk or invest money for a fund. It presents the essentials of financial modeling and shows how these can be solved numerically and simulated using computer-based software. First, it covers financial modeling fundamentals in corporate finance, financial statement simulation, portfolio problems, options, portfolio insurance, duration, and immunization. Second, it examines the issues and processes of short-term financing on industrial firms, financial analysis of cases, supplemented by readings to develop familiarity with sources and uses of working capital and the goals and problems involved in its management. Third, it also covers the analysis necessary for such long-term financial decisions as issuance of stock or bonds, contracting leases or loans, and financing a new enterprise; mergers, capital budgeting, the cost of capital, and the valuation of a business. Fourth, it further examines financial statement ratio analysis and the use of the capital asset pricing model related to risks and returns. Fifth, it finally explores leverage and capital structure and international managerial finance to examine the overall financial policy decision-making process. Prerequisites: MATH 310, 319, 333 or 316, 410; or BUAD 253, 354; and FINA 340 or 440 or permission of the Instructor. Instructional Delivery Method: On-line



**DSEN 615 Applied Statistics for Analytics.****3 credits**

This course introduces multivariate regression and data modeling, emphasizing linear regression, analysis of variance (ANOVA) and hierarchical regressions, hazard regressions, including testing, estimation, diagnostics and plots, and their extension. It is a computer course that relies on STATA, R, and MATLAB to analyze data. Major highlights include data management, variable selection, inferences, and model diagnostics. It addresses more advanced methods such as scatterplot matrices enhanced by smoothed or density contours, and search tools for finding graphics with suggestive patterns. A final project will involve modeling and exploring an actual data set with practical implications. Prerequisites: MATH 310, 319, 333 or 316, 410; or BUAD 253, 354 or permission of the Instructor. Instructional Delivery Method: On-line

**Course Master: Dr. Rob Richerson - Marketing****DSEN 635 Analytical CRM (Customer Relationship Management).****3 credits**

Today, firms commonly use IT-managed operational CRM systems to facilitate the sales process, maintain prospective and current customer information, and document customer/firm interactions. However, data-driven firms go beyond just using CRM operationally and engage in Analytical CRM. Analytical CRM uses data science techniques to transform customer-related data into actionable insights for strategic or tactical purposes. This course will cover the data science concepts and analyses used in Analytical CRM. Topics will include customer lifetime value, customer equity, k-means clustering, hierarchical clustering, customer portfolio analysis, shopping basket analysis (affinity grouping), decision trees, predictive models for propensity to purchase and probability of churn, and RFM analysis. Additional topics may include sentiment analysis and multidimensional scaling for perceptual mapping. For each technique, students will learn the technique and run the analysis. Prerequisite: Graduate Standing. Instructional Delivery Method: On-line

**Course Master: Leslie West - Accounting****DSEN640 Accounting Analytics and Data Visualization.****3 credits**

This course will introduce analytical techniques for examining complex and large financial data sets. Students will obtain insights into analyzing financial information, assisting businesses with process improvement, enhancing operational efficiency, and developing risk assessments. Topics may include an overview of big data, problem assessment, financial statement analysis, data analysis and visualization, and managing risks for decision-making. The course will utilize MS Excel and Tableau. Prerequisite: Business Statistics. Prerequisite: Graduate Standing. Instructional Delivery Method: On-line

**Course Master: Fang “Grace” Yu - Business****DSEN 645 Text Analysis for Business Application.****3 credits**

This course is an introduction to analyzing text data with a focus on business applications, intuition, and how to use algorithms. Techniques covered include simple text matching, topic modeling, regex, tf-idf, word2vec, BERT, and more. Applications covered consist of content moderation for hate speech, analyzing customer feedback, optimizing naming and description strategies for discovery on search engines, creating recommendation systems for products, and more. The course requires an introductory course or more in linear algebra and Python programming. Prerequisite: Graduate Standing. Instructional Delivery Method: On-line

**DSEN 600 Statistical inference with Business Applications.****3 credits**

This course is an introduction to cross-sectional data analysis with a focus on business applications. The course will focus mainly on the intuitive understanding of the techniques used and how to use these techniques in SPSS (or R or Stata), with some linear algebra included. Topics covered include

experiments, data cleaning, multiple linear regression, the Frisch-Waugh theorem, instrumental variables, regression discontinuities, and more. Applications covered include case studies of New Coke, the national debt, etc., and general problems, such as pricing strategy, demand projection, and customer retention. Students are required to have taken linear algebra and a probability course with calculus foundations. Students are encouraged to have some familiarity with SPSS, R, or Stata. Prerequisite: Graduate Standing. Instructional Delivery Method: On-line

**DSEN 650 Machining Learning.**

**3 credits**

This course introduces machine learning with a focus on business applications. This course will cover an intuitive understanding of the techniques used and how to use these techniques in Python, with some linear algebra included. Topics covered include sentiment analysis, word embedding, topic modeling, face detection, emotion detection, machine transcription, recommendation systems, and machine translation. These topics will be discussed regarding various algorithms and will cover related business fields for customer clustering, sales prediction, customer lifetime value, content creation, customer feedback analysis, and more. Students are required to have one course completed in linear algebra and one course in Python programming. Prerequisite: Graduate Standing. Instructional Delivery Method: On-line

**Course Master: Willie Brown/I.K. Dabipi - Aviation**

**DSEN 655 - Predictive Analytics in Engineering and Aviation Systems.**

**3 credits**

This course introduces design concepts, principles, and best practices in data science engineering that can be used to advance aviation systems and performances through predictive analytics techniques. The course covers the implementation of aviation performances and operational environments using data trends and application solutions with exploratory analysis and modeling. The learned topics to evaluate performance measures and methods include the use of data ingestion, processing, storage, and analytics. Learners are required to compare data models and system requirements by considering big data situations to evaluate predictive analytics techniques for modeling discovery in data science. Prerequisite: Graduate Standing. Instructional Delivery Method: Face-to-Face

**Course Master: Abhijit Nagchaudhuri - Robotics**

**DSEN 667 Robotics.**

**3 credits**

This course covers 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. Cross-listed with ENME/ENEE/ENCE 468. Prerequisite: Graduate Standing. Instructional Delivery Method: Face-to-Face

**Course Master: Lufan Wang – Construction**

**DSEN 665 AI and Big Data Analytics in Construction.**

**3 credits**

In this course, students will learn about the latest AI technologies that are proactively used in today's practice, explore the fundamental of unresolved AI problems that are unsolved, and identify and address the perceptual gaps between what AI in AEC is doing, what it can do, and what it's advertised doing. Course assignments will include readings, lectures by AI and AEC experts, programming exercises, and hands-on course-long projects. The ultimate goal of the course is to help students build essential knowledge and AI skills towards driving innovation in their careers. Prerequisite: Graduate Standing. Instructional Delivery Method: On-line

**Course Master: Derrek Dunn – Cyber and Spatial**

**DSEN 620 Cyber Analytics and Intelligence.**

**3 credits**

This course covers the evaluations and applications of contemporary machine learning techniques in the cybersecurity field. Topics may include an overview of popular machine learning algorithms, application areas of machine learning in cybersecurity, vulnerability and risk assessment using machine learning techniques, and development of machine learning-based solutions to mitigate cyber threats and risks, and for informed decision making. Prerequisite: Graduate Standing. Instructional Delivery Method: On-line

**DSEN 625 Spatial Technology and Data Analytics.**

**3 credits**

This course covers rich geospatial data from government agencies, social media, and the semantic web. Students will be exposed to introductory methods in Spatial Data Analytics afforded by Global Positioning Systems (GPS), Remote Sensing (RS), Geographic Information Systems (GIS), Spatial Analysis, and Mapping technologies. The course is intended to develop students' abilities to apply spatial thinking and data analytics to problem-solving. Prerequisite: Graduate Standing. Instructional Delivery Method: On-line

**Course Master: Dr. Katherine A. Quinn – Hospitality and Tourism Management**

**DSEN 670 Data Analytics for Hospitality and Tourism Industry.**

**3 credit**

The course is designed to provide students with the fundamental concepts and practical applications of data analytics in the hospitality and tourism industry. Upon completion of the course, students will understand the decision-making process and will be able to develop strategies for managing revenue using real data, trend reports, and HOST and pipeline information provided by STR (Smith Travel Research), a hotel management analytics firm. Students will also earn the Certification in Hotel Industry Analytics (CHIA), with a passing exam grade of 70%. This globally-recognized professional credential validates an advanced knowledge in hotel industry analytics and is offered by the American Hotel & Lodging Educational Institute (AHLEI) in partnership with STR, the global source for benchmarking and forecasting data.

Prerequisite: Graduate Standing. Instructional Delivery Method: On-line

**Project Option**

**DSEN 690 Data Analytics Project.**

**1-3 credits**

This course consists of the developing and implementing individual research projects geared toward students' interests. Specific requirements related to each independent research study are approved on an individual basis. Course may be repeated. Instructional Delivery Method: On-line or Face-to-Face

**Thesis Option**

**DSEN 695 Data Analytics Master's Thesis.**

**1-6 credits**

This course is required of all students involved in the preparation, data collection, and writing of the Master of Science (MS) thesis. Course may be repeated. Instructional Delivery Method: On-line or Face-to-Face

***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 or 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 and financial aid resources, and costs and payment policies.***

As with other academic programs offered by the University of Maryland Eastern Shore, 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 and financial aid resources, and costs and payment policies.

**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 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 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 currently have articulation partners at the master's program 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./M.S. articulation between the B.S. in Data Science at Salisbury University and the proposed master's 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 field to obtain a M.S. in Data Science and Analytics Engineering degree.

## **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.***

The following faculty are course masters and instructors to support the proposed program at its outset:

**Full-Time Faculty**

**Dr. Willie Brown, Jr. is an Associate Professor in the Department of Engineering and Aviation Sciences.** Dr. Brown earned his Ph.D. Business Administration specializing in Homeland Security Leadership and Policy (Aviation Safety and Security) from Northcentral University through the Embry-Riddle Aeronautical University consortium agreement partnership for aeronautics-related disciplines. His master's degree is in Software Engineering (Aeronautics) from Embry-Riddle Aeronautical University. Dr. Brown also earned dual degrees from Elizabeth City State University, North Carolina, with a Bachelor of Science in Aviation Science, and a Bachelor of Science in Computer Science. In addition, Brown is a Federal Aviation Administration (FAA) licensed private pilot. His experiences include the North Carolina Department of Transportation, the Junior Research Faculty for the IEEE Conference on Communications and Network Security (CNS), and the Office of Naval Research/National Aeronautics and Space Administration. Dr. Brown is continuing his education, research, and teaching in data analytics with a focus on aviation safety and security, systems, and software development.

**Dr. Ibibia K. Dabipi is a Professor in 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 technical staff with a primary research focus in communications and networks.

**Dr. Derrek B. Dunn is a Professor in Computer Science and Engineering Technology.** He received his Ph.D. and M.S. in Electrical Engineering from Virginia Polytechnic Institute and State University (Virginia Tech). His experiences include working at Hewlett-Packard Laboratory and Oak Ridge National Laboratory as a summer faculty researcher with a primary research focus in communications and networks. Dr. Dunn teaches and conducts research in Cybersecurity, Global Positioning Systems, and Wireless Communication Systems.

**Dr. Isaac Marcelin is a tenured Associate Professor in the Department of Business, Management and Accounting.** He received his Ph.D. and MBA in Finance from Southern Illinois University Carbondale (SIUC). He served as an advisor in Finance to two Haitian Prime Ministers and provided consultancy to several global agencies, including USAID, UNESCO, Oxfam, etc. Dr. Marcelin teaches Financial Management, Derivatives, Money and Banking, International Finance with emphasis on Blockchain, Real Estate, etc. His research emphasizes political institutions and banking.

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

**Dr. Katherine A. Quinn is an Assistant Professor of Finance and Technology in the Department of Hospitality & Tourism Management.** Dr. Quinn is a Certified Hospitality Educator (CHE) and holds certification from the AHLEI in Hotel Industry Analytics (CHIA). She received her doctorate in Organizational Leadership from the University of Maryland, Eastern Shore, and her Master of Business Administration degree in Finance from the University of Maryland, Smith School of Business. She graduated cum laude from the University of Maryland, where she earned a Bachelor of Science degree in Marketing. She is an active member of the International Council on Hotel, Restaurant, & Institutional Education (CHRIE) and is a Life Member and Chapter Officer for the

Honor Society of Phi Kappa Phi (PKP). Her research interests include the role of grit and self-discipline in student success, the adoption of e-learning resources to enhance student achievement, and the skills and competencies necessary for successful careers in the hospitality industry.

**Dr. Rob Richerson is an Assistant Professor of Marketing in the Department of Business, Management and Accounting.** He received his Ph.D. in Marketing from the University of Kentucky, and his MBA from the University of Southern Mississippi. Dr. Richerson conducts research in Consumer Behavior and Marketing. Dr. Richerson teaches Content Marketing, Marketing Research, Sales Management, Marketing Principles, and Marketing Fundamentals for Small Businesses/Entrepreneurs.

**Dr. WeiWei Zhu-Stone is an Associate Professor in Computer Science and Engineering Technology.** She received a Ph.D. degree in Applied Mathematics and a Master of Science in Computer Science from the University of Missouri-St. Louis. Her industrial experience includes working at Panda Electronics Group Co., Ltd., in Nanjing, China. She has taught over 20 courses in multi-disciplines, and advised students' research and graduate projects at both the undergraduate and graduate levels. Her research interests include Blockchain, big data analysis, game-based learning, tsunami prediction, wavelet analysis, and non-uniform B-spline analysis. Dr. Stone has been active in serving the professional areas as well as the local community. She also directs the graduate program of the department.

**Dr. Leslie L. West is an Assistant Professor in the Department of Business, Management and Accounting.** She received her Ph.D. from Hampton University and M.S. from Old Dominion University. She has obtained diverse experiences as an auditor and analyst from federal and state government, manufacturing, financial, and healthcare industries. She has worked with the U.S. Government Accountability Office, Pepsi Bottling Ventures, LLC, and the North Carolina Department of State Treasurer. Dr. West teaches and conducts research in Auditing, Financial Accounting, and Business Communication.

**Dr. Grace F. Yu-Buck is an Assistant Professor in Marketing in the Department of Business, Management and Accounting.** She received her Ph.D. in Marketing from the University of Utah. Dr. Yu-Buck teaches Principles of Marketing, Retail Management, and Marketing Software Applications. Her research currently focuses on consumer behavior and she explores the topic of consumer behavior with methods ranging from experiments to machine learning.

#### **Part-Time (Adjunct) Faculty**

**Dr. Celeste Chamberlain, CISSP, is a part-time faculty member in the Department of Computer Science and Engineering Technology.** She received her D.Sc. in Emergency Management from Jacksonville State University, M.S. in Informatics from Northeastern University, and B.Sc. in Computer Science from Hampton University. Her experiences include working with the U.S. Senate Homeland Security and Governance Affairs Committee as a cybersecurity legislative advisor, and 20 years creating cybersecurity governance under the Department of Homeland Security.

**Dr. Lufan Wang is a part-time faculty member in the School of Business and Technology.** She received her Ph.D. and M.S. in Civil Engineering with a concentration in computational science and engineering from the University of Illinois at Urbana-Champaign (UIUC). Her research interests lie in data analytics to better understand and model the behavior and interactions between the urban and human systems for the development and operation of smart, sustainable, and resilient buildings, infrastructure systems, communities, and cities.

**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 faculty program includes funding to attend pedagogy conferences, faculty workshops, FACTE working group, seminar series for new faculty, and an innovation in teaching & learning conference. 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 (as outlined in COMAR 13B.02.03.12).**

**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 Interlibrary 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**

<b>New Program(s)</b>	<b>eJournal Titles</b>	<b>eBooks</b>
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 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 (as outlined in COMAR 13B.02.03.13)**

- 1. Provide an assurance 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.**

*Physical Facilities: No additional facilities are required.*

The University of Maryland Eastern Shore, School of Business and Technology, Department of Computer Science and Engineering Technology is housed in the Engineering and Aviation Science Complex within a 166,000 square feet facility which was completed in 2015/2016.

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 available also in the same building, which makes it very convenient for students to take classes and conduct laboratory experiments.

*Infrastructure Equipment: The program does not need any additional infrastructure equipment.*

All faculty and staff in the School of Business and Technology have individual offices that will facilitate student advising, office hours, etc. Sufficient classrooms are available also 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**

All students who are admitted and enrolled at UMES are assigned a Google Gmail email system and have access to the Google Meets video conferencing systems.

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

Faculty support for development and instructions is provided by the Information Technology Department, Center for Instructional Technology and Online Learning (CITOL), and Academic Computing Unit professionals. The learning management system (LMS) is available for instructional design, software development, educational research, Canvas Learning Management System (LSM), etc. These technologies and opportunities ensure students enrolled in courses and faculty development for teaching includes adequate access to the learning resources.

In addition, the Center for Instructional Technology and Online Learning (CITOL) at UMES assists faculty and students in all aspects of e-learning including hosting, training, development, and support of the Canvas Learning Management System, Google Education Plus, Echo360, and Respondus. UMES' web portal is a single sign-on allowing students, faculty, and staff access to:

- HawkWeb - a system where student enrollments and registrations, class rosters, and administrative functions related to academics are located.
- Canvas - the learning management system where course content can be published as well as where the entire online course experience for students is managed.
- Web Help Desk - the Information Technology Help Desk system where you can create a ticket to request assistance for your computer, networking, and telephone needs.

The UMES campus has wireless networking access points to allow network access from a wireless-enabled device like a laptop, smartphone, or tablet.

**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 <sup>1</sup>	\$48,460				
2. Tuition/Fee Revenue <sup>2</sup> (c+g below)	\$71,280	\$120,180	\$170,940	\$223,720	\$278,495
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)	\$46,500	\$94,860	\$145,140	\$197,380	\$251,675
d. # PT Students	5	5	5	5	5
e. Credit Hour Rate	\$413	\$422	\$430	\$439	\$447
f. Annual Credit Hours	12	12	12	12	12
g. Total Part Time Revenue (d x e x f)	\$24,780	\$25,320	\$25,800	\$26,340	\$26,820
3. Grants, Contracts & Other External Sources <sup>3</sup>	\$20,000	\$20,000	\$20,000	\$20,000	\$20,000
4. Other Sources	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
TOTAL (Add 1 - 4)	\$139,740	\$140,180	\$190,940	\$243,720	\$298,495

### **Narrative Rationale for Resources**

1. Reallocated Funds  
One FTE faculty position will be reallocated from existing programs.

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 12 credits per academic year for part-time students.

3. Grants and Contracts

The Microsoft Corporation has provided a \$100,000 cash gift to assist UMES with the development and implementation of the proposed program. The funds are allocated for use over the first five years of the program's operation.

4. Other Sources

No additional sources of funding are expected at this time.

Total Year: 5-year estimate is provided.

**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)	\$139,740	\$139,740	\$139,740	\$139,740	\$139,740
a. # FTE	1.67	1.67	1.67	1.67	1.67
b. Total Salary	\$102,000	\$102,000	\$102,000	\$102,000	\$102,000
c. Total Benefits (37%)	\$37,740	\$37,740	\$37,740	\$37,740	\$37,740
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	\$0	\$0	\$0	\$0	\$0
5. Library	0	0	0	0	0
6. New or Renovated Space	0	0	0	0	0
7. Other Expenses	\$0	\$0	\$0	\$0	\$0
TOTAL (Add 1 - 7)	\$139,740	\$139,740	\$139,740	\$139,740	\$139,740

### **Narrative Rationale for Expenditure**

1. Faculty (# FTE, Salary and Benefits)  
Each year over the next five years, the proposed program will employ 1.67 FTE faculty per hired (with backgrounds in the proposed program course) to operate the program.  
There will be no need for additional administrative staff. The existing departments' and school administrative staff will be sufficient to run the program.
2. Support Staff (# FTE, Salary and Benefits)  
None
3. Equipment  
None.
4. Library  
None.
5. New and/or Renovated Space  
Not needed
6. Other Expenses  
None.

### **M. Adequacy of Provisions for Evaluation of Program (as outlined in COMAR 13B.02.03.15).**

1. *Discuss procedures for evaluating courses, faculty and student learning outcomes.*

### **Course Evaluation**

The University of Maryland Eastern Shore 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 to analyze results and used to improve course curriculum and pedagogy.

Once the program is launched, the courses will enter the course evaluation system. Teaching evaluation asks 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.

Achievement of the program outcomes will be assessed using direct and indirect methods as described in the proposed Assessment Plan developed by the School of Business and Technology faculty at UMES for the proposed Data Science and Analytics Engineering. The assessment procedure is currently being developed to evaluate the proposed program's courses will be designed to be in line with the continuous program improvement as required by other accreditation bodies that review other degree programs in the School of Business and Technology at UMES including the American Council

for Construction Education (ACCE), National Council for Accreditation of Teacher Education (NCATE), now called Council for the Accreditation of Educator Preparation (CAEP), Association to Advance Collegiate Schools of Business (AACSB), Accreditation Commission for Programs in Hospitality Administration (ACPHA), Professional Golfers' Association of America (PGA), and Accreditation Board for Engineering and Technology (ABET).

### **Faculty Evaluations**

Faculty evaluations are conducted with an initial meeting at the start of each academic year, a mid-year meeting typically in January of each academic year, and a final evaluation meeting in April of each academic year. The faculty evaluation process at UMES is as follows:

At the beginning of the academic year, the faculty is required to meet with the department chair to discuss goals and objectives for the academic year. The individual faculty objectives must reflect:

- Departmental, school, and university goals;
- Faculty assignment (defined as % time allocated for each category based on appointment and release time awarded for that year);
  - Note: Faculty who are on 100% teaching lines with no approved release time are expected to have the following % breakdown: 50%, teaching 35 % scholarship, 15% service; and
- Faculty member's professional development.

During the academic year, the department chair would be informed of any major changes made to the objectives. If necessary, the department chair will share information with the faculty member regarding the areas of concern.

In January, the faculty will meet with the chair to review progress towards the objectives.

In April, each faculty member will submit the faculty evaluation document to the department chair. The Department Chair will review the information and discuss his/her evaluation with the faculty member. Students' evaluations of instruction will be utilized in this discussion between the Chair and faculty members. Copies of the summary evaluations should be attached, as they become available. Note: Peer review of teaching will be included if done.

### **Student Learning Outcome Evaluation**

Based on established school standards, we will establish an ongoing program evaluation where we,

- Assess samples of student performance on computer-based problems and projects.
- Assess samples of the use of technology in student presentations.
- Assess samples of the group and individual case studies.
- Assess written and oral student presentations, written assignments, and research projects.
- Track analytical performance in courses.
- Evaluate student performance in exams, quizzes, and assignments in elective courses.
- Assess comprehensive final exams in core courses.

Assessment instruments include graded student work, and the evaluation of written project papers, and presentations. The achievement levels are determined using the rubrics developed separately for each outcome.



**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.***

In addition, every faculty is evaluated each year. The evaluation process includes an assessment of faculty teaching, faculty research record and productivity, 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 Office of Decision Sciences and Visualization 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 State's Minority Student Achievement**

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

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

As part of UMES Strategic Plan Subgoal 4.1: Improve structure for attracting, developing, and retaining high quality and diverse students; UMES takes pride in the diversity of its faculty, staff, and students with representation from 37 states and 47 countries. UMES values people of different ethnicities, orientations, cultures, and perspectives. The University of Maryland Eastern Shore has one of the most racially and ethnically diverse student populations in the University System of Maryland. Based on fall 2017 data, UMES faculty were 56% African American, 27% White, 5% Asian, 1% American Indian, and 5% international. Student race and ethnicity statistics from fall 2017 reflect a student population that was 69.7% African American, 12.3% White, 8.8% two or more races, 3.6% Hispanic, 1.2% Asian, and 3.8% international.

UMES offers the most competitive tuition rates in the state of Maryland compared to other institutions in Maryland. This improves minority student access. Our program appeals to minority students, as evidenced by the high proportion of minority student enrollment in UMES degree programs. We support educationally disadvantaged minority students by offering remediation and mentoring relationships. We also have a policy that allows us to offer provisional admission to students with a GPA less than 2.75 and who possess qualities or life experiences that suggest they are well suited for the data science profession.

**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 Master of Science in Data Science and Analytics Engineering program is not directly related to an identified low productivity program at UMES.

**P. Adequacy of Distance Education Programs**

***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.

**References:**

Brown, W., Zhang, L., Sharma, D. K., Dabipi, I., Zhu, W., Jin, Y., and Bagwell, D. (2019). Engaging undergraduate engineering and aviation students to explore project based learning with regard to community impact using data analytics in higher education, *IEEE Frontiers in Education*, pg. 1- 6

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April 2, 2021

University of Maryland Eastern Shore  
Attn: Dr. Derrek Dunn  
Comptroller's Office  
SDC Building, Suite 1160  
Princess Anne, MD 21853-1299

Dear Dr. Dunn:

Microsoft is pleased to provide University of Maryland Eastern Shore with a \$100,000 unrestricted gift to support funding requested from our recent round of Invitation for Proposals called Impact 2020. We would like to support your efforts to fund faculty to develop 10 interdisciplinary graduate Data Science Engineering courses (\$40,000) and provide the start-up funds to offer the interdisciplinary graduate program in Data Science Engineering (\$60,000).

Microsoft is committed to compliance with any and all applicable laws, regulations and ethics rules concerning the receipt of gifts, including university policies. Microsoft engaged with you 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.

I will be your main contact regarding Microsoft's financial support. If you have any questions regarding this gift, please feel free to contact me by e-mail at [kaneal@microsoft.com](mailto:kaneal@microsoft.com).

Sincerely,

A handwritten signature in cursive script that reads "Kathryn Neal".

Dr. Kathryn Neal  
Senior Director, University Relations

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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](mailto:brissaq@microsoft.com) or by phone at (559) 290-9079.

Sincerely,

A handwritten signature in cursive script that reads "Kathryn Neal".

Dr. Kathryn Neal  
Senior Director, University Relations

Microsoft Corporation is an equal opportunity employer.



**BOARD OF REGENTS**  
 SUMMARY OF ITEM FOR ACTION,  
 INFORMATION, OR DISCUSSION

**TOPIC:** University of Maryland Eastern Shore: Master of Science in Electrical and Mechatronics Engineering

**COMMITTEE:** Education Policy and Student Life

**DATE OF COMMITTEE MEETING:** Tuesday, November 15, 2022

**SUMMARY:** The University of Maryland Eastern Shore is please to present a proposal for the creating of a Master of Science degree in Electrical and Mechatronics Engineering (MSEME). This program aligns with both UMES’s and USM’s strategic goals, aiming to produce the next generation of engineers and leaders and meet demands for engineering professionals and a technical workforce in the knowledge economy of Maryland. The proposed MS program offers prospective students a graduate curriculum with strong foundations in theory and practice to address the growing need for cross-disciplinary engineers skilled in the areas of robotics, control, electronics, communications, automation, and advanced manufacturing technologies. The technical talents produced by this program are expected to help grow industries like aerospace/defense, agriculture, biotechnology, and clean energy.

Most students enrolling in the MSEME at UMES will have already completed degrees in engineering or other closely related fields such as computer science and technology. The program will prepare students for professional success in several fields that include precision agriculture, smart shellfish farming, health care, the aerospace industry, etc. Graduates who remain on the Eastern Shore of Maryland will help create a knowledge-based economy for the local community, with the potential of transforming the entire economic landscape of the lower-shore. They are expected, for example, to engage in transforming traditional farming to next-generation smart agriculture; and to reshape conventional manufacturing industries through advanced automation or artificial intelligence implementation.

**ALTERNATIVE(S):** The Regents may not approve the program or may request further information.

**FISCAL IMPACT:** No additional funds are required. The programs can be supported by the projected tuition and fees revenue.

**CHANCELLOR’S RECOMMENDATION:** That the Education Policy and Student Life Committee recommend that the Board of Regents approve the proposal from University of Maryland Eastern Shore to offer the Master of Science (M.S.) in Electrical and Mechatronics Engineering.

COMMITTEE RECOMMENDATION: DATE: November 15, 2022

BOARD ACTION: DATE:

SUBMITTED BY: Joann A. Boughman 301-445-1992 jboughman@usmd.edu



UNIVERSITY OF MARYLAND EASTERN SHORE  
*Office of the President*

October 14, 2022

Dr. Jay Perman, Chancellor  
University System of Maryland  
701 E. Pratt Street  
Baltimore, MD 21202

**RE: New Academic Program Proposal – Master of Science in Electrical and Mechatronics Engineering**

Dear Dr. Perman:

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

**Program:** MS in Electrical and Mechatronics Engineering (MSEME)

The Department of Engineering and Aviation Sciences is proposing to offer an MS degree in Electrical and Mechatronics Engineering (MSEME). This program is expected to play a crucial role in preparing professionals to work in various positions related to the field of electrical and mechatronics engineering.

The proposed program will be the first master's degree program in engineering in the Department of Engineering and Aviation Sciences since the BS engineering program at UMES was established in 2007. The proposed MS program aims to offer prospective students a graduate curriculum with strong foundations in theory and practice to address the growing need for cross-disciplinary engineers skilled in the areas of robotics, control, electronics, communications, automation, and advanced manufacturing technologies. The technical talents produced by this program are expected to help grow industries like aerospace/defense, agriculture, biotechnology, and clean energy. It will also prepare students, especially those with disadvantaged backgrounds, with the knowledge and tools necessary to take on engineering leadership roles to shape the future of the technology advancement in the state and the region including the Eastern Shore of Maryland.

The proposed MS degree program offers two options with respect to the number of required credits. For the thesis option, thirty (30) credits are required. For the non-thesis option, thirty-three (33) credits are required. 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,

A handwritten signature in cursive script, appearing to read "Heidi M. Anderson".

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. Yuanwei Jin, Professor and Chair, Department of Engineering and Aviation Sciences



**UNIVERSITY SYSTEM OF MARYLAND INSTITUTION PROPOSAL FOR**

- New Instructional Program
- Substantial Expansion/Major Modification
- Cooperative Degree Program
- Within Existing Resources, or
- Requiring New Resources

**University of Maryland Eastern Shore**

Institution Submitting Proposal

**Master of Science in Electrical and Mechatronics Engineering**

Title of Proposed Program

**Master of Science**

Award to be Offered

**Fall 2023**

Projected Implementation Date

**090900.00**

Proposed HEGIS Code

**141009.000**

Proposed CIP Code

**Engineering and Aviation Sciences**

Department in which program will be located

**Dr. Yuanwei Jin**

Department Contact

**(410) 621-3410**

Contact Phone Number

**yjin@umes.edu**

Contact E-Mail Address



Signature of President or Designee

**October 5, 2022**

Date



**DIVISION of ACADEMIC AFFAIRS**  
**Office of the Provost & Vice President**

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**Master of Science in Electrical and Mechatronics Engineering (MSEME)**

**Proposal Executive Summary**

The Department of Engineering and Aviation Sciences at the University of Maryland Eastern Shore (UMES) proposes to establish a **Master of Science in Electrical and Mechatronics Engineering (MSEME)** degree program at UMES. The MSEME aims to offer perspective students a graduate program with strong foundations in theory and practical to meet the needs of technical professionals including those in the Eastern Shore of Maryland with more advanced learning in a specialized discipline of electrical and mechatronics engineering. The program, if established, will help students develop new technologies in the emerging fields such as 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 agriculture, health care, automobile, aerospace, and clean energy systems, etc. It will also prepare them, especially those with disadvantaged background, with the knowledge and tools necessary to take on engineering leadership roles to shape the future of the technology advancement.

The MSEME has the following two areas of emphasis (Tracks):

Degree Program:

Master of Science in Electrical and Mechatronics Engineering (MSEME)

1. Track 1: Mechatronics and Control
2. Track 2: Communications and Networks

These two areas of emphasis align with the expertise and research focus of existing engineering faculty in the department and emerging research areas in the electrical engineering and related fields. The MSEME requires a minimum of thirty (30) credit hours of graduate-level course work. The program offers both thesis and non-thesis options. However, students who are supported as research assistants are required to pursue the thesis option. The following sections provide details of the rationale of the MSEME program, curriculum and course offering, program educational objectives, admission standards and requirements, program options and course requirements for each option, and details of core and elective courses for each option. A budget analysis is also provided.

**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 Master of Science in Electrical and Mechatronics Engineering (MSEME) degree program consists of two tracks: (1) Mechatronics and Control, and (2) Communications and Networks. The mission of the MSEME program is to provide students or working professionals with an advanced leaning in the discipline of electrical and mechatronics engineering; to promote innovation and technology development in the emerging field of robotics, automation, drones, and autonomous systems for UMES research enterprise; and to contribute to the

economic development in the State of Maryland, especially in the Eastern Shore region where learning opportunities in advanced engineering disciplines is severely lacking.

The objective of the proposed degree program aligns with the mission of UMES. The UMES's mission statement states "University of Maryland Eastern Shore (UMES), the State's Historically Black 1890 Land-Grant institution, emphasizes baccalaureate and graduate programs in the liberal arts ... In keeping with its land-grant mandate, the University's purpose and uniqueness are grounded in distinctive learning, discovery, and engagement opportunities in agriculture, marine and environmental sciences, technology, engineering and aviation sciences, health professions, and hospitality management. Degrees are offered at the bachelors, masters and doctoral levels." The establishment of the MSEM program at UMES will aid in fulfilling the mission of UMES as a historically black, 1890 land-grant institution and serves to support the university goal of retaining Carnegie Research University classification.

**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](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" for the purpose of fostering and facilitating interdisciplinary collaboration for research on local, regional, and global challenges to include work force needs, and
- "Goal V: Achieve and Maintain National Eminence and Global Impact" for the purpose of enhancing 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 to the forefront of emerging research in critical areas of precision agriculture, natural sciences, and pharmaceutical science. In the past years, the existing undergraduate engineering program at UMES has continuously supplied undergraduate researchers to assist in research projects conducted by faculty members in agriculture, physics, and pharmaceutical science with their skills and knowledge in the engineering discipline. The proposed MSEM program is expected to enable stronger and multi-disciplinary research collaboration across campus community, thus fueling research forward in many other different disciplines more than engineering and creating much broader impact on the entire campus 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 clean room, and Microwave Anechoic Chamber Lab, etc.

What the program needs is additional two faculty lines, at the minimum, one new faculty member in communications and network and one new faculty member in mechatronics and control. A lab specialist is also requested. Note that there were two engineering faculty lines given to the department in 2014 for the purpose of starting a Master's degree program in engineering, but the lines were taken away from the Department to balance budget. Once the two lines are returned to the department, the proposed graduate program can start hiring new faculty. If approved, the program is expected to be self-sustaining going forward.

**4. Provide a description of the institution's a commitment to:**

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

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

(a) and (b): This degree program is created by leveraging, in part, the existing faculty and staff in the Department of 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 engineering faculty (tenured and tenure-track) and dedicated support staff will collectively assist the proposed master's degree program. The university is fully committed to continue the proposed MSEM program for a sufficient period of time 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**

This degree program enables a synergistic integration of electrical, mechanical system 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 mechatronics background apply mechanical, electrical, and computer engineering theory 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 aerials 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. Many predict the demand for mechatronics engineers will soon outpace supply.

**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 U. S. Census Bureau. UMES offers the only engineering Bachelor's degree program in the Eastern Shore of Maryland. There is a strong demand for a graduate program in engineering in the region. Offering the proposed Master's degree program is critical to the needs of local economy.

The need for a Master's Degree program in engineering to the Lower Shore region has long been recognized by the University System of Maryland (USM). For Example, during a visit to the Lower Shore universities in October 2015, USM Chancellor advocated a master's degree in engineering at UMES that will allow students in STEM majors at other regional institutions to study for a Master's degree in engineering, which resemble other system campuses to build successful graduate program in engineering to serve the needs of the region and the state.

[\(https://www.delmarvanow.com/story/news/local/maryland/2015/10/01/usm-caret-su/73139452/\)](https://www.delmarvanow.com/story/news/local/maryland/2015/10/01/usm-caret-su/73139452/)

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

UMES offers the only engineering bachelor's degree program in the Eastern Shore of Maryland. The proposed Master's degree in engineering 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.

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

The proposed Master's 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 Master's Degree Program is intended to prepare highly trained engineers at the graduate level in emerging area of robotics, automation, mechatronics, etc. that is becoming increasingly important and relevant to our society. However, engineering is a specialized field with many barriers for students to access. The proposed graduate degree program will provide equitable access and quality education to all Maryland residents, including those with disadvantaged background, in order to develop a strong engineering workforce for the state.

**Success – Promote and implement practices and policies that will ensure student success.**

The practices and policies concerning the proposed Master’s degree program align with the all existing policies at the University, which will ensure student success. By providing a carefully developed curriculum, sufficient 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 Master’s 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 new knowledge and skillsets 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, Northrup 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 industry and the government sectors where engineering workforce is highly sought.

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

See below

**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.**

**2 and 3:**

The employment data from the Bureau of Labor Statistics (BLS) is typically used to determine market demand. The proposed degree program will produce engineers work 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. The medium salary was \$99,070. 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 Masters of Science in Electrical and Mechatronics Engineering program can help meet the growing demand of the emerging industry.

## Employment outlook of electrical and mechatronics engineering occupations

	Number of Jobs in 2018	Job Outlook 2018-2028
Electrical and Electronics Engineer	330,300	2% increase
Mechanical Engineer	312,900	4% increase

**4. Provide data showing the current and projected supply of prospective graduates.**

The number of graduates from the current BS engineering program at UMES is summarized as follows:

2014-2015	2015-2016	2016-2017	2017-2018	2018-2019	2019 Fall
16	11	11	7	23	17

The projected supply of prospective graduates with a focus on Electrical and Mechatronics engineering is about a dozen in the first two years based upon the number of graduates of the BS program at UMES. Given the growing interest in automation and unmanned system design, we expect growth as word spread about the program's availability and efficacy.

**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 building upon the existing faculty expertise in the general engineering program at UMES. There is no other Electrical and Mechatronics Engineering degree programs in the Eastern Shore of Maryland. Although other institutions in Maryland, such as University of Maryland College Park, University of Maryland Baltimore County, and Morgan State University offer Master's Degree in Electrical Engineering, these institutions are located about 140 miles away from the Eastern Shore.

Moreover, the proposed program offers unique curriculum with a focus in mechatronics and control, and communications and networks, aiming to offer a non-conventional pathway towards a degree that prepare students for emerging technologies in unmanned system design, automation and control, communications and networks for internet of things (IOT), precision agriculture, aerial imaging for crop monitoring, etc.

Our proposed program also differs conventional mechatronics engineering program offered by Stanford, MIT, University of Michigan, Carnegie Mellon, Berkeley, etc. where their curriculum is focused entirely on either Robotics or Mechanical Engineering. Our focus is on the electrical and mechatronics engineering with a strong flavor on unmanned system design and control. The proposed UMES program does not duplicate similar programs offered by other Maryland institutions. We serve a different geographical area and academic program degree-level.

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

By leveraging the existing engineering faculty expertise in the General Engineering in the Department in four areas, i.e., Electrical Engineering, Computer Engineering, Aerospace Engineering, and Mechanical Engineering, we are positioned, in a unique way, to address challenges in emerging industry and job sectors in automation, unmanned systems, IoTs, etc. There is a huge market demand for skills in automation, artificial intelligence, 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 manufactures in the US include Boeing Co., Lockheed Martin Corp. and AeroVironment Inc. produce drones largely as defense contractors, and AeroVironment manufactures unmanned aircraft as its principal line of business.

### **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 Master’s level at any of the Historically Black Institutions in Maryland. Morgan State has a traditional electrical engineering program, but our focus is electrical and mechatronics engineering that aims to bridge the gap between electrical and mechanical engineering to offer students unique pathway in the emerging area of automation, unmanned system design, IoTs, etc. Because the proposed program leverages existing faculty expertise of the General Engineering program (note: no other HBCUs in the state offers general engineering program), we are able to harness expertise in all four engineering specializations, i.e., electrical, mechanical, computer, and aerospace, to deliver unique learning experiences to perspective students and to serve, in particular, the needs of the Lower Shore region.

The proposed program has a strong impact on the growth of the engineering program at UMES which at this stage, only offers a BS degree program. Offering a Master’s degree program in engineering at UMES will significantly enhance the reputation of the UMES’s engineering program and positively increase the enrollment in the engineering department.



**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 Engineering program 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 Electrical and Mechatronics Engineering to do so. The establishment of the proposed Master's 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 disadvantaged background, especially for those from the Lower Shore region where learning opportunities in advanced engineering are severely lacking.

**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 in the engineering program, 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 Master's degree program will be taught by faculty in the Department of Engineering and Aviation Sciences, with additional 2 engineering faculty members to be hired to balance the teaching load and a Lab Specialist for supporting operation of the specialized engineering laboratories in the Department. Please see I for a detailed list of the faculty background.

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

Graduates with a Master's of Science in Electrical and Mechatronics Engineering will be able to:

- Demonstrate in depth knowledge of the fundamental principles, concepts, terminologies and methodologies used for design and analysis of broader mechatronics and control systems or components, as well as communications and networks systems or components.
- Demonstrate the ability to solve real-world problems in the electrical and mechatronics engineering and related field.
- Demonstrate the ability to entry research-based doctoral studies in the discipline.
- Demonstrate the ability to be in leadership positions in electrical and mechatronics engineering 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, etc. They will also be given specific instruction and hands-on laboratory experimental learning experiences on how to apply these methods to a large range of problems in automation and mechatronics.

**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.
- Assessing comprehensive thesis or research project report in the two tracks in Mechatronics and Control, and Communications and Networks. Tracking performance in regional and national competitions.

**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.

**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 Degree**

All students in the Masters of Science in Electrical Engineering program 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 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 enrolled in Electrical and Mechatronics Engineering program courses only if they have been admitted to the program or given permission by 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 engineering elective (15 credits) graduate level courses and six credits of Thesis (ENEM 697). The thesis must be supervised by a member of the faculty member as a thesis advisor and the initial thesis proposal must be defended with an oral presentation (see below) and approved by student's thesis committee (three members including 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 engineering electives (21 credits) graduate level courses and a 3-credit hour research project (ENEM 696) 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 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.

### **MSEME General Requirements**

1. Maximum of two graduate-level course units may be transferred from another institution to apply toward the MSEME 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 MSEME 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 engineering courses should be primarily from one of the two tracks specified in this document. Students in each track can take 2 courses (6 credits) from the other track to satisfy graduation requirement upon approval of both student's advisor and Director of graduate program.
6. Up to maximum 2 courses (6 credits) from other UMES departments of the physical, mathematical, biological, agricultural or similar sciences may be included to round out student's overall program study. All courses from outside of the Engineering Master's Program must be graduate 600-level courses. Prior approval of both student's advisor and Director of graduate program is required for all external courses.
7. Up to maximum 3 credits of ENEM 688 Independent Study are allowed upon student's advisor and Director of graduate program's approval. Independent Study needs to be structured by the faculty member with a clearly defined syllabus for the prior approval.

### **MSEME Degree Curriculum**

#### **Electrical and Mechatronics Engineering Program Core Courses**

	<b><u>Course Description</u></b>	<b><u>Credit Hours</u></b>
ENEM 601	Linear Systems Theory	3 hrs
ENEM 602	Computational Methods in Engineering	3 hrs
ENEM 603	Random Signals Analysis	3 hrs

**Electives Courses for Mechatronics and Control Track**

	<b><u>Course Description</u></b>	<b><u>Credit Hours</u></b>
ENEM 611	Mechatronics	3 hrs
ENEM 612	Microelectronics Devices and Circuits	3 hrs
ENEM 613	Digital Control System	3 hrs
ENEM 614	Robotics	3 hrs
ENEM 615	Nonlinear Systems Analysis and Control	3 hrs
ENEM 616	Embedded Systems Design	3 hrs
ENEM 617	Autonomous Systems	3 hrs
ENEM 618	Mechatronic System Design, Integration, and Test	3 hrs
ENEM 619	Micro-Electro-Mechanical Systems	3 hrs
ENEM 620	Mechanical Vibrations	3 hrs
ENEM 621	Structural Design	3 hrs
ENEM 622	Advanced Dynamics	3 hrs
ENEM 623	Finite Element Method and Applications	3 hrs
ENEM 624	Aerodynamics for Unmanned Aerial Systems	3 hrs

**Electives Courses for Communications and Networks Track**

	<b><u>Course Description</u></b>	<b><u>Credit Hours</u></b>
ENEM 641	Detection and Estimation Theory	3 hrs
ENEM 642	Digital Signal Processing	3 hrs
ENEM 643	Principles of Digital Communications	3 hrs
ENEM 644	Wireless Communications	3 hrs
ENEM 645	Principals of Communications Networks	3 hrs
ENEM 646	Wireless Networks	3 hrs
ENEM 647	Advanced Topics in Computers Networks	3 hrs
ENEM 648	Coding and Applications	3 hrs
ENEM 649	Design and Optimization of Networks	3 hrs
ENEM 650	Digital Integrated Circuit Design	3 hrs
ENEM 651	RF Integrated Circuit Design	3 hrs
ENEM 652	Introduction to Machine Learning	3 hrs
ENEM 653	Computer Vision and Image Processing	3 hrs
ENEM 670	Selected Topics in Engineering	3 hrs
ENEM 688	Independent Study	(1-3) hrs

**Engineering Research/Project Courses**

	<b><u>Course Description</u></b>	<b><u>Credit Hours</u></b>
ENEM 696	Master Project	3 hrs
ENEM 697	Master Thesis	(3-6) hrs

Typical Plan of Study M.S.E.M.E. Degree Students			
First Year			
3 Core Courses + 3 Approved Electives			
Fall	Credit	Spring	Credit
ENEM 601 Linear Systems Theory	3	ENEM 603 Random Signals Analysis	3
ENEM 602 Computational Methods in Engineering	3	ENEM 6XX Approved Elective	3
ENEM 6XX Approved Elective	3	ENEM 6XX Approved Elective	3
Second Year			
Fall	Credit	Spring	Credit
<b>THESIS OPTION (30 credit hours): 2 Electives + 6 Hrs for M.S. Thesis</b>			
ENEM 6XX Approved Elective	3	ENEM 697 Master Thesis	3
ENEM 6XX Approved Elective	3		
ENEM 697 Master Thesis	3		
<b>PROJECT OPTION (33 credit hours): 3 Electives + 3 Hrs for M.S. Nonthesis</b>			
ENEM 6XX Approved Elective	3	ENEM 6XX Approved Elective	3
ENEM 6XX Approved Elective	3	ENEM 696 Master Project	3
ENEM 6XX Approved Elective	3		

### **ELECTRICAL & MECHATRONICS ENGINEERING COURSE DESCRIPTIONS**

**ENEM 601 Linear Systems Theory: 3 credits.** 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 multioutput 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.** 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.** 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.** Physical and mathematical modeling of mechanical, electrical, electromechanical, thermal, fluid, and multidisciplinary physical systems; sensors and electronics for measurements of 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.** 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, 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.** 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. Actual construction of a microcomputer-based controller culminates the course

**ENEM 614 Robotics: 3 credits.** 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.** Introduction to Nonlinear Phenomena: Multiple Equilibria, Limit Cycles, Complex Dynamics, Bifurcations Second Order Nonlinear Systems: Phase Plane Techniques, Limit Cycles - Poincare-Bendixson Theory, 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, Stabilization.

**ENEM 616 Embedded Systems Design: 3 credits.** 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.** 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.** This course addresses in detail the systems engineer's responsibilities and activities during the conceptual, design and 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 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 definition of operational scenarios, functional analysis, risk assessment, system tradeoffs, measures of effectiveness, and requirements formulation.

**ENEM 619 Micro-Electro-Mechanical Systems: 3 credits.** 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.** Linear free and forced response of one and multiple degree of freedom systems. Equations of motion of discrete systems. Free vibration eigenvalues and eigenvectors. Applications to engineering systems including vibration isolation, rotating imbalance, vibration absorbers and balancing of rotating machinery, and energy harvesting.

**ENEM 621 Structural Design: 3 credits.** 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, plastic deformation.

**ENEM 622 Advanced Dynamics: 3 credits.** This graduate level course deals with the study of mechanical systems undergoing 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 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 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.** This course covers the introduction to finite element method 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 credit.** 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 rotatory 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 641 Estimation and Detection Theory: 3 credits.** Decision theory: Binary hypothesis testing, M-ary testing, Bayes, Neyman-Pearson, Min-Max. Performance. Probability of error, ROC. Estimation theory: linear and nonlinear estimation, parameter estimation. Bayes, MAP, maximum likelihood, Cramér-Rao bounds. Bias, efficiency, consistency. Asymptotic properties of estimators. Orthogonal decomposition of random processes and harmonic representation. Waveform detection and estimation. Wiener filtering and Kalman-Bucy filtering. Elements of identification. Recursive algorithms. Spectral estimation. The level of this course is suitable for research students in communications, control, signal processing, and related areas

**ENEM 642 Digital Signal Processing: 3 credits.** Introduction to digital signal processing; discrete-time description of signals; z-transform; digital filter structures; infinite and finite impulse

response filter design techniques. Advanced topics include design of quadrature mirror filter banks and discrete wavelet transforms.

**ENEM 643 Principles of Digital Communications: 3 credits.** This course focuses on the fundamental principles behind reliable digital data transmission over noisy and band-limited channels. Signaling schemes, channel models, and receiver structures widely used in practical systems are developed and analyzed. The communication techniques covered in the course are applications of digital signal processing, detection, estimation, and information theories. The covered topics include: modern communications; probabilistic viewpoint; vector representation of signal; signal spaces; vector channels; additive white Gaussian noise; optimum receivers; maximum-likelihood detection; error probabilities; memoryless modulation methods; intersymbol interference (ISI); Nyquist signaling; equalization; complex baseband models; noncoherent detection; source coding; error control coding.

**ENEM 644 Wireless Communications: 3 credits.** Introduction to wireless communication principles and systems. Wireless channel models, TDMA, FDMA, spread spectrum, CDMA, equalization, detection, estimation, coding, security, quality assessment of service and personal communications. Modern generation wireless standards are also discussed.

**ENEM 645 Principals of Communications Networks: 3 credits.** This course covers advanced subjects in computer networks. Topics will include Internet architecture and core protocols for congestion control, forwarding, naming, and routing; approaches to achieve reliability, scalability, and security; and design of hyperscale cloud networks, data centers, wireless networks, content delivery, enterprise networks, quality of service, and network security. Material will range from the classics to the latest results, and from analytical foundations to systems design and real-world deployment.

**ENEM 646 Wireless Networks: 3 credits.** Fundamental concepts of wireless networks: network architecture for personal communications systems, wireless LANs, radio, tactical and other wireless networks, and design and analysis of protocols, and wireless network programming.

**ENEM 647 Advanced Computer Networks: 3 credits.** Introduces security principles and practices of computer and network systems. Topics include basic computer security concepts, common attacking techniques, common security policies, basic cryptographic tools, authentication, access control, network intrusion detection, software security, operating system security, network security, firewalls, network management, email and web security, legal and ethical issues in computer security.

**ENEM 648 Coding Theory and Applications: 3 credits.** The theory and practice of error control coding with emphasis on linear, cyclic, convolutional, and parallel concatenated codes (Hamming codes, Repetition codes, polynomial codes, Reed Solomon Codes). Turbo codes, Viterbi decoding and applications.

**ENEM 649 Design and Optimization of Networks: 3 credits.** A comprehensive introduction to network flows with an integrative view of theory, algorithms, and applications. It covers shortest path, maximum flow, and minimum cost flow problems, including a description of new and novel polynomial-time algorithms. It also covers topics from basic network design to protection and restoration design, to multi-layer network design while taking into account routing and flow requirement as applicable in different network architecture, protocol and technologies.



**ENEM 650 Digital Integrated Circuit Design: 3 credits.** Studies the design process of VLSI CMOS circuits. Also covers all the major steps of the design process, including logic, circuit, and layout design. A variety of computer-aided tools are discussed and used to provide VLSI design experience that includes design of basic VLSI CMOS functional blocks, and verification of the design, testing, and debugging procedures.

**ENEM 651 RF Integrated Circuit Design: 3 credits.** Studies the design and analysis of radio frequency integrated circuits (RFICs) for communications. Topics include an overview of RF and wireless technology, fundamental concepts in RF design such as nonlinearity, sensitivity, and dynamic range. Matching and impedance transformation networks, and S-parameters. Transceiver architectures (Heterodyne, Direct Conversion, etc.), modulation and up-conversion concepts. A detailed examination of each of the blocks in the transceiver architectures discussed: Low Noise Amplifiers, Mixers, Oscillators, Frequency Synthesizers, and Power Amplifiers.

**ENEM 652 Introduction to Machine Learning: 3 credits.** Introduces theoretical foundations, algorithms, methodologies, and applications for machine learning and provides a foundation for advanced study in topics shared by machine learning, statistical inference, and signal processing. Topics may include supervised methods for regression and classification (linear models, trees, neural networks, ensemble methods, instance-based methods); generative and discriminative probabilistic models; Bayesian parametric learning; density estimation and clustering; Bayesian networks; time series.

**ENEM 653 Computer Vision and Image Processing: 3 credits.** An introduction to computer vision, including fundamentals of image formation, camera imaging geometry, feature detection and matching, stereo, motion estimation and tracking, image classification, scene understanding, and deep learning with neural networks. We will develop basic methods for applications that include finding known models in images, depth recovery from stereo, camera calibration, image stabilization, automated alignment, tracking, boundary detection, and recognition.

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

**ENEM 688 Independent Study: [1-3 credits].** An independent study conducted with a faculty member on a relevant topic. The course needs to be structured by the faculty member with a clearly defined syllabus for the Master's student. The course needs prior approval of the student's advisor and graduate program director.

**ENEM 696 Master Project: 3 credits.** 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. (F;S)

**ENEM 697 Master Thesis: credits var. (3-6).** 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. (F;S)

**b. Admission Standards**

To be considered for admission into the M.S. Degree Program in Electrical and Mechatronics Engineering, 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 Electrical and Mechatronics Engineering graduate committee may require higher academic standards for admitting students to the department's graduate program. 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 ABET-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 Master of Science level.

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

Not Applicable.

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

Not Applicable.

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

Not Applicable.

**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 and 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 Department of Engineering and Aviation Science website: [www.umes.edu/engavi](http://www.umes.edu/engavi). Information pertaining to 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 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.**

The program will be advertised alongside other academic graduate programs within the School of Business and Technology of UMES. Proper venues include Public Radio WESM 91.3, and social media such as UMES Facebook page, the University Key, as well as 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 Master's Degree program level. However, the proposed program will support existing articulation with other system institutions at the Bachelor's degree level, for example, a dual degree program in physics/engineering at Salisbury University. The goal of UMES is to work with partner institutions to provide a pathway for many students interested in engineering or a closed related field to obtain a Master's 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 two research tracks, i.e., Mechatronics and Control, and Communications and Networks. Two (2) new faculty members and One (1) lab specialist are needed.

**Existing seven (7) faculty are listed below:**

**Dr. Ibibia K. Dabipi, Professor in 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 technical staff with primary research focus in communications and networks.

**Dr. Yuanwei Jin, Professor in Electrical Engineering and Chair.** He received Ph.D. degree in Electrical Engineering from the University of California at Davis. 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 in 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, and sheet metal forming, drone design, etc.

**Dr. Lanju Mei, Assistant Professor in Aerospace Engineering.** She received her Ph.D. degree in Aerospace and Mechanical Engineering from Old Dominion University. Her primary research interests include MEMS sensor, additive manufacturing, computational fluid dynamics.

**Abhijit Nagchaudhuri, Professor in Mechanical Engineering.** He received 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 in 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 in 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, microprocessor and microcomputers, embedded system design, etc.

**Two (2) new faculty and one (1) lab specialist are needed:**

The Engineering and Aviation Sciences Department will need two (2) additional faculty in the following areas:

- 1 Electrical Engineering or Computer Engineering faculty with expertise in Communications and Networks
- 1 Mechanical/Aerospace Engineering faculty with expertise in Control and Mechatronics
- 1 Lab Specialist with background in MEMS and Electromagnetic Anechoic Chamber Lab is needed.

**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**

**b) The learning management system**

(a) and (b): Faculty support for the development and instruction of courses is provided by the Faculty Development Center of UMES.

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

Not Applicable.

## **J. Adequacy of Library Resources**

The University assures that institutional library resources meet the new program 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 Explore, the technical papers could be accessed through the Inter-Library Loan (ILL) services.

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

### **1. Provide an assurance 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, and Embedded System Lab, Communications Lab, Microwave Chamber, CAD/VLSI Lab, High Bay Area, and Multiple Computer Labs, etc. These labs can support majority of the activities in the new courses and research activities. A complete list of engineering labs with brief descriptions is shown by the link:

<https://www.umes.edu/Engineering/DynContent/Laboratories/>

All engineering faculty and staff have individual offices that will facilitate student advising, office hours, etc. Sufficient classrooms are available also in the same building, which make 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 leaning 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 <sup>1</sup>	\$210,260	\$143,412	\$96,564	\$49,716	\$0.00
2. Tuition/Fee Revenue <sup>2</sup> (c+g below)	\$87,840	\$134,688	\$181,536	\$228,384	\$281,088
a. # FT Students	8	12	16	20	24
b. # Annual Tuition/Fee Rate	\$8,784	\$8,784	\$8,784	\$8,784	\$8,784
c. Annual / Full Time Revenue (a x b)	\$70,272	\$105,408	\$140,544	\$175,680	\$210,816
d. # PT Students	3	5	7	9	12
e. Credit Hour Rate	\$488.00	\$488.00	\$488.00	\$488.00	\$488.00
f. Annual Credit Hours	12	12	12	12	12
g. Total Part Time Revenue (d x e x f)	\$17,568	\$29,280	\$40,992	\$52,704	\$70,272
3. Grants, Contracts & Other External Sources <sup>3</sup>	\$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)	\$298,100	\$278,100	\$278,100	\$278,100	\$281,088

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)	216,000	216,000	216,000	216,000	216,000
a. # FTE	2	2	2	2	2
b. Total Salary	160,000	160,000	160,000	160,000	160,000
c. Total Benefits	56,000	56,000	56,000	56,000	56,000
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)	62,100	62,100	62,100	62,100	62,100
a. # FTE	1	1	1	1	1
b. Total Salary	60,000	60,000	60,000	60,000	60,000
c. Total Benefits	2,100	2,100	2,100	2,100	2,100
4. Equipment	0	0	0	0	0
5. Library	0	0	0	0	0
6. New or Renovated Space	0	0	0	0	0
7. Other Expenses	20,000	0	0	0	0
TOTAL (Add 1 - 7)	298,100	278,100	278,100	278,100	278,100

### **Narrative Rational for Table 1: Resources**

1.     **Reallocated Funds**  
Reallocated funds will be required for the first four years of the program. These funds have been allocated from the HBCU Settlement Fund.
  
2.     **Tuition and Fee Revenue**  
We assumed that tuition and fees will be constant for the next five years. For full-time students, the in-state tuition rate (estimated in 2021-2022) is **\$348** per credit hour and out-of-state tuition rate is **\$628**. We will use the average value of **\$488** for calculation student tuition assuming that 50% of the students in state and 50% of the students out-of-state. This value was used in calculating the revenue assuming 9 credits per semester for full-time students and 6 credits per semester for part-time students, or 18 credits per year for full time students and 12 credits per 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 Rational for Table 2: Expenditures**

1.     **Faculty (# FTE, Salary and Benefits)**  
  
**Two (2) new full-time tenure-track faculty members (1 with background in communications and networks and 1 with background in mechatronics and control)** are required to support the proposed Master of Science in Electrical and Mechatronics Engineering Program.  
  
There will be no need for additional administrative staff. The existing department and school administrative staff will be sufficient to run the program.
  
2.     **Support Staff ( # FTE, Salary and Benefits)**  
**One lab specialist** as a support staff in the Department of Engineering and Aviation Sciences is needed to administer the specialized engineering laboratories, for example, MEMS lab with a clean room, and Microwave Anechoic Chamber Lab, etc.
  
3.     **Equipment**  
No major equipment is requested.
  
4.     **Library**  
Minimal funds are needed to purchase additional engineering textbook.



5. New and/or Renovated Space  
Not needed
  
6. Other Expenses  
\$20,000 Startup Package for the two new hires at the rate of \$10,000 per person. The startup package is to support new faculty, especially at the assistant professor level, for professional development, including developing proposals for grant 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 portfolio 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, school wide and department service. In order to receive high evaluation, a faculty member must demonstrate effective teaching, active scholarly activities and publication, etc. There is also a provision for administration to set out an improvement plan for faculty members who have not done well in the area of teaching. Tenured faculty will undergo 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 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 student population is 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 has no relationship to low productivity programs.

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

Not applicable. The proposed program is not a distance education program.



**BOARD OF REGENTS**  
SUMMARY OF ITEM FOR ACTION,  
INFORMATION, OR DISCUSSION

**TOPIC:** University of Maryland Eastern Shore Doctor of Philosophy (Ph.D.) in Applied Computing and Engineering

**COMMITTEE:** Education Policy and Student Life

**DATE OF COMMITTEE MEETING:** Tuesday, November 15, 2022

**SUMMARY:** The University of Maryland Eastern Shore (UMES) is pleased to present a proposal for a Doctoral program in Applied Computing and Engineering (PHACE). UMES's mission includes preparing students from diverse backgrounds, particularly first-generation students and those from disadvantaged environments, to become the next generation STEM workforce. The PHACE program offers prospective students a graduate program that blends knowledges from across multiple disciplines into applied computing and engineering. The program's curriculum harnesses faculty expertise and experience from a range of technical fields that exist within the UMES School of Business and Technology (SBT). The program encourages students to develop innovative technologies in emerging fields, such as cybersecurity, data and computational science, software engineering, control engineering, mechatronics, networking and communications. It focuses on a wide range of applications, including in business, finance, agriculture, health care, automobile engineering, the aerospace industry, and clean energy systems development, among others that are critical to the economic development of the region and the state.

There are no doctorate degree programs in the field of computer science and engineering available in the universities in the Eastern Shore of Maryland. This program meets the needs of students in the region, including traditional students and working professionals, who aspire to enter advanced technical fields. Graduates who remain on the Eastern Shore of Maryland will help contribute to a knowledge-based economy within the local community and present the potential of transforming the entire economic landscape of the lower-shore.

**ALTERNATIVE(S):** The Regents may not approve the program or may request further information.

**FISCAL IMPACT:** No additional funds are required. The programs can be supported by the projected tuition and fees revenue.

**CHANCELLOR'S RECOMMENDATION:** That the Education Policy and Student Life Committee recommend that the Board of Regents approve the proposal from University of Maryland Eastern Shore to offer the Doctor of Philosophy (Ph. D.) in Applied Computing and Engineering.

COMMITTEE RECOMMENDATION:

DATE: November 15, 2022

BOARD ACTION:

DATE:

SUBMITTED BY: Joann A. Boughman 301-445-1992

jboughman@usmd.edu



UNIVERSITY OF MARYLAND EASTERN SHORE  
*Office of the President*

October 14, 2022

Dr. Jay Perman, Chancellor  
University System of Maryland  
701 E. Pratt Street  
Baltimore, MD 21202

**RE: New Academic Program Proposal – Doctor of Philosophy in Applied Computing and Engineering**

Dear Dr. Perman:

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

**Program:** Ph.D. in Applied Computing and Engineering

The School of Business and Technology is proposing to offer a Ph.D. degree in Applied Computing and Engineering (ACE). 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 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 cybersecurity, data and computational science, software engineering, control systems, mechatronics, networking, and communication systems, 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,

A handwritten signature in cursive script, appearing to read "Heidi M. Anderson".

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

**UNIVERSITY SYSTEM OF MARYLAND INSTITUTION PROPOSAL FOR**

- New Instructional Program
- Substantial Expansion/Major Modification
- Cooperative Degree Program
- Within Existing Resources, or
- Requiring New Resources

**University of Maryland Eastern Shore**

Institution Submitting Proposal

**Doctor of Philosophy in Applied Computing and Engineering**

Title of Proposed Program

**Doctor of Philosophy**

Award to be Offered

**Fall 2023**

Projected Implementation Date

**90100.00**

Proposed HEGIS Code

**140101.000**

Proposed CIP Code

**School of Business and Technology**

Department in which program will be located

**Dr. Derrek Dunn**

Department Contact

**(410) 621-6348**

Contact Phone Number

**ddunn@umes.edu**

Contact E-Mail Address



Signature of President or Designee

**October 5, 2022**

Date



**DIVISION of ACADEMIC AFFAIRS**  
**Office of the Provost & Vice President**

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**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 concentrations:

1. Concentration #1: Cybersecurity
2. Concentration #2: Data and Computational Science
3. Concentration #3: Software Engineering
4. Concentration #4: Mechatronics and Control
5. Concentration #5: Communications and Networks

These areas of concentration align 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 degree holders with direct admission into the proposed doctoral program who choose either the Communication and Networks concentration or 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.

Also, prospective bachelor degree holders with direct admission into the proposed doctoral program who choose the Software Engineering or Data and Computational Science Concentrations will have the option to obtain a Master's in Applied Computer Science. Lastly, prospective bachelor holders who are admitted directly into the proposed doctoral program and choose the Cybersecurity concentration will have the option to obtain a Master of Science in Cybersecurity Engineering Technology.

**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 consists of five concentrations: (1) Cybersecurity, (2) Data and Computational Science, (3) Software Engineering, (4) Mechatronics and Control, and (5) Communications and Networks. 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, 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](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.

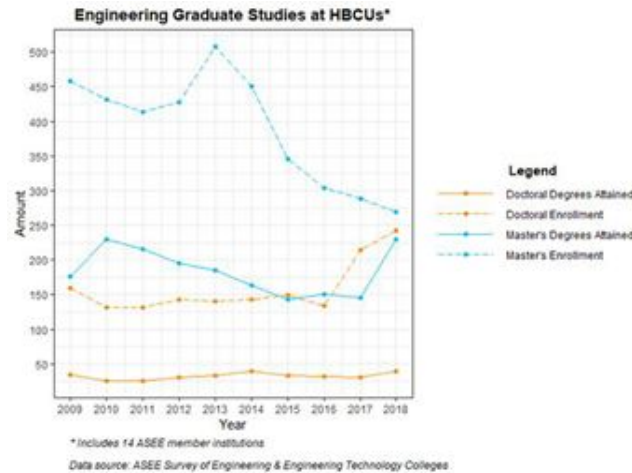
**b. Societal needs, including expanding educational opportunities and choices for minority and educationally disadvantaged students at institutions of higher education**

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 Masters’ 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 concentrations 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**

<b>Job Title</b>	<b># of Maryland Positions (2018)</b>	<b># of Maryland Position (2028)</b>	<b>Percentage Growth</b>
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**

<b>Job Title</b>	<b># of Positions (2020)</b>	<b># of Positions (2030)</b>	<b>Percentage Growth</b>
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**

<b>Employment projections data for electrical and electronics engineers, 2020-30</b>			
<b>Occupation Title</b>	<b>Employment 2020</b>	<b>Projected Employment 2030</b>	<b>Change 2020-2030</b>
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**

<b>Computer occupations projected employment 2019-2029</b>			
<b>Occupation Title</b>	<b>Employment 2019</b>	<b>Projected Employment 2029</b>	<b>Change 2019-2029</b>
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 Projections**

<b>Maryland Occupational Projections 2018 - 2028</b>			
<b>Occupation Title</b>	<b>Employment 2018</b>	<b>Employment 2028</b>	<b>Change 2018-2028</b>
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 Science in Computer Science (BSCS), Bachelor 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:

<b>Program</b>	<b>2014-2015</b>	<b>2015-2016</b>	<b>2016-2017</b>	<b>2017-2018</b>	<b>2018-2019</b>	<b>2019-2020*</b>
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
<b>Total</b>	<b>34</b>	<b>36</b>	<b>30</b>	<b>32</b>	<b>55</b>	<b>52</b>

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 programs' 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 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. 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 not producing enough STEM majors with graduate degrees in general, and particularly, in computer science and engineering, to satisfy the demand 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 concentration areas 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 concentrations. 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.

**3. 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 area 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 one of the five concentrations specified in this document. Students in each concentration can take 2 courses (6 credits) from the other concentrations to satisfy graduation requirements upon approval of both student's advisor and 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.

### **CYBERSECURITY COURSES**

#### **ETCS 600 Statistical Applications for Technology – 3 Credits (Current)**

This course presents a broad treatment of statistics, concentrating on specific statistical techniques used in science and industry. Prerequisite(s): Graduate Standing

#### **ETCS 606 Applied Research for Technology – 3 Credits (Current)**

This course studies the research methods and processes applicable to engineering and technology. Emphasis will be placed on defining research problems, collecting, analyzing, recording, and interpreting data. Students will be required to conduct a research project. Prerequisite(s): Graduate Standing

#### **ETCS 620 Project Management for Technology – 3 Credits (Current)**

This is the introductory project management course, which is a core course in the Master's degree programs. Prerequisite(s): Graduate Standing

**ETCS 678 Mobile Wireless Networking and Security – 3 Credits (Current)**

This course is a comprehensive examination of wireless local area networks, with an emphasis on the IEEE P802.11 family of WLAN standards. Prerequisite(s): Graduate Status or Permission of Instructor

**ETCS 680 Networking Technology for Industry – 3 Credits (Current)**

An advanced study of network technology fundamentals. The course stresses the state-of-the-art developments that support the World Wide Web and a wide array of specific applications. Prerequisite(s): Graduate Standing

**ETCS 681 System Integrity for Cyber security – 3 Credits (Current)**

This course identifies elements of system integrity for Cyber security including firewall design, types of security threats, and responses to security attacks. This course also studies the use of best practices to design, implement, and monitor a network security plan. This course also examines security incident postmortem reporting, and ongoing network security activities. Prerequisite(s): Graduate Status or Permission of Instructor.

**ETCS 682 Cyber security Administration – 3 Credits (Current)**

This course explores the concepts of governance and how it applies to information systems. Discussion includes the importance of compliance with laws, regulations, policies, and procedures as a means of minimizing risk through mandated security and control measures. Through this course, students also gain an understanding of Cyber security Auditing processes and principles. Prerequisite(s): Graduate Standing

**ETCS 683 Network Intrusion, Detection and Incident Response – 3 Credits (Current)**

This course presents an exploration of the theory and implementation of intrusion detection and intrusion prevention. Prerequisite(s): ETCS 685 or Permission of Instructor

**ETCS 685 Fundamentals of Network Security – 3 Credits (Current)**

This course presents topics that include cryptography, cipher systems, practical security schemes, confidentiality, authentication, integrity, access control, nonrepudiation, and their integration across telecommunications (i.e., computer) networks. Prerequisite(s): Graduate Status or Permission of Instructor

**ETCS 686 Advance Network Security – 3 Credits (Current)**

This course covers advanced information from topics presented in ETCS 685. Topics include cryptography, cipher systems, practical security schemes, confidentiality, authentication, integrity, access control, nonrepudiation, and their integration across telecommunications (i.e., computer) networks. Prerequisite(s): ETCS 685 or Permission of Instructor

**ETCS 687 Legal and Ethical Issues in Cybersecurity – 3 Credits (Current)**

This course focuses on the ways that law, ethics, and Cyber security overlap and intersect. Besides laws related to Cyber security, the course examines laws related to intellectual property, civil litigation, criminal prosecutions, and privacy. Prerequisite(s): Graduate Standing

**ETCS 690 Master’s Seminar – 3 Credits (Current)**

This course serves a dual role. First and foremost, this is a graduate seminar course with the major objective of preparing students for research in practical applications. It will challenge students with a

critical and philosophical exploration of the ideas of Cyber security and will consist of lectures, readings, and class discussions in which every student is expected to be an active participant. Since students come to this course with diverse interests in graduate work in Cyber security, the scope of readings and discussions on research and practical applications will be broad. The second role of this course is a capstone graduation requirement for all master's students. For that purpose, the goal is to learn the practical skills of giving a presentation and writing a research paper. Prerequisite(s): Permission of Instructor

### **DOCTORAL LEVEL CYBERSECURITY CONCENTRATION COURSES**

#### **ETCS 700 Applied Cryptography – 3 Credits (New)**

This course presents a study of cryptographic topics such as classical cryptographic algorithms, symmetric-key cryptography, public-key cryptosystems, authentication, stream ciphers, block ciphers, public-key cryptography, RSA cryptosystem, hash functions, and digital signatures. The course will also discuss advanced cryptographic tasks, privacy mechanisms, and other forms of encryption. Prerequisite: Graduate Standing

#### **ETCS 710 Advanced Study in Cybersecurity I – 3 Credits (New)**

This course presents an advanced study of cybersecurity topics including cybersecurity administration, social engineering, legal and ethical Issues, cyber-operations project management. Prerequisite: Graduate Standing

#### **ETCS 720 Advanced Study in Cybersecurity II – 3 Credits (New)**

This course presents an advanced study of cybersecurity topics including wireless security, applied cryptography, cellular mobile, and network instruction, detection, and incidence response. Prerequisite: Graduate Standing

#### **ETCS 730 Cybersecurity and Intelligent Systems – 3 Credits (New)**

This course presents an advanced study of cybersecurity issues for intelligent systems focusing on such areas as agriculture (precision farming), transportation (smart cars), medical devices (intelligent sensors), and government initiatives (smart cities). Prerequisite: Graduate Standing

#### **ETCS 740 Cybersecurity for Critical Infrastructure – 3 Credits (New)**

This course presents an advanced study of critical infrastructure, including physical and cyber systems and assets vital to the modern world's operation. Prerequisite: Graduate Standing

#### **ETCS 750 Cybersecurity for Navigation Systems – 3 Credits (New)**

This course presents an advanced study of cyber risk associated with navigation systems such as the Global Navigation Satellite Systems (GNSS) and the impact of spoofing and jamming attacks. Prerequisite: Graduate Standing

### **DOCTORAL LEVEL DISSERTATION COURSES**

#### **ACIE 795 Research/Ph.D. Dissertation Writing I – 3 Credits (New)**

Research under faculty supervision in an area of specialization leads to the preparation and submission of a Dissertation in partial fulfillment of the graduation requirements.

#### **ACIE 796 Research/Ph.D. Dissertation Writing II – 3 Credits (New)**



Research under faculty supervision in an area of specialization leads to the preparation and submission of a Dissertation in partial fulfillment of the graduation requirements.

**ACIE 797 Research/Ph.D. Dissertation Writing II – 3 Credits (New)**

Research under faculty supervision in an area of specialization leads to the preparation and submission of a Dissertation in partial fulfillment of the graduation requirements.

**ACIE 798 Research/Ph.D. Dissertation Writing II – 3 Credits (New)**

Research under faculty supervision in an area of specialization leads to the preparation and submission of a Dissertation in partial fulfillment of the graduation requirements.

The table below is a mapping for students who enter the Ph.D. program with an M.S. in Cybersecurity Engineering Technology.

**CYBERSECURITY CONCENTRATION**

<b>Courses</b>	<b>Master's</b>			<b>Ph.D.</b>			
	<b>Core</b>	<b>Free Ele</b>	<b>Project</b>	<b>Core</b>	<b>Concen</b>	<b>Free Ele</b>	<b>Diss</b>
ETCS 600	X					X	
ETCS 606	X					X	
ETCS 620	X					X	
ETCS 678		X			X		
ETCS 680		X			X		
ETCS 681		X			X		
ETCS 682		X			X		
ETCS 683		X			X		
ETCS 685		X			X		
ETCS 686		X			X		
ETCS 687		X				X	
ETCS 690			X			X	
ETCS 700				X			
ETCS 710				X			
ETCS 720				X			
ECTS 730				X			
ETCS 740					X		
ETCS 750					X		
ACIE 795							X
ACIE 796							X
ACIE 797							X
ACIE 798							X

**COMPUTER SCIENCE COURSES**

**CSDP 600 Advanced Programming Languages – 3 Credits (Current)**

Topics include (not limited to): Advanced topics in programming language theory, design and implementation, in depth understanding of data types, binding, scope and extent abstraction, extensibility and control mechanisms, formal semantics and program verification, and alternative programming language paradigms.

**CSDP 601 Analysis and Design of Algorithms – 3 Credits (Current)**

Topics include (not limited to); NP completeness and approximation algorithms, design techniques for efficient algorithms such as amortized analysis, dynamic programming, and greedy algorithms. Computational geometry, graph algorithms, primality and other number-theoretic algorithms, specialized data structure techniques such as augmenting data structures, combinational graph reduction, and functional repetition.

**CSDP 602 Database Management System – 3 Credits (Current)**

Topics include (not limited to); A study of the theoretical foundations of database management systems. Design and implementation of alternatives for various database models, including, but not limited to, hierarchical network and relational models, comparison of the reliability, security, and integrity of various database systems. Implementation of a simple database system.

**CSDP 603 Advanced Operating System – 3 Credits (Current)**

Topics include (not limited to); Structure and functions of operating system, inter-process communication techniques, high-level concurrent programming, virtual memory system, basic queuing theory, security, distributed system, design and implementation of operating systems.

**CSDP 604 Computer Methods in Statistics – 3 Credits (Current)**

This course is an introduction to the principles and applications of probability and statistics needed in graduate studies in various academic areas and to the computer realization of these methods. The course begins with a brief intensive review of basic statistical principles.

Prerequisite(s): One semester of calculus. NOTE: The department is committed to offering CSDP 604 (Computer Methods in Statistics) as an elective course on-demand.

**CSDP 605 Software Engineering – 3 Credits (Current)**

Topics include (not limited to); A formal study of the software development process, lifecycle models, requirements definition specifications, design, implementation, validation, verification, maintenance and reuse, team work on a project.

**CSDP 638 Computer Applications in Science and Mathematics – 3 Credits (Current)**

Current areas include numerical methods, exact solutions of algebraic problems, and special computer methods in number theory.

**CSDP 648 Computer Applications in Industry – 3 Credits (Current)**

Current areas include artificial neural networks and their algorithms, parallel operating environments, and the use of parallel languages under parallel environments.

**CSDP 668 Advance Data Management – 3 Credits (Current)**

Topics include (but are not limited to): Parallel and Distributed database system architectures, distributed database design, client/server database systems, selected topics from new development in extended relational databases, multimedia databases, information retrieval systems, object-oriented databases, temporal databases.

**CSDP 697 CSDP Special Topics – 3 Credits (Current)**

A special topic course is introduced by the faculty in his/her research area or the current topic related to the master's curriculum which is approved by the graduate committee. This course may be repeated (with different topics) for a maximum of 9 credits.

**CSDP 698 Master's Project I – 4 Credits (Current)**

The student is required to take a minimum of ten graduate level courses (30 credits) and a 4-credit hour research project (CSDP 698) 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.

**CSDP 699 Master's Project in Computer Science I – 4 Credits (Current)**

During this semester/session, the student will carry out the analysis and design of a state-of-the-art system of programs in his/her area of expertise and interest and begin the actual programming and documentation. Students desiring to change their project topic after it has been approved MUST sign up for CSDP 699 for a second time. Prerequisite: Certification by the advisor that the student is prepared to begin research work in computer science.

**CSDP 798 Master's Project II – 4 Credits (Current)**

During this semester, the student will complete the project begun in CSDP 699, including all documentation, and give a public demonstration of its effectiveness, originality, and appropriateness to the field of application. In addition, the student will prepare a written version of the material in a form consistent with departmental and Graduate School standards. Successful completion of this course requires either: (a) the acceptance for publication of this project description by a national journal in the appropriate field or by a national conference that publishes its proceedings in full [the actual publication may occur after the course ends]; or (b) the approval of this project and its documentation by a departmental graduate committee set up for this purpose. CSDP 798 is four (4) credits in the first semester/session it is taken; and then one credit for each semester/session thereafter as required. A student must be enrolled in CSDP 798 for any semester/session in which he/she needs to consult with his/her project advisor. Prerequisite: CSDP 699.

**DOCTORAL LEVEL COMPUTER SCIENCE COURSES**

The following are new CS courses for the PHACE program.

**CSDP 705 Programming Language Semantics – 3 Credits (New)**

The theory of design, description, and implementation of programming languages, and comparative study of major programming languages. Topics can be selected from the following types of languages: Procedural-Oriented, Object-Oriented, Functional, Algorithmic, Artificial Intelligence, Computational, Data-Oriented, or others.

**CSDP 710 Machine Learning – 3 Credits (New)**

Introduction to fundamental concepts in machine learning, including various learning algorithms, and applications to real-world problems. The choice of topics includes but is not limited to supervised learning, unsupervised learning, computational learning theory, deep learning, reinforcement learning, and applications.

**CSDP 715 Object-Oriented Design – 3 Credits (New)**

This course addresses the concepts, skills, methods, techniques, and tools in object-oriented programming and design. It is focused on both object-oriented design and efficient implementation of the design. Topics include principles of software engineering, management issues, and the prototyping, development, testing, debugging, reuse, and maintenance of software systems.

**CSDP 720 Data Science and Analytics – 3 Credits (New)**

Introduction to fundamental concepts, theories, and technologies of data and data science, including data acquisition, wrangling, visualization, exploration, modeling, transformation, and classification. Topics can be selected from parameter estimation, hypothesis testing, regression analysis, dimensionality reduction, model selection, and feature selection.

**CSDP 725 Big Data Analytics – 3 Credits (New)**

Introduction to fundamental concepts, techniques, algorithms to big data, including various topics in big data from data generation, storage, management, transfer, analytics, data mining, and knowledge discovery. Applications in different areas are introduced to illustrate the development, deployment, and execution of a wide range of emerging big-data solutions.

**CSDP 730 Computational Science – 3 Credits (New)**

Introduction to the numerical algorithms that form the foundations of computations, and that apply advanced computing capabilities to understand and solve complex problems. Algorithms include mathematical models, computational models, and computer simulations. Applications can be selected from a wide range of areas in Computational X.

**CSDP 740 Advanced Software Engineering – 3 Credits (New)**

This course covers advanced software engineering principles and techniques. Topics can be selected from specification, design patterns, reverse engineering, design recovery, refactoring, software analysis, software comprehension, software evolution, domain specific techniques, advanced design, formal methods, software life-cycle, etc.

**CSDP 750 Special Topics in Software Engineering – 3 Credits (New)**

A special topic course is introduced by the faculty in his/her research area in software engineering related to the curriculum which is approved by the graduate committee. This course may be repeated (with different topics) for a maximum of 9 credits.

**CSDP 760 Special Topics in Data Science – 3 Credits (New)**

A special topic course is introduced by the faculty in his/her research area in data science related to the curriculum which is approved by the graduate committee. This course may be repeated (with different topics) for a maximum of 9 credits.

**CSDP 770 Special Topics in Computational Science – 3 Credits (New)**

A special topic course is introduced by the faculty in his/her research area in computational science related to the curriculum which is approved by the graduate committee. This course may be repeated (with different topics) for a maximum of 9 credits.

**CSDP 780 Special Topics – 3 Credits (New)**

A special topic course is introduced by the faculty in his/her research area or the current topic related to the curriculum which is approved by the graduate committee. This course may be repeated (with different topics) for a maximum of 9 credits.

The tables below are mappings for students who enter the Ph.D. program with an M.S. in Applied Computer Science.

**DATA AND COMPUTATIONAL SCIENCE CONCENTRATION**

<u>Courses</u>	<u>Master's</u>			<u>Ph.D.</u>			
	<u>Core</u>	<u>Free Ele</u>	<u>Project</u>	<u>Core</u>	<u>Concen</u>	<u>Free Ele</u>	<u>Diss</u>
CSDP 600							
CSDP 601	X			X			
CSDP 602	X			X			
CSDP 603	X			X			
CSDP 604		X		X			
CSDP 605		X				X	
CSDP 606		X			X		
CSDP 610		X			X		
CSDP 613		X				X	
CSDP 615		X				X	
CSDP 619		X				X	
CSDP 628		X				X	
CSDP 638		X			X	X	
CSDP 648		X				X	
CSDP 658		X				X	
CSDP 697		X				X	
CSDP 698			X				
CSDP 705		X			X		
CSDP 710					X		
CSDP 715		X				X	
CSDP 720	X				X		
CSDP 725	X				X		
CSDP 730	X				X		
CSDP 740		X				X	
CSDP 750		X				X	
CSDP 760						X	
CSDP 770						X	
CSDP 780						X	
ACIE 795							X
ACIE 796							X
ACIE 797							X
ACIE 798							X

**SOFTWARE ENGINEERING CONCENTRATION**

<b><u>Courses</u></b>	<b><u>Master's</u></b>			<b><u>Ph.D.</u></b>			
	<b><u>Core</u></b>	<b><u>Free Ele</u></b>	<b><u>Project</u></b>	<b><u>Core</u></b>	<b><u>Concen</u></b>	<b><u>Free Ele</u></b>	<b><u>Diss</u></b>
CSDP 600							
CSDP 601	X			X			
CSDP 602	X			X			
CSDP 603	X				X		
CSDP 604		X			X		
CSDP 605	X				X		
CSDP 606		X				X	
CSDP 610		X				X	
CSDP 613		X				X	
CSDP 615		X				X	
CSDP 619		X				X	
CSDP 628		X				X	
CSDP 638		X				X	
CSDP 648		X				X	
CSDP 658		X				X	
CSDP 697		X				X	
CSDP 698			X				
CSDP 705		X			X		
CSDP 710		X				X	
CSDP 715	X				X		
CSDP 720		X				X	
CSDP 725		X				X	
CSDP 730		X				X	
CSDP 740	X				X		
CSDP 750		X			X		
CSDP 760		X				X	
CSDP 770						X	
CSDP 780						X	
ACIE 795							X
ACIE 796							X
ACIE 797							X
ACIE 798							X

The following are new ENEM courses for the PHACE program.

### **ELECTRICAL AND MECHATRONICS ENGINEERING 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 641 Estimation and Detection Theory – 3 Credits (New)**

Decision theory: Binary hypothesis testing, M-ary testing, Bayes, Neyman-Pearson, Min-Max. Performance. Probability of error, ROC. Estimation theory: linear and nonlinear estimation, and parameter estimation. Bayes, MAP, maximum likelihood, Cramér-Rao bounds. Bias, efficiency, consistency. Asymptotic properties of estimators. Orthogonal decomposition of random processes and harmonic representation. Waveform detection and estimation. Wiener filtering and Kalman-Bucy filtering. Elements of identification. Recursive algorithms. Spectral estimation. The level of this course is suitable for research students in communications and control, signal processing, and related areas.

**ENEM 642 Digital Signal Processing – 3 Credits (New)**

Introduction to digital signal processing; discrete-time description of signals; z-transform; digital filter structures; infinite and finite impulse response filter design techniques. Advanced topics include the design of quadrature mirror filter banks and discrete wavelet transforms.

**ENEM 643 Principles of Digital Communications – 3 Credits (New)**

This course focuses on the fundamental principles behind reliable digital data transmission over noisy and band-limited channels. Signaling schemes, channel models, and receiver structures widely used

in practical systems are developed and analyzed. The communication techniques covered in the course are applications of digital signal processing, detection, estimation, and information theories. The covered topics include modern communications; probabilistic viewpoint; vector representation of signal; signal spaces; vector channels; additive white Gaussian noise; optimum receivers; maximum-likelihood detection; error probabilities; memoryless modulation methods; intersymbol interference (ISI); Nyquist signaling; equalization; complex baseband models; noncoherent detection; source coding; error control coding.

#### **ENEM 644 Wireless Communications – 3 Credits (New)**

Introduction to wireless communication principles and systems. Wireless channel models, TDMA, FDMA, spread spectrum, CDMA, equalization, detection, estimation, coding, security, quality assessment of service, and personal communications. Modern generation wireless standards are also discussed.

#### **ENEM 645 Principles of Communications Networks – 3 Credits (New)**

This course covers advanced subjects in computer networks. Topics will include Internet architecture and core protocols for congestion control, forwarding, naming, and routing; approaches to achieve reliability, scalability, and security; and design of hyper-scale cloud networks, data centers, wireless networks, content delivery, enterprise networks, quality of service, and network security. The material will range from the classics to the latest results, and from analytical foundations to systems design, and real-world deployment.

#### **ENEM 646 Wireless Networks – 3 Credits (New)**

Fundamental concepts of wireless networks: network architecture for personal communications systems, wireless LANs, radio, tactical, and other wireless networks, design, and analysis of protocols, and wireless network programming.

#### **ENEM 647 Advanced Computer Networks – 3 Credits (New)**

Introduces security principles and practices of computer and network systems. Topics include basic computer security concepts, common attacking techniques, common security policies, basic cryptographic tools, authentication, access control, network intrusion detection, software security, operating system security, network security, firewalls, network management, email, and web security, legal and ethical issues in computer security.

#### **ENEM 648 Coding Theory and Applications – 3 Credits (New)**

The theory and practice of error control coding with emphasis on linear, cyclic, convolutional, and parallel concatenated codes (Hamming codes, Repetition codes, polynomial codes, Reed Solomon Codes). Turbo codes, Viterbi decoding, and applications.

#### **ENEM 649 Design and Optimization of Networks – 3 Credits (New)**

A comprehensive introduction to network flows with an integrative view of theory, algorithms, and applications. It covers shortest path, maximum flow, and minimum cost flow problems, including a description of new and novel polynomial-time algorithms. It also covers topics from basic network design to protection and restoration design, to multi-layer network design while taking into account routing and flow requirements as applicable in different network architecture, protocols, and technologies.

**ENEM 650 Digital Integrated Circuit Design – 3 Credits (New)**

Studies the design process of VLSI CMOS circuits. Also covers all the major steps of the design process, including logic, circuit, and layout design. A variety of computer-aided tools are discussed and used to provide VLSI design experience that includes design of basic VLSI CMOS functional blocks, and verification of the design, testing, and debugging procedures.

**ENEM 651 RF Integrated Circuit Design – 3 Credits (New)**

Studies the design and analysis of radio frequency integrated circuits (RFICs) for communications. Topics include an overview of RF and wireless technology, fundamental concepts in RF design such as nonlinearity, sensitivity, and dynamic range. Matching and impedance transformation networks, and S-parameters. Transceiver architectures (Heterodyne, Direct Conversion, etc.), modulation, and up-conversion concepts. A detailed examination of each of the blocks in the transceiver architectures discussed: Low Noise Amplifiers, Mixers, Oscillators, Frequency Synthesizers, and Power Amplifiers.

**ENEM 652 Introduction to Machine Learning – 3 Credits (New)**

Introduces theoretical foundations, algorithms, methodologies, and applications for machine learning and provides a foundation for advanced study in topics shared by machine learning, statistical inference, and signal processing. Topics may include supervised methods for regression and classification (linear models, trees, neural networks, ensemble methods, instance-based methods); generative and discriminative probabilistic models; Bayesian parametric learning; density estimation and clustering; Bayesian networks; time series.

**ENEM 653 Computer Vision and Image Processing – 3 Credits (New)**

An introduction to computer vision, including fundamentals of image formation, camera imaging geometry, feature detection, and matching, stereo, motion estimation, and tracking, image classification, scene understanding, and deep learning with neural networks. We will develop basic methods for applications that include finding known models in images, depth recovery from the stereo, camera calibration, image stabilization, automated alignment, tracking, boundary detection, and recognition.

**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 ELECTRICAL AND MECHATRONICS ENGINEERING 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 741 Probability and Random Process – 3 Credits (New)**

Discrete-time and continuous-time cases. Basic concepts of random variables, random vectors, stochastic processes, and random fields. Common random processes include the white noise, Gaussian processes, Markov processes, Poisson processes, and Markov random fields. Moment analysis (including Karhunen- Loeve transform), the frequency-domain description, and linear systems applied to stochastic processes. Elements of estimation theory and optimal filtering include Wiener and Kalman filtering. Advanced topics in modern statistical signal processing such as linear prediction, linear models, and spectrum estimation are discussed.

**ENEE 742 Stochastic Process – 3 Credits (New)**

Correlations and spectra. Quadratic mean calculus, including stochastic integrals and representations, wide-sense stationary processes (filtering, white noise, sampling, time averages, moving averages, autoregression). Renewal and regenerative processes, Markov chains, random walk and run, branching processes, Markov jump processes, uniformization, reversibility and queuing applications.

**ENEM 743 Information Theory – 3 Credits (New)**

Introduction to information theory. Information measures: entropy, mutual information, relative entropy, and differential entropy. These topics are connected to practical problems in communications, compression, and inference, including lossless data compression, Huffman coding, asymptotic equipartition property, channel capacity, Gaussian channels, rate distortion theory, and Fisher information.

**ENEM 744 Adaptive Signal Processing – 3 Credits (New)**

Theory and application of adaptive algorithms like LMS and RLS in addition to non-linear extensions like generalized linear models, and Fokker-Planck theory for discrete time measurements of a continuous time state.

**ENEM 745 Channel Coding Theory and Applications – 3 Credits (New)**

The theory and application of channel coding for reliable communication. Basic results from information and coding theory (e.g., error exponents). Study of families of good codes, collectively referred to as turbo-like codes. Space-time code for multi-antenna wireless fading channels. Channel coding with transmitter side information, coding in the presence of feedback, connections between communications and control, coding for multi-user channels, recent capacity achieving codes such as polar codes, etc.

**ENEM 746 Stochastic Control – 3 Credits (New)**

Analysis and optimization of controlled stochastic systems. Models: linear and nonlinear stochastic controlled systems, controlled Markov chains. Optimization of systems described by Markov processes; dynamic programming under perfect and imperfect information, finite and infinite horizons. System identification: off-line, recursive. Stochastic adaptive control: Markov chains, self-tuning regulators, and bandit problems.

**ENEM 747 Optimization Methods in Signal Processing and Machine Learning – 3 Credits (New)**

Optimization methods that are suitable for large-scale problems arising in data science and machine learning applications. Optimization algorithms are explored for solving convex/nonconvex, and smooth/nonsmooth problems appearing in signal processing and machine learning. The efficacy of these methods, which include (sub)gradient methods, proximal methods, Nesterov's accelerated methods, ADMM, quasi-Newton, trust-region, cubic regularization methods, and (some of) their Stochastic variants are studied. Constraint optimization over Riemannian manifold is also included.

**ENEM 748 Introduction to Microwave Circuit – 3 Credits (New)**

Transmission-line theory, microstrip and coplanar lines, S-parameters, signal-flow graphs, matching networks, directional couplers, low-pass and band-pass filters, diode detectors. Design, fabrication and measurements (1-10GHz) of microwave-integrated circuits using CAD tools and network analyzers.

**ENEM 749 Introduction to Numerical Electromagnetics – 3 Credits (New)**

Introduction to numerical methods in electromagnetics including finite difference, finite element and integral equation methods for static, harmonic and time dependent fields; use of commercial software for analysis and design purposes; applications to open and shielded transmission lines, antennas, cavity resonances and scattering.

**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.

**ELECTRICAL AND MECHATRONICS ENGINEERING**

<b>Courses</b>	<b>Master's</b>			<b>Ph.D.</b>			
	<b>Core</b>	<b>Elective</b>	<b>Project/Thesis</b>	<b>Core</b>	<b>Concen</b>	<b>Elective</b>	<b>Diss</b>
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 641		X				X	
ENEM 642		X				X	
ENEM 643		X				X	
ENEM 644		X				X	
ENEM 645		X				X	
ENEM 646		X				X	
ENEM 647		X				X	
ENEM 648		X				X	
ENEM 649		X				X	
ENEM 650		X				X	
ENEM 651		X				X	
ENEM 652		X				X	
ENEM 653		X				X	
ENEM 670		X					
ENEM 688		X					
ENEM 696		X	X				
ENEM 697		X	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 741		X			X		
ENEM 742		X			X		
ENEM 743		X			X		
ENEM 744		X			X		
ENEM 745		X			X		
ENEM 746		X			X		
ENEM 747		X			X		
ENEM 748		X			X		
ENEM 749		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 towards 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 towards 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 concentrations 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:

- i. Graduate Record Examination (GRE) basic test scores;
- ii. A letter of intent describing his/her graduate studies goals and objectives.
- iii. 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 or 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 six (6) full-time faculty qualified and (3) part-time faculty to teach in the Cybersecurity, Data and Computational Science, and Software Engineering concentrations.

In addition to the current faculty resources, three (3) new faculty members will be added via the hiring process to support the Cybersecurity, Data and Computational Science, and Software Engineering concentrations over the next five years. Therefore, at the end of the five-year period, there will be nine (9) full-time faculty and (3) part-time faculty dedicated to the Cybersecurity, Data and Computational Science, and Software Engineering concentrations.

The existing nine (9) faculty are listed below.

**Dr. Joe Ashby is a part-time faculty member in the Department of Computer Science and Engineering Technology.** He received his Ph.D. in Computing Technology in Education from Nova Southeastern, M.S and B.S. degrees in Electronics & Computer Engineering Technology from Indiana State University. Dr. Ashby has extensive experience in Automation Engineering and Project Management, experience as a department chair, and face-to-face as well as online course development and delivery practice.

**Dr. DeWayne Brown is a part-time faculty member in the Department of Computer Science and Engineering Technology.** Dr. Dewayne R. Brown holds the rank of Professor in Electronics Technology. He received his Ph.D. in Electrical Engineering from Virginia Polytechnic Institute and State University (Virginia Tech), his M.S. in Electrical Engineering from North Carolina Agricultural & Technical State University. He received his B.S. in Electrical Engineering from the University of South Carolina. His experiences include working at Naval Surface Warfare Center (NSWC), SPAWAR Joint-Base, Charleston, SC, and Penn State Applied Research Laboratory as a summer faculty researcher with a primary research focus in the area of global positioning systems.

**Dr. Celeste Chamberlain, CISSP, is a part-time faculty member in the Department of Computer Science and Engineering Technology.** She received her D.Sc. in Emergency Management from Jacksonville State University, M.S. in Informatics from Northeastern University, and B.Sc. in Computer Science from Hampton University. Her experiences include working with the U.S. Senate Homeland Security and Governance Affairs Committee as a cybersecurity legislative advisor, and 20 years creating cybersecurity governance under the Department of Homeland Security.

**Dr. Derrek B. Dunn is a tenured Professor in Computer Science and Engineering Technology.** He received his Ph.D. and M.S. in Electrical Engineering from Virginia Polytechnic Institute and State University (Virginia Tech). His experiences include working at Hewlett-Packard Laboratory and Oak Ridge National Laboratory as a summer faculty researcher with a primary research focus in communications and networks. Dr. Dunn teaches and conducts research in the areas of Cybersecurity, Global Positioning Systems, and Wireless Communication Systems.

**Dr. Kenny Fotouhi is a Professor of Electrical Engineering Technology in the Department of Computer Science and Engineering Technology.** He received his MS in Electrical Engineering from Oklahoma State University in 1979, and his Ph.D. in Electrical Engineering from the University of Missouri-Rolla in 1983. He was an Interim Chair of the Department of Technology from 2018-to 2021. Dr. Fotouhi has been active in area research and published numerous papers in Electrical Engineering and Solid- State Physics Fields. He has been involved in joint research in the growth and development of new semiconductors

and Maryland offshore Wind Energy Research and Smart Agriculture- Smart farming. He was the recipient of the 1990 University of Maryland Eastern Presidential Distinguished Research Award and he is a member of ASEE and IEEE and the Eta Kappa Nu Honor Society.

**Dr. Gurdeep S. Hura is a faculty in the Department of Computer Science and Engineering Technology.** Dr. Gurdeep S. Hura received his B. E. from Jabalpur University (India) in 1972, M. E. from University of Roorkee (India) in 1975, and Ph.D. from University of Roorkee (India) in 1984, respectively. He was on the faculty of REC, Kurukshetra (India) 1975-1984, a Post-Doctoral Fellow in the Department of Computer Science, Concordia University, Montreal, Canada 1984-1985, faculty in the Department of Computer Science and Engineering of Wright State University, Dayton, Ohio (USA), 1984-1993, faculty and visiting research fellow in the School of Applied Science, Nanyang Technological University, Singapore 1993-1998, Director and coordinator of Department of Computer Science, University of Idaho, Idaho Falls 1998-2005. Dr. Hura served as Professor and Chair in the Department of Electrical and Computer Engineering, West Virginia University Institute of Technology, Montgomery, West Virginia Jan 2005-July, 2006, Professor and Chair of Department of Mathematics and Computer Science, University of Maryland Eastern Shore July 2006-Sept 2011, and a Professor in the same department since Oct 2011. He was awarded an excellent teaching award in 1991 and 2001 and excellence in advising in 2003. He is an author/co-author of over a hundred technical papers, which were published, in International IEEE journals and refereed conferences. He guest edited three special issues on "Petri nets and related graph models: Past, Present and Future", 1991, "The Practice of Performance modeling and reliability analysis," 1996, and "Internet: The state of the art," Computer Communication (Elsevier, UK), 1998. He is a senior member of IEEE and was elevated to Fellow of the Society for Design and Process Science in 2002. He received a Post-Tenure Review award of Excellence in recognition of the outstanding achievement of exemplary Research/Scholarship and Service, May 2018 and Distinguished Scholar Award, School of Graduate Studies, UMES, 2015. He has organized tutorials on Computer Networks, Modeling and analysis, Software engineering, Cyberinfrastructure, Cyber security, and Accreditation Boards of Engineering and Technology (ABET) accreditation, and has presented invited talks on these at various International Conferences.

**Dr. Rakesh Sharma is a Lecturer in the Department of Computer Science and Engineering.** He has been teaching Computer Science and Math classes in the Department of Computer Science and Engineering Technology at the University of Maryland Eastern Shore for more than 18 years. He completed his B.S. degree in Engineering from the University of North Carolina at Charlotte, and MIS Degree from the North Carolina Central University-Durham. He has completed 18 graduate credit hours in Computer Science and 18 credit hours in Cyber Security. He completed his Ph.D. in Computer Science from Gyan Vihar University, Jaipur. Before joining the University of Maryland, he worked for EDS (as an IT contractor for the Department of Defense, American Airlines, US Postal Service), IBM, and Micron Computers. Dr. Sharma has done considerable research in the following areas: machine learning, cybersecurity, decision support systems for critical infrastructure, data analysis, and project and resource management. He has published over fifteen research papers in peer-reviewed journals and given several conference presentations.

**Dr. Weiwei Stone is an Associate Professor in the Department of Computer Science and Engineering.** With a multi-background in computer science, applied mathematics, and electronic engineering, she has taught over 20 courses in multi-disciplines and advised

students' research and graduate projects at both the undergraduate and graduate levels. Her research interests include Blockchain, big data analysis, game-based learning, tsunami prediction, wavelet analysis, and non-uniform B-spline analysis. Dr. Stone has been active in serving in professional areas as well as in the local community. She also directs the graduate program of the department.

**Dr. Jun Zhang is a tenured Associate Professor in the Department of Computer Science and Engineering Technology.** He is the first Interim Chair of the new Department of Computer Science and Engineering Technology, established in January 2021. He joined UMES as an Assistant Professor in August 2014. At UMES, he has taught over 10 classes at both the undergraduate and graduate levels, including Programming Languages, Algorithms and Data Structures, Operating Systems, Software Engineering, Computational Science, among other courses. Dr. Zhang has been actively conducting research works; his research interests include algorithms and theory, data and computational science, and computer science education. Dr. Zhang is well educated in both China and the USA. He has four degrees, including a Ph.D. from the University of Rhode Island in Computer Science. Dr. Zhang has ample work experience in both academia and industry, as he previously worked as an advanced software engineer at Siemen and has taught in China, Vietnam, and the USA.

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

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 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**

<b>New Program(s)</b>	<b>eJournal Titles</b>	<b>eBooks</b>
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://www.wcp.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 <sup>1</sup>	\$161,292	\$214,444	\$207,188	\$257,475	\$306,089
2. Tuition/Fee Revenue <sup>2</sup> (c+g below)	\$95,208	\$135,056	\$236,812	\$281,025	\$326,911
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 <sup>3</sup>	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
4. Other Sources	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
<b>TOTAL (Add 1 - 4)</b>	<b>\$256,500</b>	<b>\$349,500</b>	<b>\$444,000</b>	<b>\$538,500</b>	<b>\$633,000</b>

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 funds identified as reallocated will be provided by the HBCU Settlement Fund.
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, six (6) new full-time tenure-track faculty members (with backgrounds in the proposed concentrations) 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 run the program.
2. **Support Staff (# FTE, Salary and Benefits)**  
None
3. **Equipment**  
Funds in this budget line will be used to purchase major equipment to support the research efforts of the proposed granted program.
4. **Library**  
Minimal funds are needed to purchase additional engineering textbooks.
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 has no relationship to low productivity programs.

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

Not applicable. The proposed program is not a distance education program.

**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



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](mailto:brissaq@microsoft.com) or by phone at (559) 290-9079.

Sincerely,

A handwritten signature in cursive script that reads "Kathryn Neal".

Dr. Kathryn Neal  
Senior Director, University Relations

Microsoft Corporation is an equal opportunity employer.



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,

A handwritten signature in black ink, appearing to read 'David Ryan', is written over a light grey circular background.

David Ryan  
Executive Director

ONE PLAZA EAST, SUITE 501 | P.O. BOX 4700 | SALISBURY, MD 21803  
410.749.1251  
SWED.ORG | INFO@SWED.ORG





**BOARD OF REGENTS**  
SUMMARY OF ITEM FOR ACTION,  
INFORMATION, OR DISCUSSION

**TOPIC:** Proposed Revision:  
Policy on Faculty, Student, and Institutional Rights and Responsibilities for Academic Integrity (III-I.00)

**COMMITTEE:** Education Policy and Student Life

**DATE OF COMMITTEE MEETING:** Tuesday, November 15, 2022

**SUMMARY:** Amid growing concerns from faculty, staff, and students about academic dishonesty at USM institutions and the increasing realization that “dishonesty prevention” is an insufficient approach to working with today’s learners, in December 2017 the Board of Regents charged the Council of University System Faculty (CUSF) and the USM Office of Academic and Student Affairs with exploring next steps to create a culture of academic integrity across our campuses. After CUSF spent many months examining and recrafting the institutional and USM-level academic integrity policies based on their research into best practices in the field, starting in Fall 2021, a workgroup of campus professionals, CUSF and faculty representatives, USM Student Council reps, as well as Office of the Attorney General and USMO representatives developed possible revisions to the USM Policy on Faculty, Student, and Institutional Rights and Responsibilities for Academic Integrity. Major, proposed changes include:

1. The addition of a purpose section.
2. Clarification that the policy applies primarily to students’ conduct in examinations and in fulfilling course requirements, not issues of misconduct in scholarly work (covered in USM Policy on Misconduct in Scholarly Work (III-I.10)).
3. Removing separate rights and responsibilities for/of faculty, students, and the institution to establish that “All members of our academic community—students, faculty, staff, and administrators—share responsibility to promote and maintain the highest level of integrity across the academic experience.”
4. A shift from punitive and legalistic measures and language (“guilty”) to discussion of community responsibilities, educational focus, and the establishment of a culture of academic integrity.
5. A new “Guidelines” section that provides specific guidance to the institutions on how to craft their own policies within their unique contexts.
6. An accountability section that establishes that each institution will be held accountable to their academic communities.
7. Language that denies admission to another USM institution while a student is suspended under this policy and a one-year denial of admission to another USM institution if a student is expelled under this policy.

In addition to the proposed amendments being supported by CUSF and the policy workgroup, the Academic and Student Affairs staff socialized and vetted the proposed amendments with USM’s provosts, vice presidents for student affairs, and the USM Student Council. These stakeholders support the proposed amendments. The draft has also been reviewed by the Office of the Attorney General for legal form and sufficiency.

Finally, proposed policy amendments are usually distributed for feedback and approval in the form of a track-changed document. In this case, the proposed changes are so significant and numerous that a track-changed document is too difficult to process and read. Therefore, following are the current policy and a clean version of the proposed policy.

**ALTERNATIVE(S):** The regents could reject the proposed amendments or ask for additional information.

**FISCAL IMPACT:** None

**CHANCELLOR'S RECOMMENDATION:** That the Committee on Education Policy and Student Life recommend that the Board of Regents approve the revisions to USM's Policy on Faculty, Student, and Institutional Rights and Responsibilities for Academic Integrity (III-1.00) to become USM's Policy on Academic Integrity (III-1.00)

---

COMMITTEE RECOMMENDATION:

DATE: November 15, 2022

---

BOARD ACTION:

DATE:

---

SUBMITTED BY: Joann A. Boughman      301-445-1992

[jboughman@usmd.edu](mailto:jboughman@usmd.edu)

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**USM Bylaws, Policies and Procedures of the Board of Regents**

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## **UNIVERSITY SYSTEM OF MARYLAND**

### **III-1.00 - POLICY ON FACULTY, STUDENT, AND INSTITUTIONAL RIGHTS AND RESPONSIBILITIES FOR ACADEMIC INTEGRITY**

(Approved by the Board of Regents, November 30, 1989; Technical amendments by the Board, December 12, 2014)

The academic enterprise is characterized by reasoned discussion between student and teacher, a mutual respect for the learning and teaching process, and intellectual honesty in the pursuit of new knowledge. By tradition, students and teachers have certain rights and responsibilities which they bring to the academic community. While the following statements do not imply a contract between the teacher or the institution and the student, they are nevertheless conventions which should be central to the learning and teaching process.

#### **I. FACULTY RIGHTS AND RESPONSIBILITIES**

- A. Faculty members shall share with students and administrators the responsibility for academic integrity.
- B. Faculty members shall enjoy freedom in the classroom to discuss all subject matter reasonably related to the course. In turn, they have the responsibility to encourage free and honest inquiry and expression on the part of students.
- C. Faculty members, consistent with the principles of academic freedom, have the responsibility to present courses that are consistent with their descriptions in the catalog of the institution. In addition, faculty members have the obligation to make students aware of the expectations in the course, the evaluation procedures, and the grading policy.
- D. Faculty members are obligated to evaluate students fairly, equitably, and in a manner appropriate to the course and its objectives. Grades must be assigned without prejudice or bias.
- E. Faculty members shall make all reasonable efforts to prevent the occurrence of academic dishonesty through appropriate design and administration of assignments and examinations, careful safeguarding of course materials and examinations, and regular reassessment of evaluation procedures.

#### **III-1.00-1**

## **USM Bylaws, Policies and Procedures of the Board of Regents**

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- F. When instances of academic dishonesty are suspected, faculty members shall have the responsibility to see that appropriate action is taken in accordance with institutional regulations.

### **II. STUDENT RIGHTS AND RESPONSIBILITIES**

- A. Students share with faculty members and the administrators the responsibility for academic integrity.
- B. Students have the right of free and honest inquiry and expression in their courses. In addition, students have the right to know the requirements of their courses and to know the manner in which they will be evaluated and graded.
- C. Students have the obligation to complete the requirements of their courses in the time and manner prescribed and to submit their work for evaluation.
- D. Students have the right to be evaluated fairly, equitably, and in a timely manner appropriate to the course and its objectives.
- E. Students shall not submit as their own work any work which has been prepared by others. Outside assistance in the preparation of this work, such as librarian assistance, tutorial assistance, typing assistance, or such special assistance as may be specified or approved by the appropriate faculty member, is allowed.
- F. Students shall make all reasonable efforts to prevent the occurrence of academic dishonesty. They shall by their own example encourage academic integrity and shall themselves refrain from acts of cheating and plagiarism or other acts of academic dishonesty.
- G. When instances of academic dishonesty are suspected, students shall have the right and responsibility to bring this to the attention of the faculty or other appropriate authority.

### **III. INSTITUTIONAL RESPONSIBILITIES**

- A. Constituent institutions of the University System of Maryland shall take appropriate measures to foster academic integrity in the classroom.
- B. Each institution shall take steps to define acts of academic dishonesty, to ensure procedures for due process for students accused or suspected of acts of academic dishonesty, and to impose appropriate sanctions on students found to be guilty of acts of academic dishonesty.
- C. Students expelled or suspended for reasons of academic dishonesty by any institution in the University System of Maryland shall not be admissible to any other System institution if expelled, or during any period of suspension.

Replacement for: BOR I-9.00

### **III-1.00-2**

### III-1.00 - POLICY ON ACADEMIC INTEGRITY

(Approved by the Board of Regents, November 30, 1989; Technical amendments by the Board, December 12, 2014; Revised \_\_\_\_\_)

#### I. PURPOSE

The University System of Maryland is an academic community whose fundamental purpose is the pursuit of knowledge. Essential to the success of this educational mission is a commitment to adhere to clearly established principles of academic integrity. This policy is the basis for practices designed to instill and to promote across the University System of Maryland a culture of teaching and learning with integrity and to hold ourselves to the highest standards of academic conduct. The University System of Maryland is committed to due process in circumstances where students are suspected of academic misconduct.

This policy applies to academic conduct of persons fulfilling requirements of courses or programs including in examinations, not misconduct in scholarly work covered in the USM Policy on Misconduct in Scholarly Work (III-1.10), which applies primarily to faculty, staff, and student research, scholarly writing, and the creation of works of art.

#### II. POLICY

All members of our academic communities—students, faculty, staff, administrators, post-doctoral trainees, and other academic professionals—share responsibility to promote and maintain the highest level of integrity across the academic experience. Accordingly:

- A. Constituent institutions of the University System of Maryland shall take measures to foster a culture of teaching and learning integrity on campus.
- B. All members of the community shall make all reasonable efforts to promote academic integrity and, by their own example, refrain from acts of academic misconduct themselves.
- C. Each institution shall conduct periodic evaluations of procedures and practices that instill and promote academic integrity.
- D. Following the “Guidelines for Policies and Procedures Relating to the Promotion of Academic Integrity,” each institution in the System shall prepare, implement, and publicize policies and procedures that define acts of academic misconduct, ensure due process for students accused of academic misconduct, and impose sanctions on students found to be responsible for acts of academic misconduct.
- E. All members of the community of each USM institution should report suspected academic misconduct, ensure student due process, and see that action is taken in accordance with institutional regulations.
- F. A student suspended under this policy shall not be admitted to any other institution in the System during the term of the suspension. A student expelled under this policy shall not be admitted to any other institution in the System for at least one year from the effective date of expulsion.

#### III. ACCOUNTABILITY

Each institution will be held accountable to their academic communities, the Chancellor, and the Board of Regents for the development, implementation, administration, and enforcement of policies, procedures, and practices aimed at fostering, sustaining, and upholding principles of academic integrity on their individual campuses. A template for collecting, evaluating, reporting, and sharing data on the institution’s progress consistent with the purpose of this policy will be developed by administrators and shared governance bodies collaborating with the University System of Maryland Office.

## **GUIDELINES FOR POLICIES, PROCEDURES, AND PRACTICES RELATING TO THE PROMOTION OF ACADEMIC INTEGRITY**

### **I. PURPOSE**

The purpose of these guidelines is to provide institutions in the University System of Maryland a framework for policies, procedures, and practices designed to instill and promote a culture of teaching and learning with integrity, to prevent academic misconduct, and to discover and censure instances of academic misconduct when they occur. Using these guidelines, each institution in the System must prepare, implement, and publicize policies and procedures including disciplinary measures appropriate for its unique organization and administration, as required by III-1.00: USM Policy on Academic Integrity.

These guidelines apply to academic conduct of persons fulfilling requirements for courses or programs, including in examinations, not misconduct in scholarly work covered in the USM Policy on Misconduct in Scholarly Work (III-1.10), which applies primarily to faculty, staff, and student research, scholarly writing, and the creation of works of art.

### **II. PHILOSOPHY OF ACADEMIC INTEGRITY**

Institutions should consider developing a statement that establishes a vision for teaching, learning, and supporting student success with integrity across the academic experience on their campus. It should be aspirational, describing high-level values, commitments, and principles that will guide the university's efforts to intentionally instill, maintain, and enhance a shared culture of integrity, through integrity-related policies, procedures, and practices.

### **III. DEFINITIONS**

According to the policy, USM institutions must develop and include in their policies and practices clear definitions for academic integrity as well as for the kinds of behaviors they consider to be academic misconduct as detailed in USM's Policy on Academic Integrity (III-1.00). Some examples include:

- A. Academic Integrity: "A commitment, even in the face of adversity, to six fundamental values: honesty, trust, fairness, respect, responsibility, and courage."\*
- B. Academic Misconduct: Academic misconduct can include, but is not limited to:
  - 1. Plagiarism: The intentional or unintentional use and re-use of one's own or another person's ideas, theories, words, data, work, or product.
  - 2. Cheating: To use or attempt to use unauthorized materials, information, notes, study aids, or other devices in any academic exercise. This includes unauthorized communication of information during the execution of an examination or other activity to fulfill course requirements.
  - 3. Misrepresentation: Any act or omission that is intended to deceive for academic advantage, such as fabricating or falsifying information in an academic exercise.
  - 4. Facilitating Academic Dishonesty: To help or attempt to help another person commit an act of academic dishonesty, including the unauthorized uploading or sale of course materials to third-party study-aid websites (e.g. CourseHero, Chegg).

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\* <http://www.academicintegrity.org>

#### IV. BEST PRACTICES IN ACADEMIC INTEGRITY POLICIES AND PROCEDURES

The most effective and enforceable academic integrity policies and procedures are transparent, inclusive, equitable, and fair. Accordingly, USM institutions should consider developing written policies and procedures that:

- A. Clearly reflect and communicate the expectations of all stakeholders in the institution.
- B. Are easily understood, ADA- and Title VI compliant, available in a variety of languages appropriate to members of the community, and broadly disseminated using a variety of methods.
- C. Ensure due process and maintain confidentiality in reporting, recording, adjudicating, and sanctioning of alleged acts of academic misconduct.
- D. Identify the responsibility of all members of the academic community for reporting misconduct.
- E. Include consequences for intentional or unintentional academic misconduct, when established, that reflect the seriousness and/or repetitiveness of the behavior, ranging from educational remediation to expulsion.
- F. Provide for regular and transparent evaluation of the success of its implementation, administration, and enforcement of policies and procedures.

#### V. CREATING A CULTURE OF ACADEMIC INTEGRITY

While establishing a culture of academic integrity will be unique to each institution, research\* suggests there are multiple ways institutions can successfully implement policies, procedures, and practices that foster academic integrity by:

- A. Clearly and regularly articulating how a culture of academic integrity supports achieving the institution's mission and vision.
- B. Educating all members of the community about academic integrity standards so that expectations are well understood as integral components of the community culture.
- C. Re-envisioning pedagogy to include equitable practice as well as demonstrated competencies and learning outcomes where relevant.
- D. Establishing on-campus partnerships and collaborations to help faculty create positive pedagogical environments and promote integrity in the classroom.
- E. Developing and publicizing clear, fair, academic integrity policies, procedures, and statements that can be effectively understood, procedurally sound, and consistently implemented.
- F. Promoting the positive aspects of academic integrity among all segments of the campus community.
- G. Regularly reviewing academic integrity policies to ensure that they are consistent, equitable and transparent, effective at their stated purpose, address changes in the field (e.g., new technology and evolving methods of misconduct), educational, and forward looking in their scope.
- H. Supporting those who follow the policies and procedures to uphold institutional standards for academic integrity.
- I. Creating and promoting support services that encourage student success such as tutoring centers, writing labs, counseling services, accessibility services, etc.
- J. Dedicating institutional resources to these goals, even when resources are scarce.
- K. Regularly evaluating progress toward creating a culture of academic integrity.

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\* Adapted from [https://academicintegrity.org/images/pdfs/20019\\_ICAI-Fundamental-Values\\_R12.pdf](https://academicintegrity.org/images/pdfs/20019_ICAI-Fundamental-Values_R12.pdf)



**BOARD OF REGENTS**  
SUMMARY OF ITEM FOR ACTION,  
INFORMATION, OR DISCUSSION

**TOPIC:** Maryland Center for Computing Education at USM

**COMMITTEE:** Education Policy and Student Life

**DATE OF COMMITTEE MEETING:** Tuesday, November 15, 2022

**SUMMARY:** USM's Maryland Center for Computing Education (MCCE) was formally established in statute and funded with the enactment of Maryland's *Securing the Future: Computer Science Education for All Act* on July 1, 2018. (Maryland Code, § 12-118). MCCE received an initial \$5 million in FY2019 state funding and an additional one million dollars in state funding each year since. The MCCE fund is a special, non-lapsing fund in which the balance remains with the center and is spent in accordance with the specifications in the governing legislation. MCCE's primary purpose is to expand access to high-quality PreK-12 computer science education by strengthening the educators' skills and increasing the number of computer science certified teachers in Maryland's public schools. Recently, MCCE and its computer science community were recognized as the first state in history to ever offer computer science courses in every public high school (CODE.ORG; CSEDCON-The Global CS Education Conference, October 2022). ([Maryland #1 in Computer Science Education](#)) ([Computer Science in Maryland](#))

**MCCE MAJOR AREAS OF IMPACT**

**Support for Maryland K-12 Schools ([MCCE Newsletter](#))**

MCCE provides practical, hands-on experiences that translate directly into Maryland public K-12 classrooms. The MCCE team supports K-12 teachers, counselors, and administrators by providing high-quality computer science professional learning opportunities. MCCE regularly partners with state and local educational organizations to encourage teachers to continue to increase their knowledge in this rapidly changing field. Through MCCE's collaborative workshops and summer institutions, Maryland educators continue to learn new teaching methods, applications, and integration of computing concepts.

**MCCE PRE-SERVICE COMPUTER SCIENCE & COMPUTATIONAL THINKING ([MCCE Pre-Services Grants RFP](#))**

USM's MCCE is working with Maryland colleges and universities to redesign undergraduate preservice educator preparation program. MCCE collaborates with higher education institutions to:

- (1) expand access to high-quality computer science education,
- (2) strengthen the computer science skills of future educators, and,
- (3) increase the number of computer science teachers.

**MCCE MLDS DATA DASHBOARDS ([MCCE Dashboards](#))**

Using data that is available in the Maryland Longitudinal Data System, MCCE created the *Dashboards: Participation in Maryland High Quality Computing Courses and Post-graduation Outcomes* (Garvin & Koerner, 2021). The online interactive MCCE dashboards are a model for other content-specific dashboards and provide stakeholders with important computer science teaching and learning data at the state, local school system and high school levels.

**ALTERNATIVE(S):** This is an information item.

**FISCAL IMPACT:** This is an information item.

**CHANCELLOR'S RECOMMENDATION:** This is an information item.

COMMITTEE RECOMMENDATION: Information Only

DATE: November 15, 2022

BOARD ACTION:

DATE:

SUBMITTED BY: Joann A. Boughman 301-445-1992

jboughman@usmd.edu



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# October 2022 Newsletter

## Featured this month:

- [Family Cyber Safety Night](#)
- [Interviews with Kathleen Mazurek, Sharon Ball, & Colin Hamill](#)
- [10th Annual CSTA Summit](#)
- [Featured Resource: MyCyber CS Curriculum](#)
- [Bebras Challenge](#)
- [MD Stem Festival](#)
- [GWC Cyber Threat Challenge](#)



## This Month Across the State

Do you know a school administrator who is supporting the growth of computer science education in Maryland? Nominate them to be recognized by MCCE [here!](#)



**Every family can be a target of cyber crime.  
Every school can help.**

Along with our partner Cyber.org, we're asking every school and district to invite their families to participate in this free, national online learning event. Inspired by our Family Code Night, Family Cyber Safety Night is an hour-long family event where, along with their parents and guardians, K-8 children will learn simple ways to avoid cyber scams through fun cyber safety activities- plus create their own family cyber safety plan! Join us any Tuesday during October; 10/11 (8-9 PM), 10/18 (7-8 PM), or 10/25 (6-7 PM).

Register here: [School sign up](#); [Family sign up](#)



**Amazon Future Engineer program leaders visited students in PG County middle and elementary schools to see the program in action as students demonstrated their awesome coding skills in the classroom.**



## Interviews From Across the State



[Kathleen Mazurek](#) is Maryland's newest CSTA Equity Fellow and a dual-certified art and special education teacher for BCPS who has worked hard to create equitable opportunities in CS for their students at the William S. Baer School. [Sharon Ball](#) is a recently retired Golden Crab-winning engineering and CS teacher from BCPS who has always gone the extra mile for her students. [Colin Hamill](#) is an entrepreneur in cybersecurity designs for small businesses here in Maryland who is focusing on supporting the cybersecurity needs of local agriculture.

## Upcoming Events for Educators

### CSTA Maryland

Next CSTA-MD meeting Thursday 11/3, 4-5pm.  
Topic: CS Education Week. [Join to get invitations!](#)

Calling CSTA Maryland Members to join the 2022-23 Chapter Inquiry Group to engage in identity-inclusive CS topics, safe conversation practices, and community building. This 1-year program includes a free online course in Identity Inclusion and 5 monthly meetings from January-May 2023. [Find out more here.](#)

### Go BIG at the 10th Annual CS Summit!

[Register now](#) to join us with Common Ground this November 18th and 19th at the Convention Center in Ocean City!



[Visit the cs4md website for more information](#)

### Webinar: Technology and farming in Maryland, what's new and what to know.



Read MCCE's [interview with Sentinel Forge founder Mark Hamill](#)

[Sentinel Forge Technologies](#) will provide an overview of the many applications of computing in modern day farming and the associated cybersecurity risks that most people remain unaware of. High speed internet is coming to all rural areas and now there are drones to monitor the land, cameras and artificial intelligence that make decisions about insect pests, livestock feeding and health, and more. [Register here](#) to learn about farming, technology and cybersecurity.

XXXXXXXXXXXXXXXXXXXX

Tuesday, November 1, 2022; 4:30-5:15pm

# Resources for Educators

## Featured Resource: MyCyber

A 9-week [middle years cybersecurity curriculum](#) for grades 6-8. Request access to teacher resources by emailing [dogrady@usmd.edu](mailto:dogrady@usmd.edu)



Are you teaching a new class in computer science? Experts are here to help. [Register to be paired with a mentor](#) to help get the year off to a good start and to answer questions throughout the year.

Are you teaching a new Code.org class? There's a great resource for teachers who are new to teaching CSF, CSD, or CSP at: <https://code.org/educate/professional-development-online>.

**Free CPD credit workshops are here for the fall: Intro to Cybersecurity, Coding and Music, Intro to Artificial Intelligence, Computational Thinking and Social Studies. Expand your reach! [cs4md.com/secondary](https://cs4md.com/secondary)**

## Early Childhood CS

[ScratchJr](#) is a developmentally appropriate coding platform for kids ages 4 to 7, who don't necessarily need to know how read or write.

ScratchJr can be used on tablets, iPads, and Chromebooks.

The [Coding as Another Language \(CAL\)](#)



[Visit ScratchJr Connect](#) to find a free, curated

[curriculum](#) introduces powerful ideas through unplugged games, storytelling, movement, singing, and coding.

database and to share ScratchJr resources, lessons, and projects.



The Bebras team have supported teachers for years by offering fun and interactive computer science competitions. [Register your class now](#) to participate in the 2022-2023 Bebras Challenge this November 7th-23rd.

Practice tasks from previous years' challenges are available [here](#); help your students prepare for the upcoming challenge and optimize their scores!

## Opportunities for Students



[The Maryland STEM Festival](#) is a month-long celebration of science, technology, engineering and mathematics that takes place every Fall. This year's festival theme is Cybersecurity and Information Technology. Join us from October 14th through November 14th as we explore these exciting topics and their associated fields and careers! Students of all grades, along with their families and friends, STEM professionals, teachers, and volunteers can choose from a selection of hundreds of different fun, interactive science learning opportunities taking place throughout Maryland. [See event offerings and register here.](#)

Aspirations in Computing: An award open to students whose genders are underrepresented in

computing! All girls, trans- and cisgender, as well as all genderqueer and non-binary students in grades 9 through 12 are encouraged to apply. Fill out a short form to nominate yourself! Applicants can also choose to nominate a teacher who has inspired them. [Applications](#) are now open through 10/27!



All individual high school students and Girls Who Code club members (grades 6-12) are invited to participate in the Cyber Threat Challenge this fall! Participants design a creative project that spreads awareness about a cyber threat in their community by explaining the threat, sharing tips on its prevention, and introducing a related career. Two winning submissions at the middle school level and two at the high school level will be awarded \$250 cash prizes, plus more! All submissions are due by 11/18. Detailed information is available [here for GWC members](#), and [here for individual high school students](#); or, [visit the FAQ page](#) and [watch this short video](#) to learn more.



[The Congressional App Challenge](#), for middle and high school students, is helping to transform how Congress views computer science and STEM. Since the challenge was first announced, Congress' mentions of computer science and coding have increased by 2,000%! Win prizes! Enter for free. Due by 11/1

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## 2022 State of Computer Science Education

The tremendous growth of computer science (CS) education has significantly slowed during the COVID-19 pandemic, with few schools able to add new classes to the curriculum. Now, in 2022, it is time for policymakers to reassess the knowledge, skills, and curricula that will engage students, support learning objectives, and prepare students for their post-school lives.

**Just over half (53%) of high schools in the U.S. offer a single computer science course.** Although this represents significant growth (from 35% in 2018), the number of schools offering CS—a foundational subject that is critical to the nation’s economy and security—has grown by just two percent in the past year. State and federal policy can accelerate growth in computer science education by reexamining the foundational needs for all our K-12 students. Policymakers and school decision-makers must answer this call to ensure all students have equitable access to computer science education.

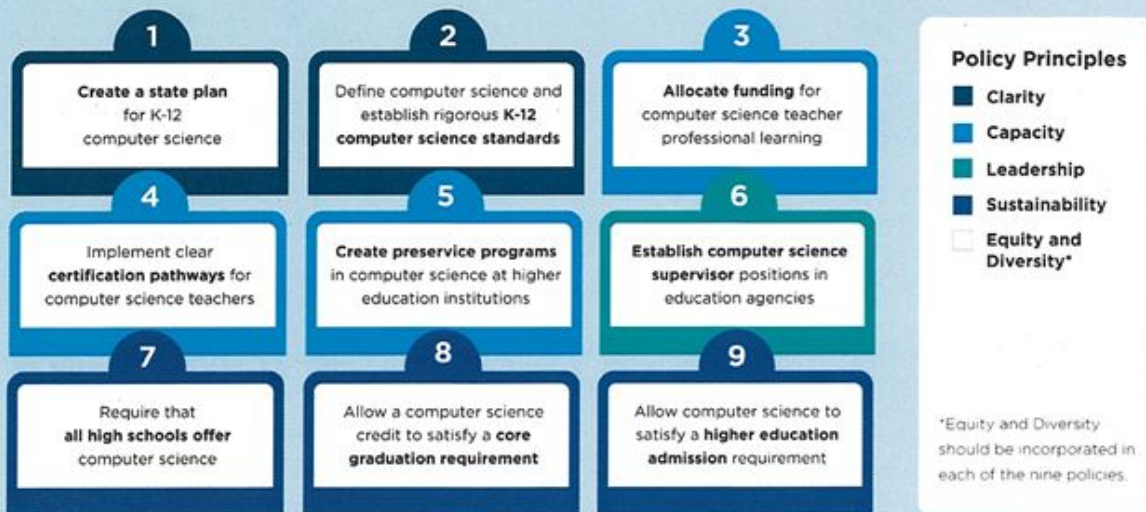
### Maryland by the Numbers

**15,432**  
 In 2022, MD averaged 15,432 open computing jobs each month

**\$105,129**  
 These jobs have an average salary of \$105,129

**4,807**  
 Yet there were only 4,807 graduates in computer science in 2019

### Nine Policies to Make Computer Science Fundamental





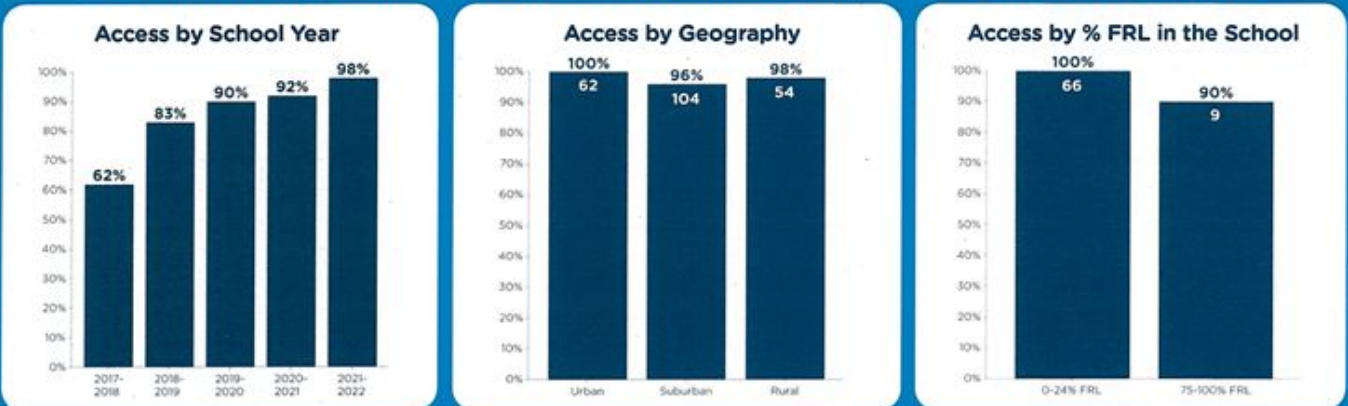
# Maryland

## Policies to Make CS Fundamental

<b>State Plan</b> ✓ YES	<b>Standards</b> ✓ YES	<b>Funding</b> ✓ YES
<b>Certification</b> ✓ YES	<b>Preservice</b> ✓ YES	<b>State CS Position</b> ✓ YES
<b>Require HS to Offer</b> ✓ YES	<b>Can Count</b> ✓ YES	<b>Admissions</b> ✓ YES

**94.2% of MD high school students** attend a school that offers foundational computer science, but only **14.3%** of students are **enrolled in a computer science course**. **42.4%** of students enrolled in a computer science course are **female**.

## Percentage of Public High Schools Offering Foundational Computer Science

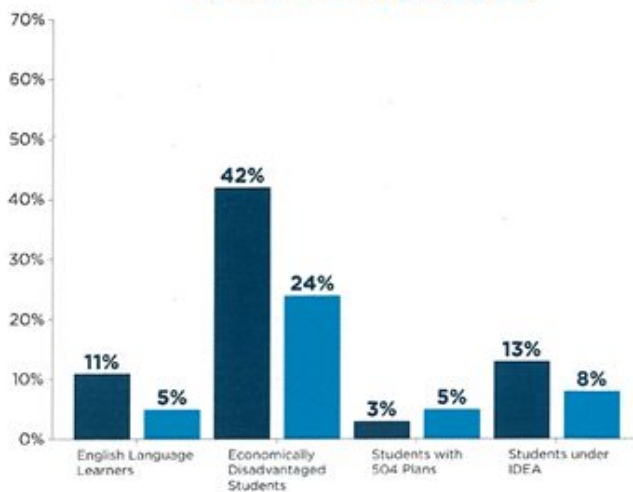


Data provided primarily by the Department of Education and school catalogs, based on 226 schools with high school grades. The state reports economically disadvantaged students rather than students who qualify for free and reduced-price meals. Participation data was masked at low counts.

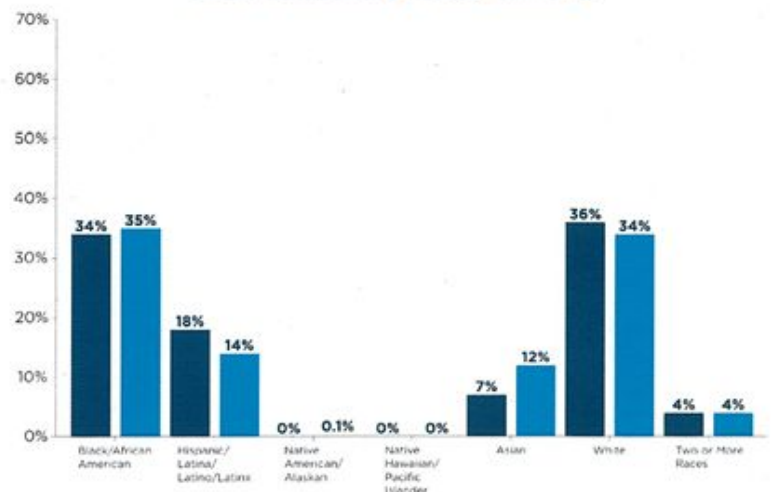
## Participation in Foundational High School Computer Science Courses by Demographic

■ Student Demographics 9-12 ■ Participation in Foundational Courses

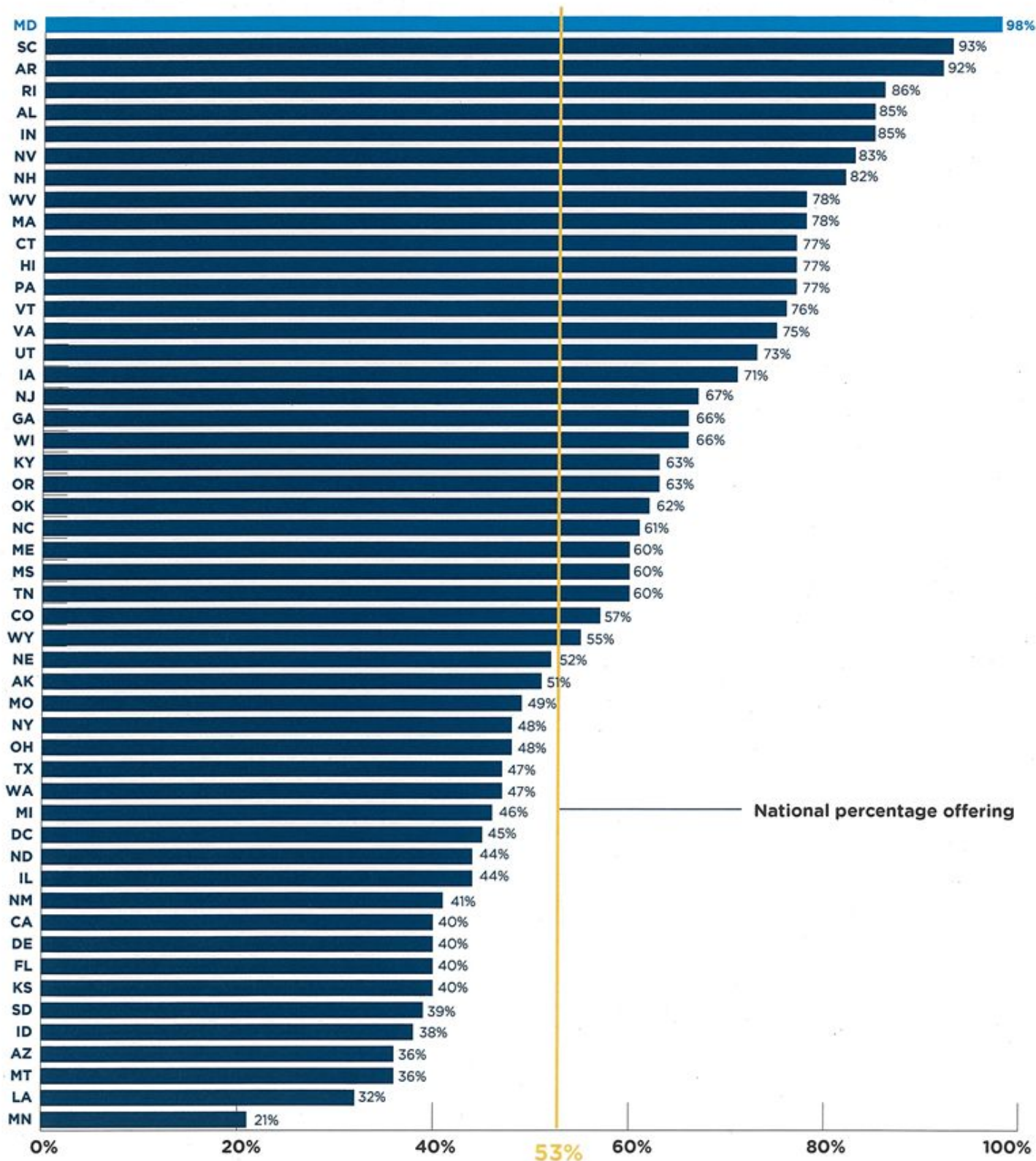
### CS Enrollment by Subgroup



### CS Enrollment by Race/Ethnicity



# Percentage of High Schools Offering Computer Science, by State\*



\*for the most recent school year reported by each state

# Participation in Maryland High Quality Computing Courses and Post-graduation Outcomes

## Introduction

State Overview

State Details

State Trends

Local Overview

Local Details

Data Notes

The following dashboards explore the changes in computing course enrollment of high school students and their post-graduation outcomes. The Maryland Center for Computing Education (MCCE) created them with the use of data from the Maryland Longitudinal Data System Center (MLDSC). More information about the methods used for classifying courses, majors, and high schools is included in the data notes section.

### Defining a Computing Course

Which courses count as computing is not universally defined, so four definitions have been included in this dashboard analysis. These definitions are further explained in the data notes but include more specific (1) and more broad (2) MCCE defined options.

The page title will change to further identify your selection.

#### Computing Course Definition

- 1. Maryland High Quality
- 2. All IT SCED Courses

2019-2020 School Year

**87%**  
of high schools had a course  
**12%**  
of all students enrolled

### Annual Enrollment in Computing Courses

One way to analyze the access and participation in computing courses is based on enrollment within a specific school year. This type of analysis is used to calculate the percent of schools that are offering computing courses, the number and types of courses that are being offered, and the percent of the total high school population enrolled.

### Participating Graduates and Post-graduation Outcomes

Another way to analyze access and participation is to examine the full course history of graduates and identify if they took at least one computing course. These students are referred to as *Participating Graduates*, and this population of students is used to explore post-graduation outcomes. Percentages for these outcomes are calculated based on the students from the previous outcome group.

**26%**

of 2020 graduates took at least one computing related course

**59%**

of these graduates enrolled in college full-time the following fall

### Student Subgroups

Monitoring steps towards equity across traditionally underrepresented student subgroups requires further analysis. Student subgroup data are presented as a measure within the subgroup and not as a distribution (e.g.. For Hispanic students, 18% were participating graduates and NOT 18% of participating graduates were Hispanic students. Subgroups include gender, race/ethnicity, Free and Reduced Meal (FARMS) and Students with Disabilities / Special Education (SWD).

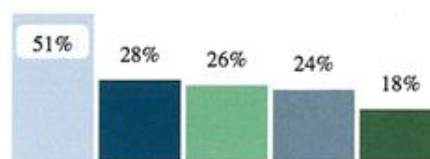
#### Student Subgroups

FARMS

Race / Eth...

SWD

#### CC Participation by Race / Ethnicity



Go back

Introduction



# Participation in Maryland High Quality Computing Courses and Post-graduation Outcomes

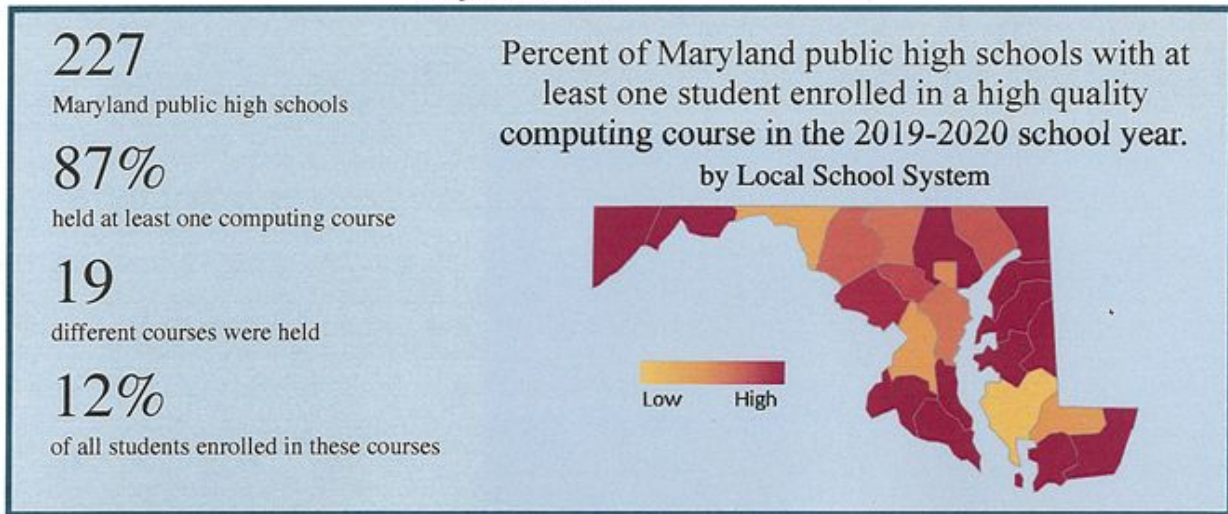
## State Overview

- State Overview**
- State Details
- State Trends
- Local Overview
- Local Details
- Data Notes

Computing Course Definition

- 1. Maryland High Quality
- 2. All IT SCED Courses

The state overview provides summary information for the most current year of available data analysis. There are varying definitions of what counts as CS courses by several organizations. Select the definition on the left that you would like to view. More information about these definitions and the courses included can be found on the [Course Listing](#) page under Data Notes. On the other pages of this dashboard, you can select these definitions from a drop-down menu.



\*Maryland public high schools only include those that issue diplomas and the count of courses is based on local school



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## Part 1: Which state is doing the best to improve access to computing education?

It's not who you think.

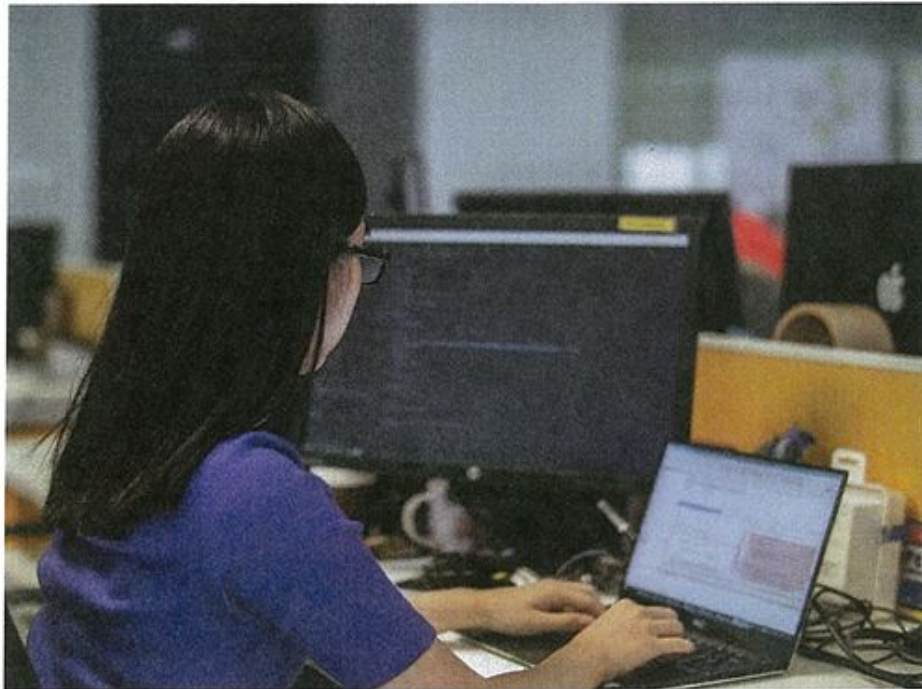
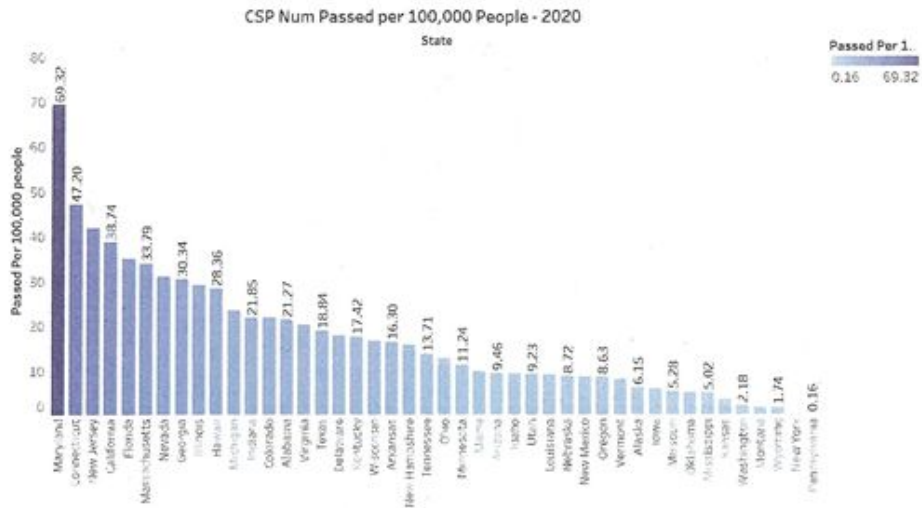


Photo by [Mimi Thian](#) on [Unsplash](#)

Pop quiz: which state do you think is best preparing high school students for the hundreds of thousands of computing jobs that await them in our increasingly digitized world? Hint: It's not a coastal state with a tech hub, like California (home of Silicon Valley) or New York (home of Silicon Alley).

It's **Maryland**. Surprised? Adjusting for population size, in 2020, Maryland had more students pass the Advanced Placement Computer Science Principles exam *than any other state in the United States*. Maryland also ranked fifth in the nation for students passing the Advanced Placement Computer Science A

exam.



How did it happen, and what can we learn?

**Surely there's an easy explanation for Maryland's success.**

Let's address some of the contributing factors that make this success possible (but not inevitable).

1. Maryland has a relatively wealthy population. The state's median household income is \$86,738, which places it at the top of the list of states ranked by wealth. Given the well documented link between wealth and access to computer science, this might seem to be the most obvious explanation. Still, other wealthy states (like Massachusetts, Connecticut, or

New Jersey) do not achieve the same consistency of results, so high incomes alone aren't responsible for success.

2. **Maryland is relatively small, in terms of square footage.** The state is 9th in area. But if that were the only factor, we'd expect that to play out in other states: the smaller the area, the higher the participation. That's definitely not the case. So it can't just be that.

### **So what's the full story?**

Three interdependent factors: money, people, and policies.

#### **Money**

There's no way around the fact that it is nearly impossible to make meaningful systems change without substantial funding. Maryland has had a total of \$8 million dedicated to CS education funding since FY2019. What made Maryland's efforts stand out is the range of priorities the state chose to fund: not just computer science standards, but network-strengthening investments like teacher training and a dedicated center at the University of Maryland.

Money also pays for important things like systems and people to track data. Because the Maryland Center for Computing Education dashboard tracks high school participation, they know that one in ten Maryland public high school students were enrolled in at least one CS class.

#### **People**

Where did those funds come from? Critical factor number two: people. Many states have strong leaders working to increase access to computer science, and Maryland is no exception. Governor Larry Hogan made CS education a top priority with a particular focus on expanding access for girls and people of color. Making CS education a priority — and the dollars needed to turn that priority into a reality — came straight from the top.

Hundreds more are making change happen, but a few stand out:

- **Tiara Booker Dwyer**, Assistant State Superintendent for the Maryland Department of Education, was part of the team that wrote the K-12 Computer Science Standards and continues to be a strong supporter of CS for ALL at the state level.
- **Dianne O'Grady Cuniff** has been one of the most influential behind-the-scenes players. As the Director of the Maryland Center for Computing

Education, she has probably done more than anyone else to connect the dots on the ground by building and managing relationships all over the state.

- It certainly doesn't hurt that Maryland has a ringer going to the mat for CS education: **Pat Yongpradit**, the Chief Academic Officer of code.org is from Maryland and has been both a classroom teacher and one of the nation's leading advocates for CS education.

And of course, we cannot ignore the hundreds of teachers providing the daily instruction and inspiration at the core of all computing education. Especially in a small state like Maryland, even a dozen superb teachers can impact a high percentage of students. (Want to dive deeper into the importance of teachers? [Click here.](#))

### **Policies**

**The right policies make a massive difference.** And how does policy change happen? With people and money. Maryland is one of only five states that have achieved what code.org has identified as the [nine policies](#) necessary to make CS education fundamental.

Maryland requires students to take one "Computer Science, Engineering, or Technology Education credit," which most students use a CS class to fill. And as a result, 89% of Maryland high schools offer computer science, the highest rate in the nation. [96.5% of Maryland high school students](#) attend high schools that offer computer science. It is also the only state in the nation that requires middle schools to provide "computational learning" opportunities.

Local decision makers are the ones who actually put laws into practice, and in Maryland, [there are only 25 school districts](#). Why does that matter? It means that there are only 25 chief executives that have to align on a vision about computer science. This is when the "people" part of the equation becomes important. CS education advocates — or even a single, dogged person — could have a relationship with *every* school system in the state. Maryland's size makes this a lot easier; as Dianne O'Grady Cuniff said, "You can get all the way across the state and back in a day!" (Compare this with California, which is 16 times bigger than Maryland and has over 2,000 school districts.)

### **Why does this matter?**

Simply put: it strengthens the pathway to a degree. Computing degrees unlock





computing careers, and computing careers bring more jobs and higher wages. K-12 computer science exposure goes a LONG way in inspiring interest in the field, *especially* when we think about the intersection of race and gender.

Image credit: [code.org](https://code.org)

We know what you're thinking: **what does this mean for Black, Latina, and Native American women?** Does this success go beyond “all students”? True, increasing access to computing in general often does not increase access for Black, Latina, and Native American girls and young women. While Maryland's results may not be replicable everywhere, the trifecta of money, people, and policy can set the stage for what does improve access for Black, Latina, and Native American women: **intentional, specific programs** like [Code in the Schools](#), [Rise Up](#), [Break Through Tech DC](#), and others.

And get this: **In 2020, more Black women high school students passed the AP CSA exam in Maryland than in *any other state*.** And, that K-12 exposure seems to translate into college degrees: [IPEDs](#) data indicate that the state of Maryland alone graduates 16% of all the Black women computing graduates in the nation. For a small state, that's a huge number. There's more to learn from our friends in Maryland. Stay tuned for Part 2, where we'll look more deeply at how the state's people, policies, and funding worked for Black women *specifically*.

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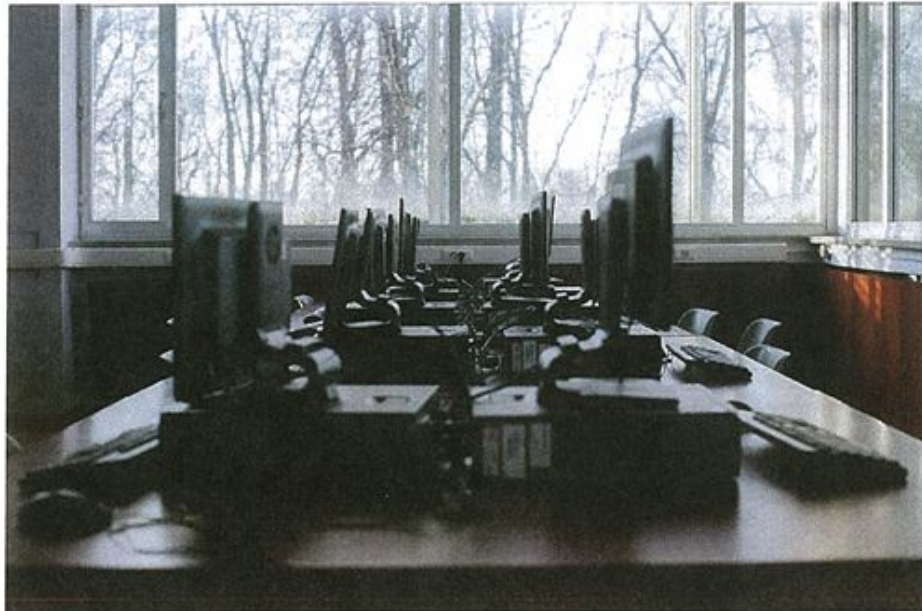
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## Part 2: Which state is doing the best to improve access to computing education?

*We already knew Maryland was getting something right. What else can we learn from them?*



Meet Holland Henderson-Boyer, a high school senior in Maryland. In elementary school, she had the opportunity to participate in robotics, where she was the lead programmer for the autonomous portion of the competition. She continued with robotics through middle school; in high school, she joined clubs that introduced her to new passions in cybersecurity and software development, so she decided to take CS classes.

She had a teacher who inspired and encouraged her to keep at it (shout out to [Mrs. Blasko](#)). She joined her local Girls Who Code chapter and the older girls mentored her, eventually propelling her into a position of leadership. While

taking Advanced Placement Computer Science (APCS), she participated in extra help sessions through a program called Rise Up 4 CS, through which University of Maryland (UMD) students mentored and tutored high school students.

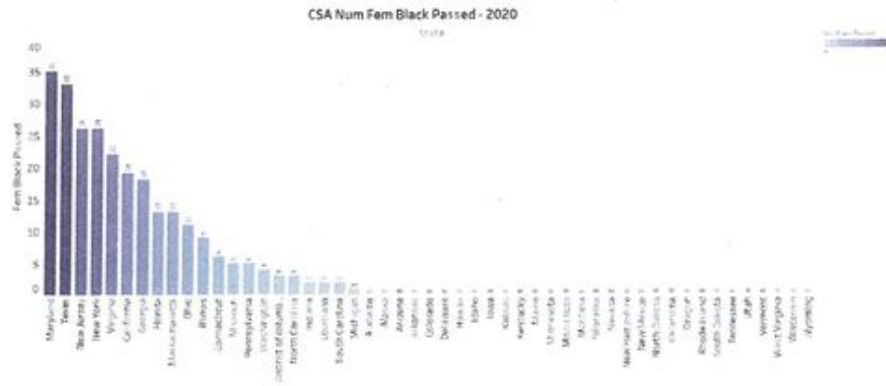
This year, Holland was awarded the prestigious National NCWIT Aspirations in Computing Award. On a Discord server, the winners share dreams and backgrounds and GIFs. She knows she wants to study computer science in college, and she's excited about the future of cybersecurity.

Holland's success is part of a statewide story that we've started to explore: Maryland is doing a fantastic job providing *all* high school students access to computing education. Specifically, Maryland is leaps and bounds above many other states in terms of access to and performance on AP CS courses. In 2020, Maryland had more students pass the Advanced Placement Computer Science Principles (AP CSP) exam than any other state, adjusting for population size.

But we know that "all students" can obscure the experiences and realities for Black, Latina, and Native American (BLNA) women, so we looked deeper. Here's what we saw: *Black women specifically excelled in AP CS in Maryland.*

Maryland came in first and second in the nation for AP CSA and AP CSP pass rates for Black women. (Side note: AP CSA focuses on problem solving and programming with Java, and AP CSP focuses on broader computing principles. Both are important, and AP CSP has had a lot of success bringing CS to a larger group of students.)

This is particularly impressive because these are *raw numbers* — not per capita. In 2020, more Black women high school students passed the AP CSA exam in Maryland *than in any other state.*



## Money + People + Policies = PROGRAMS

As we described in [Part I](#), the magic formula of dedicated funding, passionate people, and top-down policies is still relevant here. The output is carefully designed and intentionally marketed programs dedicated to K-12 computing education and access for historically underrepresented populations – in Maryland, this means Black communities, especially girls and women in those communities.

And when we interviewed computing education leaders in Maryland, we found that a statewide effort is underway to ensure that all districts- and especially districts with high percentages of Black students- are providing CS from elementary school to high school, throughout the school year and during the school day.

### The Programming Landscape in Maryland

Let's take a look at some of the educational and extracurricular institutions supported by funding, people, and policies in the state.



### Okay, there are programs. So what?

Lots of states have programs and are not seeing the same results. We've also discussed how intentional program design must be to engage students who have been made to feel unwelcome in technology spaces (and they often miss the mark). How did Maryland get it right for Black women? What can we replicate? Our interviewees painted a picture for us.

| *“There is an overarching spirit of collaboration.”*

The secret sauce is that all of these programs are not just one-offs — they are connected.

- MCWiC is housed at UMD, so leadership is able to communicate regularly within a stable infrastructure...
- CompSciConnect is also centered at UMD, so camp leadership can encourage students to participate in Rise Up when they take AP CS A...
- Rise Up students are introduced to college level computing and have a near-peer mentor to make the leap more welcoming...
- The NCWIT Aspirations work is centered at UMD, so UMD works to ensure that the Aspirations award winners know how to get into UMD (and how inclusive they are trying to be)...
- Code in the Schools partners with MCCE (which is housed at the University System of Maryland and works across education organizations) and code.org to bring professional development to the entire state...

You get the picture — listing all the overlaps could fill a novel. The effect of this collaboration is two-fold. First, an enmeshed network of programs and supports for students from middle school through college, with few gaps. Second, consistent communication among program leadership that cemented an aligned focus on women and people of color and especially Black women.

| *“To expand the pool of teachers, we have to expand options and training.”*

The call for more computer science in schools can elicit skeptical responses: We need more teachers in the midst of a teacher shortage? We need teachers who could get high-paying private sector jobs to opt for public school salaries? Or... we need teachers who are already working full-time to become CS teachers?

Maryland leaders got creative. The state DOE created pathways for knowledgeable people (like private sector employees and university professors) to get in front of K-12 students. They developed a certification team that gave these experts a foundation in the curriculum without training them to be full-time teachers. Revising regulations to bring the best minds to Maryland students? Check.

| *“From the outset, we saw the huge gap in representation.”*

Code in the Schools supplements formal instruction by providing CS instruction to students **during the school day**. They work within the formal school system by operating outside of it — the organization hires diverse, engaging staff and partners with school districts to provide curriculum, instruction, and materials during the school schedule. This is no small feat — integrating into a school schedule is logistically complicated, but it is also one of the best ways to ensure maximum reach. They *also* provide after school programs AND summer programs AND professional development.

Representation impacts not just what kids see but what they learn — and Code in the Schools saw a huge representation gap in program and classroom leadership. They set out to simultaneously recruit more representative classroom leadership *and* train all teachers in how to support students who are historically underestimated and underrepresented in computing. Through Maryland Codes, they are working to bring that focus to every district in Maryland. This piece matters. It's not just about having classes available and people to teach them — it's also about making sure that those classes and those teachers are set up to succeed, and that means valuing ongoing learning and development.

| *“We need to send a message that there is a place in this industry for you.”*

Bridging the gap between education and career can be tough, especially for BLNA women who don't often see themselves in the industry — either through personal connections or through stories (in the news, in movies, in books, etc.) that demonstrate the real-world possibilities. Maryland leaders thought about this, too. Leaders have partnered with the [Maryland Business Roundtable for Education](#) (a coalition of employers committed to education reform and student achievement) to bring in specialists from local companies to teach classes. Maryland is also (by some estimates) [one of the best states for Black women-owned businesses](#) — so there are opportunities for public-private partnerships that are affirming diversity and inclusion beyond the classroom and into the office. These efforts depend on a thriving industry to welcome BLNA women after they move through the education system.

| *“Cultural responsiveness needs to be built in, not shoehorned.”*

Culturally responsive curriculum doesn't happen by accident or by the force of good intentions — it's a thoughtful and thorough effort that brings a lot of different perspectives together. Maryland leaders recognized that culturally-



responsive curricula required a) deep review and b) teacher training. If teachers weren't set up for success, they could have created uncomfortable and exclusive spaces in their classrooms.

Maryland leaders also recognized that hitting people over the head with cultural responsiveness is not a path to long-term success, even if it is critically important. Instead, they focused on baking it in at every level — in the curriculum, in the classroom, in professional development, in industry. The result is a relatively non-politicized environment, especially compared to other states where inclusivity has become a political lightning rod. When inclusivity is an aligned priority, everyone wins — students stay engaged, teachers develop professionally, and the business community welcomes talent.



### So what does this all add up to?

Remember Holland? Hers is just one story, but you can see how these networked programs and support nurture incredible students like her. And she loves the community that has come out of this computing network. “I am developing these skills because these amazing women and people of color came before me,” she told us. “There was not a time where I was constantly thinking about my identity. I feel like I’ve been lucky.”

IPEDs data indicate that the state of Maryland alone graduates 16% of all the Black women computing graduates in the nation. That’s a big number for a small state — and the foundation that these leaders are laying in K-12 is a huge

part of that success. Maryland's long history of Black academic prowess, especially at the post-secondary level, is also undeniable. Maryland is one of three states with four public, 4-year HBCUs, all of which have a computer science program.

### **Still, there is much work ahead.**

No tech equity advocate in Maryland is resting on their laurels — it's clear that they think of this work as constantly evolving and not as a target to hit. All of the advocates we interviewed immediately told us that they are working hard to continue to increase access, especially for rural students, and continuing to increase access for all BLNA students. And there's more work to be done at the higher education level — for example, community college pathways in Maryland can and must be strengthened.



For now though, we can all take a page from Maryland's book and learn from the culture they've created. They've put collaboration and shared priorities first. They've worked within the public education system instead of working against it. They've made sure that the educators working with students are prepared for a range of situations. And they've made sure that students can see a future for themselves in a world they have historically been excluded from.

Are you all thinking about what you can learn from Maryland's example? Because we are.

*Thank you to everyone who took the time to speak with us about their work in Maryland. This piece would not be possible without:*

- **Kate Atchison** (Associate Director, Iribe Initiative for Inclusion and Diversity in Computing)
- **Charlotte Avery** (Outreach Coordinator, Iribe Initiative for Inclusion and Diversity in Computing)
- **Tiara Booker-Dwyer** (Former Assistant State Superintendent, Maryland Department of Education)
- **Megean Garvin** (Director of Research and Assessment, Maryland Center for Computing Education)

- **Holland Henderson-Boyer** (Student and NCWIT Aspirations recipient)
- **Gretchen LeGrand** (Co-founder and CEO, Code in the Schools)
- **Dianne O’Grady Cunniff** (Director, Maryland Center for Computing Education)
- **Jan Plane** (Principal Lecturer at University of Maryland in the Department of Computer Science, Director of Iribe Initiative for Inclusion and Diversity in Computing, Director of Maryland Center for Women in Computing)
- **Pat Yongpradit** (Chief Academic Officer, [Code.org](https://code.org))

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