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June 07, 2021

James D. Fielder, Jr. Ph.D.

Maryland Higher Education Commission

6 North Liberty Street

Baltimore, MD 21201

Dear Secretary Fielder:

UMBC proposes to offer the upper division of its outstanding Bachelor of Science in Mechanical Engineering at the Universities at Shady Grove. This is a high demand employment field, and the UMBC program is taught by high caliber faculty. We are delighted to offer this opportunity to students in Montgomery County.

I am immensely pleased that USM has committed funds from its USM Workforce Development Initiative (WDI) to offer this program at Universities of Shady Grove.

Thank you very much for your review of the program.

Sincerely,

Freeman A. Hrabowski, III
President

C: Dr. Antonio Moreira

Beth Wells



Cover Sheet for In-State Institutions

New Program or Substantial Modification to Existing Program

Institution Submitting Proposal	
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Each action below requires a separate proposal and cover sheet.

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

Payment Submitted:	Yes	Payment Type:	R*STARS # Check #	Payment Amount:	Date Submitted:
Department Proposing Program					
Degree Level and Degree Type					
Title of Proposed Program					
Total Number of Credits					
Suggested Codes			HEGIS:	CIP:	
Program Modality			On-campus		Distance Education (<i>fully online</i>)
Program Resources			Using Existing Resources		Requiring New Resources
Projected Implementation Date			Fall	Spring	Summer Year:
Provide Link to Most Recent Academic Catalog			URL:		
Preferred Contact for this Proposal			Name:		
			Title:		
			Phone:		
			Email:		
President/Chief Executive			Type Name:		
			Signature: <i>Freeman A. Hrabowski</i>		Date: June 3, 2021
			Date of Approval/Endorsement by Governing Board:		

Revised 1/2021

UNIVERSITY SYSTEM OF MARYLAND INSTITUTION PROPOSAL FOR

<input type="checkbox"/>	New Instructional Program
<input checked="" type="checkbox"/>	Substantial Expansion/Major Modification
<input type="checkbox"/>	Cooperative Degree Program
<input type="checkbox"/>	Within Existing Resources, or
<input type="checkbox"/>	Requiring New Resources

UMBC

Institution Submitting Proposal

Mechanical Engineering at USG

Title of Proposed Program

B. S.

Award to be Offered

Fall 2022

Projected Implementation Date

091000

Proposed HEGIS Code

14.1901

Proposed CIP Code

Mechanical Engineering

Department in which program will be located

Beth Wells

Department Contact

410-274-8660

Contact Phone Number

bwells@umbc.edu

Contact E-Mail Address

Freeman A. Hrabowski

Signature of President or Designee

June 3, 2021

Date

Maryland Higher Education Commission (MHEC)
Academic Program Proposal to Offer Existing Bachelor's Degree in Mechanical Engineering at the
Universities at Shady Grove
UMBC

- A. Centrality to Institutional Mission and Planning Priorities:** Offering the upper division of UMBC's current Bachelor of Science Degree in Mechanical Engineering (ME) at the Universities at Shady Grove (USG) campus in Montgomery County is consistent with UMBC's mission statement. Specifically, the mission statement references the commitment to "contribute to the economic development of the State and the region". Currently, there are no universities that offer a B.S. in Mechanical Engineering at USG. Expanding this program to the Montgomery County campus will provide affordable educational opportunities to the residents of Montgomery County and support the state economy by graduating qualified engineering professionals. Montgomery County is home to the National Institute of Standards and Technology and the National Institutes for Health and private sector companies such as Lockheed Martin and BAE Systems, all of which employ Mechanical Engineers.

The Community and Extended Connections section of the UMBC strategic plan: A Strategic Plan for Advancing Excellence specifically highlights a strategic objective to "continue to address novel and important professional development and continuing education needs in Maryland through courses, programs, and services provided by the Division of Professional Studies (DPS)...including UMBC programs offered at Shady Grove." Growing UMBC's presence at USG also contributes to one of the Community and Extended Connections strategic goals to "advance UMBC's regional reputation as a vital stakeholder in Maryland's innovation economy."

UMBC is committed to supporting this program administratively, financially, and technically. The source of funds includes both tuition revenue and funding from the University System of Maryland (USM). UMBC has been offering programs at USG since 2001 and the infrastructure to support new programs is already in place. UMBC at Shady Grove has administrative offices and access to classroom space, as well as an administrative staff of five.

- B. Critical and Compelling Regional or Statewide Need as Identified in the State Plan:** Offering the B.S. in Mechanical Engineering responds to crucial state needs as identified in the Maryland State Plan for Postsecondary Education (2017 - 2021). One of the overarching themes of the plan is increasing access to higher education. Specifically, the plan references a goal to, "Ensure equitable access to affordable

and quality postsecondary education for all Maryland residents.” One of USG’s core values is to expand access to higher education by providing programs to Montgomery County residents who for family, personal, or financial reasons want to stay in Montgomery County to earn their degree. According to the USG Research and Data Office, 75% of USG undergraduate students transfer from Montgomery College. Additionally, both USG and Montgomery College are majority-minority campuses. As of Fall 2017, 77.2% of the 22,875 students attending Montgomery College identify as a race other than white.¹ At USG, 67% of the student body identifies as a race other than white.² Currently, there is no way for a student to earn a B.S. in Mechanical Engineering in Montgomery County, thus limiting their access to this program. The B.S. in Mechanical Engineering is a large and in-demand major at UMBC. It is a highly respected program with over 600 enrolled undergraduate students on the main campus. The number of B.S. degrees awarded has increased steadily since 2000 and surpassed 100 the past three years.

The USM Through 2020: A Renewed Vision for Powering Maryland Forward, an update to USM’s 10-year Strategic Plan, also supports the expansion of the B.S. in Mechanical Engineering to a racially diverse campus like USG. The first three goals listed in the new and revised plan are:

- Increase the number of bachelor’s degrees awarded to underrepresented minority students by 900.
- Expand bachelor’s degrees earned annually by underrepresented minority students in STEM and health fields by 14% and 50% (to over 1,800 and 1,000 respectively).
- Increase the number of underrepresented minority students, faculty, and staff studying, working, and/or teaching at USM institutions.

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

and State: Mechanical Engineers are in high-demand in the Washington-Baltimore metropolitan region. The Bureau of Labor Statistics projects that the labor market demand for mechanical engineers will continue to remain strong. In particular, Mechanical Engineers who have skills in computational design and simulation will have strong job prospects.³

According to O*NET, an occupational information database sponsored by the U.S. Department of Labor, the number of job openings for Mechanical Engineering in Maryland is expected to increase by 4%

¹ https://www.montgomerycollege.edu/_documents/offices/institutional-research-and-effectiveness/student-enrollment-profile-and-fact-book.pdf

² <https://shadygrove.umd.edu/sites/default/files/u80/USG%20At%20A%20Glance%20-%20Executive%20Flyer.pdf>

³ Bureau of Labor Statistics, U.S. Department of Labor, *Occupational Outlook Handbook*, Mechanical Engineers, <https://www.bls.gov/ooh/architecture-and-engineering/mechanical-engineers.htm>

during the period 2016 – 2026.⁴ Additionally, in Fall 2018, 20% of the incoming Freshman and 19% of the transfer students in UMBC's Mechanical Engineering program were residents of Montgomery County. There is a significant pipeline of students from Montgomery County interested in UMBC's B.S. in Mechanical Engineering. We anticipate that the bulk of the enrollment at USG will be students who otherwise would not have the opportunity to study Mechanical Engineering close to their home, thus increasing the total number of Mechanical Engineering majors graduating from UMBC.

Montgomery County is home to both companies and large organizations such as the National Institute of Standards and Technology, the National Institutes of Health, and the National Oceanographic and Atmospheric Administration. The labor market for Mechanical Engineering professionals in the Washington DC area has a 30% higher demand than the national average.⁵

The target audience will be community college and other transfer students who have completed coursework or an Associate of Science (A.S) degree in Engineering. Due to the location of USG, Montgomery College (MC) is likely to be the largest feeder of students. MC offers an A.S. degree in Engineering. There are 11 engineering specializations within the degree, including Mechanical.

D. Reasonableness of Program Duplication: A search of the IPEDS College Navigator and other university websites found one other Bachelor of Science in Mechanical Engineering programs in the greater Washington DC metro area of Maryland.

Institution	Program Title	Location	Full Time Program Tuition per year as of Fall 2019
University of Maryland, College Park	Bachelor of Science in Mechanical Engineering	College Park	\$11,680*(Maryland resident)

***Full-time juniors and seniors majoring in Engineering pay a differential tuition rate of \$2,856 per year on top of the \$8,824 per year Maryland resident tuition.**

⁴ <https://www.onetonline.org/>

⁵ Source: Burning Glass Technologies. <http://www.burning-glass.com>. 2018.

The University of Maryland, College Park (UMCP) program is not offered at USG or in Montgomery County. As of Fall 2019, full-time tuition per year for a student in a UMBC program at USG is \$8,704 per year vs. \$11,680 per year for a junior or senior Engineering student at UMCP. UMBC offering a B.S. in Mechanical Engineering at USG provides an option to students who need or want to complete their degree in Montgomery County due to financial, personal, or family reasons.

E. Relevance to High-demand Programs at Historically Black Institutions (HBIs): Of the four HBIs in Maryland (Bowie State University, Morgan State University, Coppin State University, University of Maryland, Eastern Shore), only University of Maryland, Eastern Shore (UMES) offers a similar program; a General Engineering degree with a specialization in Mechanical. Offering the existing Mechanical Engineering program at USG should have minimal impact on enrollment at UMES, as the USG program in Montgomery College is unlikely to compete with one on the Eastern Shore.

F. Relevance to the support of the uniqueness and identity of Historically Black Institutions (HBIs)
Offering UMBC's program at USG should have no impact on the uniqueness and institutional identities and mission of the HBIs. Bowie State University and Coppin State University do not offer programs in Engineering; Morgan State University does not offer a program in Mechanical Engineering; and UMES offers a General Engineering degree with a specialization in Mechanical. What is proposed here is to offer UMBC's existing B.S. in Mechanical Engineering at USG.

G. Adequacy of Curriculum Design, Program Modality, and Related Learning Outcomes: UMBC's Mechanical Engineering program is housed in the College of Engineering and Information Technology (COEIT)'s Department of Mechanical Engineering (ME). The program is accredited by the Accreditation Board for Engineering and Technology (ABET).

At USG, ME will offer upper-division (300 and 400 level) Mechanical Engineering courses needed by transfer students to complete ME degree requirements. Most general education requirements will be met at the community college or other institutions the student previously attended. A copy of an existing articulation agreement between Montgomery College and UMBC is available. This will streamline the transition from MC to UMBC. UMBC offers pre-transfer advising at Montgomery College to ensure that MC students are taking the appropriate courses to fit into the 4-year program plan.

A full-time Program Director will be located at USG and will be responsible for the oversight of Mechanical Engineering at USG. The Program Director will report to the Department Chair of Mechanical Engineering and will work closely with the department's Undergraduate Program Director to ensure that the curriculum continues to meet ABET requirements. The next round of ABET accreditation is in Fall of 2023, and the program is expected to be reaccredited as of 2024. The assessment of student outcomes at the USG site will be a part of the reaccreditation self-study. The new accreditation will be retroactive for two years, so students graduating from the program at USG after October of 2022 will have an ABET-accredited degree. The students will be eligible to take the exams to become certified as Professional Engineers.

Additionally, Mechanical Engineering reviews its educational objectives using the following mechanisms:

- The Department of Mechanical Engineering has an active Industrial Advisory Board composed of representatives, including alumni, from local industry and government agencies. They are asked to review the educational objectives periodically.
- Selected courses in the Mechanical Engineering curriculum are reviewed to assess the degree to which the prescribed ABET student outcomes are being met. When needed, changes are made to the course pedagogy and/or content, and the course student outcomes are re-evaluated. This cycle occurs every three years, or twice during every six-year accreditation cycle.
- The Undergraduate Program Committee for Mechanical Engineering is focused on curriculum, assessment, and implementation of undergraduate curriculum including new/modified courses, new assessment plans to meet changing ABET requirements, course scheduling, and other relevant academic topics.

After each of these events, the department chair and ME's ABET/Assessment Committee convenes to determine if any changes are in order and, if so, to present them to the Mechanical Engineering faculty for discussion and a decision.

UMBC's Division of Professional Studies (DPS) has an existing infrastructure at USG that includes on-site staff who coordinate services to the academic programs. The UMBC staff at USG also provide an essential connecting role to offices and resources on the UMBC campus. The presence of five full-time

UMBC staff members at USG, along with the faculty members associated with the program, will ensure the continuous quality of the Program. The program will be subjected to the same standards that govern the main campus program. In partnership with the Office of Student and Academic Services at USG, UMBC will offer all the necessary services to ensure student success, and students will also have access to services on the main campus. Curricular oversight will be maintained at both campuses by the ME department. Faculty will be vetted by the Program Director and Department Chair. Instructors in the program will be eligible for the services provided by UMBC's Center for the Advancement of Teaching and Learning and will receive mentoring from the Program Director.

The outcomes below are the knowledge and skills students are expected to attain by the time of graduation:

- an ability to apply knowledge of mathematics, science, and engineering
- an ability to design and conduct experiments, as well as to analyze and interpret data
- an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
- an ability to function on multidisciplinary teams
- an ability to identify, formulate, and solve engineering problems
- an understanding of professional and ethical responsibility
- an ability to communicate effectively
- the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context
- a recognition of the need for, and an ability to engage in life-long learning
- a knowledge of contemporary issues
- an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

In order to fulfill ABET accreditation requirements, the complete B.S. program requires 127 total credit hours. It will require 59 upper division credits taken at UMBC and 68 credits at a community college or other college or university. An associate's degree is not required for transfer admission into the Mechanical Engineering program, although some students may complete an associate's degree before transferring. The "Credit When It's Due" program allows students to earn an associate's degree after transferring to UMBC through reverse awarding of credit. Applicable coursework earned at UMBC is

transferred back to the community college and allows for the freedom of early transfer and the ability to earn an associate's degree and bachelor's degree in 127 credits. UMBC is committed to advising students about this program.

UMBC does require that all students complete a foreign language through the intermediate level or demonstrate proficiency at that level. The coursework for the language sequence typically requires three classes (for example SPAN 101, SPAN 102, and SPAN 201). UMBC students in a USG program can take these courses at a previous institution or be waived out the credits by demonstrating language proficiency.

Program requirements for the B.S. in Mechanical Engineering at USG are:

Lower-level credits transferred in from a community college or other college or university	68 credits
Required courses in Mechanical Engineering (as listed in Appendix A)	31 credits
Statistics course	4 credits
Technical electives in Mechanical Engineering (as listed in Appendix B)	9 credits
Social Science general education requirements*	9 credits
Arts and Humanities general education requirements**	6 credits
Total	127 credits

*UMBC departments already located at USG that offer courses fulfilling the social science general education requirement include: the Department of Sociology, Anthropology, and Public Health; the Department of Psychology; the Department of American Studies; the Department of History; the Department of Political Science; and the Social Work program.

**UMBC departments already located at USG that offer courses fulfilling the arts and humanities general education requirement include: the Department of Sociology, Anthropology, and Public Health; the Department of American Studies; the Department of History; and the Department of Political Science.

The website for UMBC's Department of Mechanical Engineering - <https://me.umbc.edu/> - provides both current and prospective students information on curriculum, course descriptions, and degree requirements, as well as information about faculty, faculty research areas, technical requirements, scholarship opportunities, students groups, and academic policies. In addition, the Department regularly hosts open houses where prospective students can ask questions of department leadership. Once admitted, students will have access to academic advisors and faculty advisors to assist with scheduling and course selection. Information will be distributed between the Department and the students in several ways. Personal communications will be carried out by personal mail/email. General communications normally will be carried out by distributions of written messages and announcements in each Mechanical Engineering class and posted on doorways and bulletin boards as much as possible. All faculty members have an email address which is listed in the UMBC directory. All general messages from the department to students will be also be distributed to students via email.

At least once each semester the Mechanical Engineering Chair and the Undergraduate Coordinator will hold an open meeting to which all Mechanical Engineering Majors are invited. The purpose of this meeting is to discuss general departmental issues, problems, and new initiatives. The Mechanical Engineering Faculty are also invited to attend this meeting.

All students will be provided technical support for student accounts, such as their UMBC email address, and assistance with UMBC's Learning Management System, Blackboard, through UMBC's Division of Information Systems.

H. Adequacy of Articulation

An articulation agreement between Montgomery College and UMBC is available.

Most students are expected to take the majority of their General Education requirements at Montgomery College. UMBC will brief academic advisors at Montgomery College and the UMBC academic advisor at USG to ensure a smooth transition for students from Montgomery College to UMBC. No other articulation agreements are anticipated at this time.

I. Adequacy of Faculty Resources

Both current and newly-hired faculty will teach in the program at USG. A full-time Program Director will be located at USG and is responsible for the ME program at USG. The Chair of Mechanical Engineering, with concurrence of the Dean of COEIT, will appoint the Program Director. The Program Director shall have the qualifications (including a Ph.D.) to be appointed as a tenured faculty within the Department of Mechanical Engineering, and preference will be given to candidates with working knowledge of UMBC's academic policy, culture, and environment to ensure program success in its earliest stages. The Program Director will report to the Chair of Mechanical Engineering on all matters related to delivery of curriculum, personnel, and budget.

A table of faculty who will teach in the program, including their qualifications, areas of research, and proposed courses taught is in Appendix C.

In addition to the Program Director, the five-year hiring plan includes two Lecturers, and two Assistant Professors. These will be full-time positions and will teach more than 50% of the courses. The Professor of the Practice and Lecturer positions will require a minimum of a Master's degree in Mechanical Engineering or a related field. The Assistant Professor position will require a Ph.D. in Mechanical Engineering or a related field.

The chair of the Mechanical Engineering program will provide the program oversight. The current Chair, Dr. Ray Chen, is full professor with a Ph.D. in Aerospace Engineering from the University of Michigan.

As with the main campus, the faculty in the program will have access to UMBC's Center for the Advancement of Teaching and Learning, including all professional development training and workshops. Faculty will be eligible for annual conference travel funds.

Both tenure-track faculty and lecturers will be evaluated by the chair during the first year for contract renewal for the following two years, based on the initial student evaluation of teaching and the initial progress toward establishing of independent research and creative activities.

The Department Promotion and Tenure Committee (DP&TC) and the chair will conduct the mid-term, or the 3-year, review of the tenure-track faculty members for renewal up to and including the year for tenure and promotion review, usually conduct during the sixth year. The review, conducted during the third year, is based on the student teaching evaluations, service to the university community, promise of establishing independent research and creative activities and obtaining extramural research funding.

The process is guided by Section 6.3 of the UMBC Faculty Handbook.

The tenure and promotion review follows the process described in Section 6.3 of the UMBC Faculty Handbook. Inputs from the Department Promotion and Tenure Committee (DP&TC), the chair, and authorities from outside UMBC comprise the data for evaluation.

J. Adequacy of Library Resources

Students in the program will have access to both the Albin O. Kuhn Library at UMBC and the Priddy Library at USG. Lynda Aldana, UMBC's Associate Director for Technical Services & Library IT Services, affirmed that the amount included in the attached budget for library resources is sufficient to cover any necessary additional materials. If needed, the projected increases for the library budget for this program will assist in covering cost increases or additional resources. All electronic resources at the Albin O. Kuhn library are available to UMBC students in programs at USG, including the online journal subscriptions and databases related to Mechanical Engineering. From the Priddy Library, UMBC students also have access to the full collection of research databases provided by the University of Maryland, College Park. The Priddy Library regularly acquires scholarly monographs on a variety of topics relevant to Mechanical Engineering. Monographs not already part of the collection can typically be added upon faculty request.

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

UMBC has been offering programs at USG since 2001. The ME program will be located in the new Biomedical Sciences and Engineering Education Facility at USG. This building opened in November 2019. The laboratory space required by the Mechanical Engineering curriculum is available in the new building and USG will be furnishing the labs with the appropriate equipment. The start-up equipment will be owned by USG and funds used to purchase the equipment would be under the direction of USG. The approximate budget for this is \$1,100,000.

UMBC at Shady Grove has administrative offices and access to classroom space, as well as an administrative staff of five. UMBC at Shady Grove has adequate facilities, infrastructure, and equipment to support the learning needs of the Mechanical Engineering students. Students will be provided with an email address and library account. UMBC uses Blackboard as the Learning Management System. Blackboard support is provided by UMBC's Division of Information Technology.

L. Adequacy of Financial Resources with Documentation

A projected 5-year budget is included in the proposal. Explanatory footnotes are included for line items in the budget. As shown in the budget table, revenue for the program will be a combination of tuition revenue and workforce development support from the University System of Maryland. Please note that

enrollment projections for the program are quite conservative, and actual tuition revenue may be more than projected.

M. Adequacy of Provisions for Evaluation of Program

The Mechanical Engineering program at USG will be subject to the same evaluation requirements as the main campus program. All students complete course evaluations at the end of each course. The results of these evaluations are provided to the department chair. The existing Mechanical Engineering program has educational objectives that are mapped to the courses within the program. As part of the ABET accreditation process, each of the courses has a set of student-learning outcomes (SLO) with specific assignments and associated rubrics to assess students' competency against the course SLOs.

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

Inclusive excellence is a hallmark of UMBC. The University is one of the most diverse public research universities in the nation, with a minority enrollment of 49.8%. The Mechanical Engineering major is comprised of 18.1% underrepresented minorities. Additionally, according to the 2018 USG Fact Sheet, USG is a majority-minority campus with an ethnic diversity breakdown as follows:

33%	White
21%	African American
21%	Hispanic
14%	Asian
10%	Other
1%	Unknown

Offering the existing UMBC B.S. in Mechanical Engineering at USG allows the State of Maryland to provide a high-demand program from a diverse university to an even more diverse population of students.

O. Relationship to Low Productivity Programs Identified by the Commission

This is not applicable.

P. Adequacy of Distance Education Programs

This is not a distance education program.

Appendix A: Required Courses for all ME majors (31 Mechanical Engineering credits and 4 Statistics credits)

<p>ENME 301 - The Structure and Properties of Engineering Materials (3 credits)</p> <p>The nature and properties of engineering materials as related to their use in all phases of mechanical engineering will be studied. Materials covered include metals, ceramics and glasses, polymer and composites.</p>
<p>ENME 303 - Computational Methods for Engineers (3 credits)</p> <p>This course is intended as an introduction to programming using MATHLAB, elements of linear algebra, computational methods, and their application to solving engineering and specific problems through computational programming. Solution of ordinary differential equations with application in engineering.</p>
<p>ENME 304 - Machine Design (3 credits)</p> <p>In-depth design course that is a follow-up to ENME 204. The focus here is on designing machine components. Emphasis is on kinematics, working stresses, repeated loadings, fatigue and heating effects. The course requires completion of a design project and the use of such computational tools as CAD and engineering codes. Note This course may be subject to a Course Materials Charge. The charge may vary by semester, depending on the course materials required. The Course Materials Initiative (CMI) was established to provide students with more affordable course materials, enhance the students' experience on a common digital platform via Blackboard, and position UMBC to be ahead of the curve with digital content.</p>
<p>ENME 320 - Fluid Mechanics (3 credits)</p> <p>Fluid flow concepts and basic equations, effects of viscosity and compressibility, dimensional analysis and laws of similarity, flow through pipes and over-immersed bodies, and principles of flow measurement.</p>
<p>ENME 321 - Transfer Processes (3 credits)</p> <p>Conduction by steady state and transient heat flow; laminar and turbulent flow; free and forced convection; radiation, evaporation and condensation of vapors; and transfer of mass, heat and momentum.</p>
<p>ENME 332L - Solid Mechanics and Materials Laboratory (3 credits)</p>

A laboratory course in testing mechanical properties of materials. Emphasis will be on experimental techniques in solid mechanics, strain gages, strain gage rosettes, photoelasticity, acoustic emissions, metallurgical and electron microscopy.
ENME 360 – Vibrations (3 credits) Dynamic characteristics of machinery with emphasis on systems with single and multiple degrees of freedom.
ENME 403 - Automatic Controls (3 credits) Hydraulic, electrical, mechanical and pneumatic automatic control systems; open and closed loops; steady-state and transient operations; stability criteria; linear and non-linear systems; and Laplace transforms.
ENME 432L - Fluids/Energy Laboratory (2 credits) Measurement of fluid properties, fluid forces and observation of flow phenomenon; demonstration of flow measurement techniques; and measurement of heat-transfer properties: conduction, convection and radiation; and condensation and evaporation measurements.
ENME 444 - Mechanical Engineering Systems Design (3 credits) This course allows students completing the Mechanical Engineering curriculum to engage in a complete system design experience, integrating the various technical concepts they have learned in prior courses and is the last in a sequence of design courses that are an integral component of the undergraduate program. The course imparts a foundation in team leadership and project management and emphasizes entrepreneurial skills necessary to function in any organization, regardless of size. Engineers in industry solve problems that simultaneously resolve budgetary, time, technical and sometimes social, ethical and environmental constraints. Students will enjoy an experience that closely matches this environment.
ENME 482L - Vibrations/Controls Laboratory (2 credits) Various methods of spectral and modal analysis. Open-and closed-loop control experiments Methods and instrumentation for determining the vibration properties of mechanical systems.
STAT 355 Probability and Statistics (4 credits) An introduction to applied statistics designed for science majors and others with demonstrated quantitative ability. Topics include nature of statistical methods, random variables and their distribution functions, general principles of estimation and hypothesis testing. A laboratory introduces students to computer techniques in statistical analysis

Appendix B: Mechanical Engineering electives expected to be offered at USG (Nine credits required.)

<p>ENME 408 - Selected Topics in Engineering Design (3 credits)</p> <p>Three lecture periods per week. Creativity and innovation in design, generalized performance analysis, reliability and optimization as applied to the design of components and engineering systems, use of computers in design, and design of multivariable systems. Note May be repeated for a maximum of nine credits with permission of advisor and allowed multiple enrollment in term.</p>
<p>ENME 409 - Mechanics of Deformable Solids (3 credits)</p> <p>Introduction to the mechanics of engineering materials in three dimensions, concepts of stress and strain, generalized Hooke's law and equilibrium of solids. Modes of failure, including plasticity, stability, fatigue and fracture, will be treated. This course is repeatable for credit.</p>
<p>ENME 410 - Operations Research I (3 credits)</p> <p>Applications of linear programming queuing model, theory of games and competitive models to engineering problems.</p>
<p>ENME 412 - Mechanical Design for Manufacturing and Production (3 credits)</p> <p>Physical properties of materials and review of fundamental principles of product design. Various classes of engineering materials are characterized. Types of manufacturing processes that can be applied to the production of the design are discussed.</p>
<p>ENME 416 - Intermediate Thermodynamics (3 credits)</p> <p>Application of the first and second laws of thermo-dynamics in the analysis of basic heat engines, air compression and vapor cycles, and heat sources in fossil fuels and nuclear fuels.</p>
<p>ENME 422 - Heat Transfer in Biological Systems (3 credits)</p> <p>This is a cross-listed course offered to upper level undergraduate students as a science elective, and regular graduate students. The course focuses on how heat transfer mechanisms and principles are applied to biological systems. It includes how to model heat transfer in tissue with blood perfusion, major experimental approaches for measuring thermal and physiological properties of tissue, as well as detailed description of various aspects of bioheat transfer analyses in hyperthermia treatment to kill tumor.</p>
<p>ENME 423 - Heating, Ventilation and Air Conditioning Design (3 credits)</p>

Topics will include heating and cooling load calculations; psychrometrics applied to HVAC design, thermodynamics of refrigeration, space air diffusion, piping and duct flow analysis, introduction to solar energy and indoor air quality
<p>ENME 471 - Computer Aided Finite Element Based Design (3 credits)</p> <p>This course introduces the method of finite elements as a tool for mechanical design. The concepts of geometry discretization and function interpolation are used in formulating the linear finite element equations. Various types of elements and general guidelines of finite element modeling are presented. The one-dimensional model is fully formulated, and aspects of nondimensional finite element modeling are presented. During the two-hour weekly labs, students are introduced to several finite element packages, such as the I-DEAS, ABAQUS and in-house DENDRO softwares. Emphasis is placed on the use of Integrated Design and Analysis Software (IDEAS), which is required for the completion of term design projects.</p>
<p>ENME 472 - Materials and Processes for Micro/Nanoscale Systems (MEMS) (3 credits)</p> <p>A fundamental course presenting key topics in materials and processing for the design and manufacture of micro and nano scale systems often called microelectromechanical systems (MEMS). Students will focus on understanding materials and microfabrication technologies commonly employed in these smallscale systems. Material properties, parameters and their relationship with microfabrication processes, length scale and applications are discussed with regards to elastic and inelastic deformation, fracture, residual stress, fatigue, creep, adhesion, and stiction. Case studies on devices for sensing and actuation applications will be addressed to connect the course topics.</p> <p>Recommended Preparation ENME 301, ENME 220</p>
<p>ENME 488 - Special Problems (3 credits)</p> <p>Advanced problems in mechanical engineering, with special emphasis on mathematical and experimental methods. This course is repeatable for credit. Recommended Preparation Permission of department chairman and senior standing in mechanical engineering.</p>
<p>ENME 489 - Special Topics in Mechanical Engineering (3 credits)</p> <p>Selected topics of current importance in mechanical engineering. This course is repeatable for a maximum of 9 credits or 3 attempts. Recommended Preparation Senior standing and permission of department. Note May be repeated for a maximum of nine credits with permission of student's advisor.</p>

Appendix C: ME faculty, specializations, and courses taught

Faculty	Specialization	Course(s) taught
Dr. Charles Eggleton, Ph.D., Professor	Thermofluids	ENME 320, ENME 432L
Dr. LDT Topoleski, Ph.D., Professor	Solid Mechanics-Material Science	ENME 301
Dr. Weidong Zhu, Ph.D., Professor	Design System Dynamics	ENME 360
Dr. Marc Zupan, Ph.D., Associate Professor	Solid Mechanics-Material Science	ENME 332L
Dr. Anthony Farquhar, Ph.D., Associate Professor	Design System Dynamics	ENME 304
Dr. Roy Wu, Ph.D., POP	Design System Dynamics	ENME 303, ENME 403, ENME 482L

Projected Budget for UMBC's proposed B.S. in Mechanical Engineering at USG

TABLE 1: RESOURCES					
Resources Categories	FY23	FY24	FY25	FY26	FY27
1.Reallocated Funds	0	0	0	0	0
2. Tuition Revenue ^{6,7} (c+g below)	138,322	393,408	599,060	755,230	908,396
a. #F.T Students ⁸	13	36	53	65	76
b. Annual Tuition Rate	9,226	9,487	9,748	10,010	10,271
c. Annual Full Time Tuition Revenue (a x b)	119,938	341,532	516,644	650,650	780,596
d. # Part Time Students ⁹	4	11	17	21	25
e. Credit Hour Rate	383	393	404	415	426
f. Annual Credit Hours	48	132	204	252	300
g. Total Part Time Tuition Revenue (e x f)	18,384	51,876	82,416	104,580	127,800
3. Grants, Contracts, & Other External Sources ¹⁰	900,000	900,000	900,000	900,000	900,000

¹ This assumes a 3% tuition increase annually.

² This includes only tuition revenue as fees are treated as a pass through to USG.

³ This includes both new and continuing students.

⁴ This includes both new and continuing students.

⁵ The University System of Maryland is providing workforce development funds for this initiative.

4. Other Sources	0	0	0	0	0
TOTAL (Add 1 - 4)	1,038,322	1,293,408	1,499,060	1,655,230	1,808,396

TABLE 2: EXPENDITURES					
Expenditure Categories	FY23	FY24	FY25	FY26	FY27
1. Total Faculty Expenses (b + c below)	455,948 ¹¹	496,692 ¹²	661,853 ¹³	802,861 ¹⁴	838,830 ¹⁵
a. # FTE	3	3	5	6	6
b. Total Salary	340,260	377,729	493,920	599,150	629,849
c. Total Benefits	115,688	118,963	167,933	203,711	208,981
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

⁶ Faculty lines for Year 1 include a Program Director, a Lecturer and an Assistant Professor.

⁷ In Year 2, adjunct faculty will be added.

⁸ In Year 3, another Assistant Professor position will be added.

⁹ In Year 4, an additional full-time Lecturer will be added.

¹⁰ In Year 5, additional adjunct faculty will be used.

3. Total Support Staff ¹⁶ Expenses (b + c below)	19,281	40,821	51,531	63,986	73,231
a. # FTE	0	0	0	0	0
b. Total Salary	12,725	26,941	34,010	42,230	48,332
c. Total Benefits	6,556	13,880	17,521	21,756	24,889
4. Equipment ¹⁷	28,800	29,520	30,229	30,927	31,613
5. Library	3,000	3,180	3,371	3,573	3,787
6. New or Renovated Space	0	0	0	0	0
7. Other Expenses ¹⁸	372,568	545,795	737,272	607,084	743,912

¹¹ Support staff for UMBC at USG is shared by all UMBC USG programs. These expenses are an estimate of Mechanical Engineering's share of the support staff's time.

¹² This includes computing needs for faculty and staff.

¹³ Other expenses includes start-up costs, indirect costs, funding for honorariums, travel, supplies, fixed charges such as association dues, graduate assistants, subscriptions, and rental of classrooms and staff offices at USG.

TOTAL (Add 1 - 7)	879,597	1,106,008	1,484,261	1,508,431	1,691,373
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