University Council

February 9, 2024

UNIVERSITY CURRICULUM COMMITTEE – 2023-2024
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Undergraduate Student Representative – Gabriella Lewis
Graduate Student Representative – Kelsey Wohlford

Dear Colleagues:

The attached proposal from the College of Engineering to create a major in Mechanical Engineering (M.S.) will be an agenda item for the February 16, 2024, Full University Curriculum Committee meeting.

Sincerely,

Susan Sanchez, Chair

cc: Provost S. Jack Hu
Dr. Marisa Pagnattaro

UNIVERSITY SYSTEM OF GEORGIA

USG Academic Degree Program

Application

Released

Updated Version: Summer 2023

Point of Contacts

Dr. Dana Nichols

Vice Chancellor for Academic Affairs

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Version Control

Date	*Changes*	*USG Approved date*	*Website update date*
7/15/2023	*Overview: Added Degree Acronym*	*7/31/2023*	*8/28/2023*
7/15/2023	*Overview: Changed 6-Digit CIP Code to 8_Digit CIP Code*	*7/31/2023*	*8/28/2023*
7/15/2023	*Chart #28 deleted to reduce redundancy.*	*7/31/2023*	*8/28/2023*
7/15/2023	*Minor grammatical edits for clarity*	*7/31/2023*	*8/28/2023*
7/15/2023	*Prompt #30 – Delivery Mode chart changed to match DMA*	*7/31/2023*	*8/28/2023*
12/1/2022	*Updated column title in Table 25 from "Experienced Salary" to "Future Potential Earnings"*	*12/1/2022*	*12/1/2022*
12/1/2022	*Corrected numbering*	*12/1/2022*	*12/1/2022*
12/1/2022	*Corrected footnote dates*	*12/1/2022*	*12/1/2022*
8/19/2022	*Attach as a WORD document only – no PDFs. Use Times New Roman 12pt. font.*	*8/19/2022*	*8/19/2022*
8/19/2022	*All questions are required for ALL degree levels.*	*8/19/2022*	*8/19/2022*
8/19/2022	*Some charts have been modified/deleted for consistency and to reduce redundancy.*	*8/19/2022*	*8/19/2022*
8/19/2022	*Signature page must be fully completed. Any addendums must be signed off by CBO.*	*8/19/2022*	*8/19/2022*
8/19/2022	*External Reviews for Doctoral Degrees are the responsibility of the Institution. See Prompt 30 for more information.*	*8/19/2022*	*8/19/2022*

NOTE:

Italicization indicates a question or field on the in-take form

^= indicates accreditation related content

USG Routing Only

- ☐ *Program was part of the Annual Academic Forecast*
- ☐ *This proposal requires USG integrated review*

USG ACADEMIC PROGRAM APPLICATION

A. OVERVIEW

To be completed as part of SharePoint Submission

1. ***Request ID:*** *(SharePoint Generated unique ID)*

2. ***Institution Name:*** *University of Georgia*

3. ***USG Sector:*** *Research University*

4. ***School/Division/College:*** *College of Engineering*

5. ***Academic Department:*** *School of Environmental, Civil, Agricultural, and Mechanical Engineering*

6. ***Degree Level:*** *Master of Science*

7. ***Proposed Program Name****: Master of Science with a major in Mechanical Engineering*

8. ***Major:*** *Mechanical Engineering*

9. ***Degree Acronym:*** *M.S.*

10. ***CIP Code (6 digit):*** *14.190100*

10. ***Anticipated Implementation Semester and Year:*** *Fall 2024*

11. ***Was this program listed in the most recent Academic Forecast?***

☐ *Yes*

☒ *No (If no, explain why below)*

This program was not included in the Academic Forecast because it had not been approved through faculty governance.

12. **Program Description (Provide a description of the program to be used in the Board of Regents meeting packet):**

Mechanical engineering, renowned for its multidisciplinary nature, plays a pivotal role in the development of diverse products and processes across varying dimensions. As societal and technological complexities continue to develop, advanced degrees in mechanical engineering have gained prominence. In light of this, the University of Georgia (UGA) aims to present an innovative and interdisciplinary M.S. in Mechanical Engineering which addresses emerging challenges while encompassing an array of fields, including social sciences, behavioral sciences, computer science, and artificial intelligence. This proposal outlines the motivation behind establishing this program, the potential areas of specialization, and its alignment with the strategic goals of the State of Georgia and the United States.

Mechanical engineering has long been celebrated as a multifaceted and versatile engineering discipline, embracing a wide spectrum of engineered systems varying in size and complexity. The allure of its interdisciplinary nature attracts students aspiring to join diverse engineering industries. Throughout the lifecycle of complex systems, from design and analysis to deployment, maintenance, and eventual retirement, the prowess of mechanical engineers remains indispensable. This proposal is about launching an advanced M.S. in Mechanical Engineering at UGA, going beyond the current area of emphasis under Engineering (M.S.), thus better equipping graduates with the expertise to tackle contemporary engineering challenges while encompassing an interdisciplinary approach and thus serve the needs of the State of Georgia better.

As the intricacy of engineered systems continues to evolve, so does the appeal of advanced degrees in mechanical engineering. A master's degree in mechanical engineering offers students the opportunity to delve into the intricacies of all engineered systems. With a focus on automation, robotics, thermal and fluid systems, energy systems, mechanics, design and manufacturing, and nanoengineering, the program aims to hone students' skills for careers spanning industry, academia, and government. Graduates will be equipped to confront the demands of an interconnected society reliant on cutting-edge technologies and inventions.

In recognition of the increasing interdependence of various disciplines, the proposed M.S. in Mechanical Engineering at UGA will transcend traditional boundaries and embrace an interdisciplinary outlook. The curriculum will encompass recent advances and emerging research in mechanical engineering while drawing insights from social sciences, behavioral sciences, computer science, and artificial intelligence. By blending knowledge across these domains, graduates will be better prepared to address the complex engineering challenges of tomorrow.

The significance of mechanical engineering talent is underscored by the projections of the U.S. Bureau of Labor Statistics, which forecast a substantial 7% growth in the field over the next decade. As the nation and the State of Georgia emphasize key areas such as manufacturing, electric mobility, and infrastructure, an advanced M.S. in Mechanical Engineering program aligns seamlessly with these strategic goals. UGA, with its exceptional capabilities, stands poised to address the needs of the state and nation through this proposed program.

Mechanical engineering continues to serve as the bedrock of various industries, offering solutions to multifaceted challenges across diverse dimensions. The proposed M.S. program strives to equip graduates with the necessary skills and knowledge to address tomorrow's engineering challenges effectively, catering to the demands of an interconnected and technology-driven society.

13. Accreditation: Describe disciplinary accreditation requirements associated with the program (if applicable, otherwise indicate not applicable).

Not applicable.

14. Specify SACSCOC or other accreditation organization requirements^.

Mark all that apply.

☐ Substantive change requiring notification only [1]

☐ Substantive change requiring approval prior to implementation [2]

☐ Level Change [3]

☒ None

B. STRATEGIC PLAN

15. How does the program align with the System Wide/Strategic Plan Context (within mission fit):

The proposed M.S. in Mechanical Engineering closely aligns with the overarching strategic vision outlined in the University System of Georgia (USG) Strategic Plan. This program embodies the core principles set forth by the USG, positioning itself as a beacon of educational and innovative excellence.

Affordability, Accessibility, and Quality: The program underscores UGA's commitment to providing an accessible, high-quality education. By offering an M.S. in Mechanical Engineering, UGA extends its educational reach to aspiring engineers, enhancing their career prospects and academic growth. This affordability and accessibility are achieved without compromising on the caliber of education, equipping students with cutting-edge knowledge and skills to excel in the dynamic realm of mechanical engineering.

Lifelong Student Success: The M.S. program is designed to foster lifelong success among its students. By furnishing them with a comprehensive skill set encompassing mechanical systems, thermal systems, manufacturing, and design, the program prepares graduates for a lifetime of impactful contributions. Students are not only equipped with technical expertise but also imbued with critical thinking, problem-solving abilities, and collaborative skills that ensure their success throughout their professional journey.

Creation, Dissemination, and Application of Knowledge: The proposed M.S. program is intrinsically aligned with the mission of creating, disseminating, and applying knowledge for the advancement of the state, nation, and world. Through innovative coursework, research endeavors, and interdisciplinary

[1] See page 22 (Requiring Notification Only) of SACSCOC Substantive Change Policy and Procedures document.
[2] See page 17 (Requiring Approval Prior to Implementation) of SACSCOC Substantive Change Policy and Procedures document.
[3] See page 3 (Level Change Application) of SACSCOC Seeking Accreditation at a Higher or Lower Degree Level document for level change requirements.

collaborations, students engage in the process of knowledge creation and application, contributing to the progression of mechanical engineering and addressing pressing societal challenges. The program empowers graduates to be at the forefront of advancements in the field, driving innovation and addressing critical issues that extend beyond the academic sphere.

The M.S in Mechanical Engineering at UGA seamlessly embodies the fundamental tenets of the USG Strategy Plan. By providing an affordable, accessible, and high-quality education while fostering lifelong success among its students and contributing to the creation and application of knowledge, the program exemplifies UGA's dedication to serving the needs of the state and economy while shaping engineers who will contribute to the advancement of the state, nation, and the world.

16. How does the program align with your institutional mission and function^? If the program does not align, provide a compelling rationale for the institution to offer the program.

The prime directive of the UGA College of Engineering centers on nurturing engineers to realize their fullest potential and emboldening them to engage in collaborative research aimed at addressing the pressing challenges of our era. In pursuit of this mission, the proposed M.S. program seeks to foster visionary leaders in the mechanical engineering field that demands their specialized expertise. Additionally, bolstering the mechanical engineering program’s growth with the addition of students in this program will fortify research teams' pursuit of formidable research endeavors, thus concomitantly fulfilling the essential needs of the workforce and elevating the college's research trajectory.

At its core, the proposed M.S. program holds the potential to immediately impact three institutional missions. First and foremost, it is intrinsically aligned with the college's unwavering dedication to nurturing an exemplary teaching and learning environment, one that caters to a diverse and well-prepared student cohort, fosters elevated levels of student accomplishment, and provides requisite academic support services. Secondly, the program aligns with the college's steadfast commitment to fostering research, scholarship, and creative endeavors with an emphasis on structured programs to foster novel knowledge and theories, elevate instructional quality and efficacy, and augment faculty qualifications in ways pertinent to the institution. Lastly, the M.S. program seamlessly aligns with the college's commitment to public service, economic development, and technical assistance endeavors, all geared towards addressing the strategic needs of Georgia while delivering comprehensive and continuous educational opportunities tailored to the state's lifelong learning and professional education requirements.

By charting a trajectory of growth through an array of degree and course offerings, the program holds promise for expanding the learning environment within the realm of mechanical engineering, meeting the escalating demands of a thriving field. The envisaged community of research leaders within the program will undeniably foster a climate of enriched research, scholarship, and creative pursuits, propelling mechanical engineering to new heights. Given the evident need for mechanical engineering experts in the state, this program's establishment is poised to yield immediate impact, nurturing a skilled and competent workforce poised to meet the dynamic challenges of mechanical engineering head-on.

17. How does the program align with your institution's strategic plan and academic program portfolio?
Identify the number of existing and new courses to be included in the program.

The University of Georgia 2020 Strategic Plan states that "UGA is poised to address Georgia's most daunting issues: economic development and job creation, public health, and obesity."

In its present configuration, the College of Engineering at UGA has already established an M.S. program in Engineering, replete with diverse areas of emphasis, encompassing domains such as electrical and computer engineering and mechanical engineering, among others. These specialized areas of emphasis were originally formulated as part of the nascent graduate program within the College of Engineering upon its inception in 2012. The overarching vision was to eventually develop independent M.S. programs once a critical mass of students had been successfully enrolled.

Drawing from recent trends in M.S. student enrollment, the faculty of the School of Environmental, Civil, Agricultural, and Mechanical Engineering (ECAM) now assert that the critical mass of students has been attained. A pronounced surge in student interest has been observed in pursuing M.S. degrees within the specialized emphasis areas typically aligned with an M.S. in Mechanical Engineering, thus lending further credence to the notion that there exists substantial demand for a standalone M.S. in Mechanical Engineering.

Presently, the M.S. in Engineering with an Area of Emphasis in Mechanical Engineering offers a comprehensive suite of 42 graduate courses. This robust array of courses is deemed sufficient to serve as a solid foundation for the proposed new M.S. in Mechanical Engineering, given the demonstrable interest and enrollment levels. This observed momentum, coupled with the wealth of specialized courses already in place, signals a propitious moment for the College of Engineering to actualize its long-term aspiration of introducing a dedicated M.S. degree in Mechanical Engineering. As the college advances towards this new phase of academic enrichment, it can anticipate a promising landscape of opportunities to cultivate cutting-edge expertise and innovation in the realm of mechanical engineering.

C. NEED

18. To what extent does the program align with local, regional, and/or state talent demand or workforce strategies?

The burgeoning investment in cutting-edge technologies, encompassing artificial intelligence, automation, Internet of Things, and cyber-physical systems, coupled with the expansion of manufacturing plants, holds the promise of unprecedented growth in the traditional realm of mechanical engineering. In Georgia, the demand for mechanical engineers is surging at a remarkable rate of 22.1%, outpacing the nationwide projection of 7%. The anticipated annual influx of 1,000 job openings related to mechanical engineering in the state from 2018 to 2028 underscores the criticality of nurturing an engineering workforce aligned with these thriving economic sectors.

For the projected economic growth to realize its full potential, a commensurate investment in degree programs becomes imperative, fostering a skilled engineering cohort capable of meeting the demands of these key industries. Positioned as a public land-grant and sea-grant research university in Georgia, the University of Georgia, fortified by its strengths in interdisciplinary programs, stands uniquely equipped to establish a rigorous and expansive mechanical engineering program, poised to cater to the emergent needs of society and establish its preeminence as a national leader in this vital discipline.

Over the past decade, the University of Georgia has demonstrated steady progress in cultivating its engineering offerings. Pioneering the establishment of a comprehensive College of Engineering in 2012 and subsequently a School of Environmental, Civil, Agricultural, and Mechanical Engineering in 2017, the university laid a formidable foundation for growth. Mechanical engineering programs were successfully initiated over a decade ago and have garnered commendable implementation. Evident from the five-year moving average of 700 students enrolled in the undergraduate program, the demand for mechanical engineering education has grown steadily. The school's proactive approach to faculty expansion, coupled with their vibrant engagement in cutting-edge mechanical engineering research and teaching, underscores their dedication to nurturing a vibrant engineering community.

Endowed with the requisite infrastructure, research resources, and educational experience, the School of Environmental, Civil, Agricultural, and Mechanical Engineering is primed to embark on an ambitious journey, advancing its mechanical engineering programs by elevating the current Area of Emphasis in Mechanical Engineering under the major in Engineering (M.S.) to an independent major in Mechanical Engineering (M.S.). This critical development will undoubtedly contribute to meeting the dynamic societal needs and shaping a burgeoning engineering landscape in Georgia and beyond.

19. Was this proposal and the design of the curriculum informed by talking with alumni, employers, and community representatives or other evidence of demand (e.g. employment sector trends, clearly defined learner demand, complement to an existing program, meeting a persistent, new, or emerging demand for knowledge and innovation).

☐ *No*

☒ *Yes (If yes, use the space below to explain how their input informed this proposal)*

The College of Engineering's initial long-term objective was to establish independent M.S. programs once a substantial number of students were enrolled. The faculty within the School of Environmental, Civil, Agricultural, and Mechanical Engineering now believes that this critical enrollment threshold has been met, as evidenced by the recent growth in M.S. student numbers, rising from 19 students in 2020 to 34 students in 2023. Over the past few years, there has been a notable increase in the number of students successfully graduating from the college's Engineering (M.S.) program, particularly those focusing on mechanical engineering. Furthermore, informal feedback from current students suggests a preference for specialized majors over a generic engineering major title. The introduction of an M.S. in Mechanical Engineering is anticipated to attract a larger cohort of graduate students, subsequently enhancing research productivity in this interdisciplinary field. Additionally, it will position the school to effectively recruit and retain highly skilled faculty members dedicated to cultivating a robust and sustainable research program.

Many of UGA's peer institutions and departments have already adopted distinct majors within their disciplines, and those that have not are progressively moving away from generalized Engineering M.S. programs. UGA's alignment with these trends is crucial for maintaining competitiveness in graduate student recruitment.

Another noteworthy point pertains to the employability of graduates with a specialized degree like Mechanical Engineering (M.S.). Generalized Engineering (M.S.) programs have limitations, as numerous employers, including academic institutions, tend to prefer candidates with degrees directly aligned with their respective fields. Expanding the number of UGA M.S. graduates entering academia is poised to significantly enhance the program's reputation and maturity.

Based on enrollment figures at other universities, the growing interest in engineering at the University of Georgia, and the institution's geographic location, faculty conservatively estimate that within five years, between 40 to 50 M.S. degrees will be conferred annually.

Students Graduating from Mechanical Engineering (M.S.) Programs

Institution	2019	2020
University of Texas - Austin	58	44
University of California - Berkeley	130	149
University of California - Los Angeles	75	60
University of Illinois at Urbana - Champaign	112	27
University of Michigan - Ann Arbor	142	150
University of Minnesota - Twin Cities	54	56
University of Wisconsin - Madison	64	57
Texas A&M University	88	92
University of Florida	142	102
North Carolina State University	10	83

Data from: https://shinyapps.asee.org/apps/Profiles/

20. Identify the partners you are working with to create a career pipeline with this program[4].^ Mark all that apply

☐ High School CTAE
☒ Other USG institutions
☒ Professional associations
☐ High School STEM
☐ Other universities
☐ Other (specify below)
☐ Career academies
☐ Employers
☐ TCSG programs
☐ Community partnerships
☐ None

21. Are there any competing or complementary programs at your own institution?

☒ *No*

☐ *Yes (If yes, provide additional information about the competing program(s) below).*

This program's content is currently being offered as an Area of Emphasis under the M.S. in Engineering. This area of emphasis will be phased out after the approval of the M.S. in Mechanical Engineering.

22. The program service area is used as the basis for labor market supply and demand analysis. What is the program's service area (local, regional, state, national)? If outside of the institution's traditional service area, provide a compelling rationale for the institution to offer the program. If the program's service area is a region within the state, include a map showing the counties in the defined region.

The program's service area is national. The program service area is used as the basis for labor market supply and demand analysis.

23. Do any other higher education institutions in close proximity offer a similar program?

☐ No ☒ Yes (If yes, provide a rationale for the institution to offer the program)

Within the University System of Georgia, the Georgia Institute of Technology, Georgia Southern University, and Kennesaw State University currently offer M.S. degrees in Mechanical Engineering. While these institutions have a notable track record of producing high-quality mechanical engineering graduates, there exists an evident demand for a broader educational approach that equips mechanical engineers with interdisciplinary expertise from related fields such as data science. The pertinence of such a convergence-based approach is underscored by the National Science Foundation's recognition of its critical role in scientific discovery and the resolution of complex research conundrums. This proposed M.S. program, in response to this evolving academic landscape, endeavors to leverage UGA's distinct cross-disciplinary strengths, creating a platform for students to engage in collaborative research ventures with esteemed faculty from the College of Engineering and the Franklin College of Arts and Science. Notably, the faculty within the School of Environmental, Civil, Agricultural, and Mechanical Engineering actively partake in several unique interdisciplinary research centers at UGA, including but not limited to the Institute for Resilient Infrastructure Systems, the New Materials Institute, Georgia Informatics Institutes for Research and Education, Institute for Precision Agriculture, and the Engineering Education Transformations Institute.

Moreover, UGA's engineering faculty have been actively fostering partnerships with Georgia Tech on major, multi-institutional grants, exemplified by various manufacturing initiatives supported by federal and state funding. A recent example is our participation in a recent Build Back Better initiative in Aritificial Intelligence for Manufacuring led by Georgia Tech with the University of Georgia Mechanical Engineering team as collaborators (https://www.eda.gov/funding/programs/american-rescue-plan/build-back-better/finalists/georgia-tech-research-corporations and https://www.eda.gov/sites/default/files/2022-09/GA_AIM.pdf). These symbiotic collaborations leverage the complementary expertise present in both institutions, culminating in a comprehensive and convergent approach to tackling broad engineering challenges. The establishment of a dedicated M.S. in Mechanical Engineering at UGA is envisioned to augment these collective endeavors by recruiting and nurturing additional students, thus enhancing the impact of such collaborative pursuits. As the landscape of engineering education evolves, the proposed M.S. program at UGA serves as an instrumental endeavor, fostering a new generation of mechanical engineers endowed with convergent expertise, well-equipped to take on the multifaceted engineering challenges of the future. By capitalizing on the university's interdisciplinary strengths and synergistic partnerships, UGA is poised to usher in a new era of mechanical engineering education, further contributing to scientific progress and societal welfare.

24. Using IPEDS data, list the supply of graduates in the program and related programs in the service area.

Competitor Institutions Selected Based on Aspirational at the National Level

Similar or Related Degrees/Programs	CIP Code	Supply[1] (Graduates/ Completers)	Competitor Institutions[2]
Mechanical Engineering (M.S.)	14.1901	586	University of California-Berkeley (116), University of California-Los Angeles (74), University of Illinois Urbana-Champaign (61), University of Michigan-Ann Arbor (110), University of Minnesota-Twin Cities (60), The University of Texas at Austin (51), University of Wisconsin-Madison (63), The Pennsylvania State University (51)

Competitor Institutions Selected Based on Peer at the National Level

Similar or Related Degrees/Programs	CIP Code	Supply[1] (Graduates/ Completers)	Competitor Institutions[2]
Mechanical Engineering (M.S.)	14.1901	331	University of Arizona (16), University of California-Davis (31), University of Iowa (8), University of Maryland-College Park (18), Michigan State University (10), University of Missouri-Columbia (10), Stony Brook University (56), Ohio State University-Main Campus (67), Purdue University-Main Campus (115)

Competitor Institutions Selected Based on Peer at the South Regional Level

Similar or Related Degrees/Programs	CIP Code	Supply[1] (Graduates/Completers)	Competitor Institutions[2]
Mechanical Engineering (M.S.)	14.1901	304	University of Florida (138), University of Kentucky (12), North Carolina State University at Raleigh (95),

			Virginia Polytechnic Institute and State University (59)

[1] Supply = Number of program graduates last year within the study area
[2] Competitors = List other USG institutions that offer this program or a similar program in the area (see **Question 23**)

25. Based on the program's study area, what is the employment outlook for occupations related to the program. An Excel version of the CIP to SOC crosswalk is also available from NCES. If data for the study area is not available, then use state- or national-level data. Only list the jobs that are highly aligned and likely to be those for which you are preparing students and not every possibility.

Possible resources:

- Click **here** for US and Georgia occupation projections
- Click **here** for 2026 Georgia Department of Labor data projections for the State or Georgia Workforce Board Regions in Qlik (link to GDOL Projections); data is also available through the GDOL Labor Market Explore Website
- For a custom Georgia geography – request a Jobs EQ report from **USG Academic Affairs office.**
- Using data from ***O*-Net***, identify the average salary for the related occupations identified in question.

Labor Market/Career Placement Outlook/Salary:

Occupation	O*Net[1]	Current Employment	% Growth	Average Salary (O-Net data)	Future Earnings Potential (O-Net data)
Architectural and Engineering Managers https://www.onetonline.org/link/summary/11-9041.00		191,100	7.3	$159,920	$219,010
Mechanical Engineers https://www.onetonline.org/link/summary/17-2141.00	Bright Outlook	284,900	6.2	$96,310	$132,730
Mechanical Drafters https://www.onetonline.org/link/summary/17-3013.00		49,400	7.9	$61,310	$87,240

Mechanical Engineering Technologists and Technicians https://www.onetonline.org/link/summary/17-3027.00		41,700	10.1	$61,990	$100,180
Engineering Teachers, Postsecondary https://www.onetonline.org/link/summary/25-1032.00	Bright Outlook	45,800	10.2	$103,550	$178,740

[1]National Center for O*NET Development. *O*NET OnLine*. Retrieved [include date] from https://www.onetonline.org/

26. Based on the data provided in questions 24 and 25, discuss how this program will help address a need or gap in the labor market?
(Provide letters of support and explain the collaboration and how partners will share or contribute resources. Consider internal pipeline programs – "off-ramp programs," Nursing to integrated health, or MOUs for pathways with other USG institutions (pipelines – keep them in state for grad school if possible).

Embracing a diverse array of principles from mechanical systems, thermal systems, manufacturing, and design, mechanical engineering stands as the most expansive among engineering disciplines. Renowned for their creativity and versatile skill set, mechanical engineers find themselves indispensable across virtually every industry. In the transportation sector, their contributions encompass a wide spectrum, ranging from the development of hybrid and electric cars to pioneering advancements in autonomous cars, airplanes, and underwater vehicles. Additionally, mechanical engineers are at the forefront of energy systems, striving to enhance power generation efficiency and devise alternative energy sources to mitigate environmental impact. The advent of artificial intelligence, automation, Internet of Things, and cyber-physical systems heralds a new era of innovation, continuing to reshape the landscape of engineering disciplines.

In this context, the proposed M.S. in Mechanical Engineering emerges as a timely and vital initiative, aligning itself with the evolving needs of the engineering field. By cultivating skilled professionals and experts, the program aims to address the pressing requirements of local and regional engineering industries, ensuring that they remain at the vanguard of this transformative era. Fortified by Georgia's highly educated workforce, distinguished research institutions, cutting-edge technological resources, and global connectivity facilitated by Atlanta's Hartsfield-Jackson International airport, the state has emerged as a magnet for substantial federal and private investments. A case in point is the construction of one of the largest battery manufacturing facilities in the U.S., spanning nearly 2.5 million square feet, by SK Innovations in Commerce, GA. Moreover, Rivian Automotive's intent to establish a vehicle manufacturing facility in East Atlanta further attests to the state's position as a hub of growth and technological innovation.

To sustain this trajectory of progress, the demand for mechanical engineering graduates, equipped with comprehensive training in engineering and cross-disciplinary domains, is witnessing a significant surge among local and regional employers. The proposed M.S. in Mechanical Engineering will address these urgent needs and play a pivotal role in nurturing a skilled workforce capable of driving engineering advancements in the local and regional landscape. As Georgia continues to embrace an era of transformational growth, this program stands as a crucial catalyst, fostering expertise, innovation, and progress within the field of mechanical engineering.

27. Using data from *O*-Net,* identify the average salary for the related occupations identified in question. Then list at least three technical skills and three Knowledge, Skills and Abilities (KSAs) associated with the related occupations. This information can be found using at onetonline.org. (Standard Occupation Code = SOC)

Occupation	SOC Code (6 digit)	Occupation specific technology skills & KSAs
Architectural and Engineering Managers	11-9041	https://www.onetonline.org/link/summary/11-9041.00 Analytical or scientific software; Computer aided design CAD software; Complex Problem Solving; Computers and Electronics; Judgment and Decision Making
Mechanical Engineers	17-2141	https://www.onetonline.org/link/summary/17-2141.00 Computer aided manufacturing CAM software; Industrial control software; Critical Thinking; Technology Design; Quality Control Analysis; Production and Processing; Mechanical
Mechanical Drafters	17-3013	https://www.onetonline.org/link/summary/17-3013.00 Computer aided design CAD software; Document management software; Judgment and Decision Making; Active Listening; Operations Analysis; Engineering and Technology; Production and Processing
Mechanical Engineering Technologists and Technicians	17-3027	https://www.onetonline.org/link/summary/17-3027.00 Analytical or scientific software; Computer aided design CAD software; Complex Problem Solving; Mathematics; Systems Analysis; Active Listening; Engineering and Technology; Computers and Electronics; Physics
Engineering Teachers, Postsecondary	25-1032	https://www.onetonline.org/link/summary/25-1032.00 Analytical or scientific software; Computer aided manufacturing CAM software; Information retrieval or search software; Instructing; Learning Strategies; Systems Analysis; Mathematics; Engineering and Technology; Education and Training

Notes:

28. Based on the data compiled and analyzed for this section (see Section C: Need), what is the job outlook for occupations filled by students with this degree?

The landscape of mechanical engineering in Georgia is poised for unprecedented growth, with job prospects surging at an impressive rate of 22.1%, outpacing the nationwide projection of 7%. Furthermore, the anticipated annual influx of 1,000 job openings in the field from 2018 to 2028 underscores the state's vibrant and burgeoning engineering landscape. This remarkable trajectory is spurred by investments in artificial intelligence, automation, Internet of Things, cyber-physical systems, and the establishment of cutting-edge manufacturing plants, all of which are driving transformative changes in the traditional realm of mechanical engineering. This paradigm shift, in turn, necessitates a highly skilled and well-trained workforce, highlighting the pertinence of an innovative M.S. program.

At the local level, Georgia stands poised to witness an influx of corporations in critical areas such as automation, automotive, and electrification, further accentuating the demand for mechanical engineering students and highly qualified professionals. The positioning of such a program at UGA offers immense potential to bolster the state's appeal to prospective corporations, ensuring a readily available and adept workforce, thus propelling Georgia to the forefront of engineering-driven industrial developments.

In light of these transformative dynamics, the proposed M.S. in Mechanical Engineering at the University of Georgia emerges as a decisive endeavor, aligning with the evolving needs of the engineering industry. By cultivating a cadre of skilled professionals and highly qualified prospects, the program seeks to empower Georgia with a competent and adaptive workforce capable of embracing the challenges and opportunities that lie ahead. As the state positions itself as a hub of innovation and industrial progress, this forward-looking initiative will undoubtedly serve as a catalyst for propelling mechanical engineering into a new era of excellence and advancement.

D. CURRICULUM

29. Enter the number of credit hours required to graduate^

32

30. Are you requesting a credit hour requirement waiver (either below or above traditional credit hour length requirements as prescribed by the University System of Georgia? See section 2.3.5 (Degree Requirements) of the USG Board of Regents Policy Manual here for more information).

☒ *No*

☐ *Yes (*If yes, explain the rationale for the request in the space below*)*

31. Delivery Mode: related to SACSCOC accreditation, specify if the program format of the proposed program is a^:

	Format (Check 1)		**Program Percentage**
X	On Campus		<50%
	On Campus AND Online		50-94%
	Online	X	95-100%
	Partially Online		Unknown
	External		

☐	Campus/Online/External
☐	On Campus & External

32. Is the program synchronous or asynchronous?[5] Mark one of the options below.

☒ Synchronous

The majority of courses are offered at scheduled, pre-determined times with students connecting to a virtual room or location and interacting with faculty and fellow students via web/video conferencing platform.

☐ Asynchronous

33. For ALL degree proposals, which High Impact Practices[6] (HIPs) will faculty embed into the program? Mark all that apply.

☐ Internships
☐ Common Intellectual Experiences
☒ Diversity/Global Learning
☐ ePortfolios
☐ Service Learning, Community Based Learning
☒ First-Year Experiences
☐ Undergraduate Research
☐ Capstone Courses and Projects
☐ Learning Communities
☐ Writing-Intensive Courses
☒ Collaborative Assignments and Projects

34. For ALL degrees, discuss how HIPs will be embedded into the program? Your discussion should provide specific examples and include whether the HIP is required or an optional component. It should also indicate at what point the experience is offered or required.

As part of the quest to cultivate adept and proficient mechanical engineers, the proposed M.S. program mandates students to engage in a structured orientation program during their first year of enrollment. This initial phase lays the groundwork for their academic journey, fostering a robust foundation in the field while honing essential skills such as critical thinking and problem-solving. Complementing this, each student will be appointed a mentor adept at navigating the intricacies of the program, furnishing guidance on academic and research matters, and facilitating connections with diverse resources and opportunities. To equip M.S. students for their future careers, an array of workshops and seminars spanning various topics, including grant writing, communication skills, and professional development, will be offered, empowering them to meet the challenges of their prospective careers with confidence.

In the spirit of fostering collaboration and skills enhancement, collaborative assignments and projects hold intrinsic value within the realm of mechanical engineering. Through such endeavors, students are granted invaluable opportunities to work synergistically, fostering the acquisition of vital teamwork

[1] Direct measures may include assessments, HIPs, exams, etc.
[6] See Kuh (2008). High-Impact Practices: What They Are, Who Has Access to Them, and Why They Matter. *Association of American Colleges and Universities*, *14*(3), 28-29).

skills. Incorporating team-based research projects, group assignments, peer mentoring, and interdisciplinary undertakings, the M.S. program seeks to imbue students with the spirit of cooperation and ingenuity, positioning them for success in an ever-evolving engineering landscape. By championing a comprehensive and integrative approach, the proposed program seeks to empower aspiring mechanical engineers with the competence and collaborative prowess essential for making transformative contributions to the field.

35. Does the program take advantage of any USG initiatives?

Mark all that apply, and provide a letter of support from applicable initiatives' leadership.

[ ] eCampus	*[ ] Georgia Film Academy*
[ ] FinTECH	*[ ] Other: Specifiy Initiative Here*

36. List the learning outcomes for the program?^ Attach the curriculum map for the upper division or major curriculum.

The student learning outcomes and the specific, measurable performance indicators are listed below:

a. Ability to identify problems and develop economically feasible solutions through critical thinking, scientific knowledge, engineering tools, and systematic approaches related to advanced mechanical engineering field.

1. The research objectives are supported by a critical review of current, relevant literature.
2. The research objectives address a critical societal and/or technological need.
3. The research objectives will contribute novel and unique knowledge to the discipline.

b. Ability to perform efficiently in an interdisciplinary team as a member or as a leader to create a collaborative environment, integrating concepts and techniques to solve challenging mechanical engineering problems.

1. The student is able to identify and execute appropriate scientific/engineering methods to test the research objectives.
2. The student can analyze and evaluate his/her data/model/simulations using correct statistical analysis, where appropriate.
3. The student can draw sound conclusions that are supported by his/her results.
4. The student demonstrates extensive knowledge of contemporary issues that are directly and indirectly associated with his/her research.
5. The student has a clear understanding of required future work.

c. Demonstrate the ability to effectively communicate experimental results orally with a range of audiences and exhibit efficient writing skills demonstrated through scientific publications and grant proposals.

1. The student presents information in a logical and interesting sequence with a clear and strongly supported central message.
2. The student uses relevant graphics and/or multimedia to explain and reinforce the presentation.
3. The student delivery (posture, gesture, eye contact, and vocal expressiveness) make the presentation compelling, and the speaker appears polished and confident.
4. The student appearance, language, and presentation convey a high level of professionalism.

Direct assessment of the student learning outcomes will be performed by the Graduate Advisory Committee members during each student thesis defense. An assessment rubric has been developed by the College of Engineering and is currently used for assessment of students in Engineering. Indirect assessment of student learning outcomes will be undertaken with a student exit survey.

The assessment of the program will be conducted by the School of Environmental, Civil, Agricultural and Mechanical Engineering graduate faculty working in conjunction with the College of Engineering's Senior Associate Dean for Academic Affairs. The results of the annual assessment will be reported to the UGA Office of Accreditation and Institutional Effectiveness, as well as to the School of Environmental, Civil, Agricultural and Mechanical Engineering graduate faculty and the ECAM External Advisory Board for their use in program development.

37. For ALL degree proposals, fill in the table below to demonstrate the link between the learning outcomes and NACE career ready competencies.
Insert more rows as needed.

Career Ready Competencies (NACE)	Student Learning Outcomes	Direct Measure (s)[1]
Critical Thinking/ Problem Solving	Ability to identify problems and develop economically feasible solutions through critical thinking	Course assignments and exams; Research projects; Capstone projects; Direct observation from major professors.
Oral/Written Communications	Demonstrate the ability to effectively communicate experimental results orally with a range of audiences and exhibit efficient writing skills demonstrated through scientific publications and grant proposals.	Writing assignments such as research papers or technical reports; Presentations such as research seminars or project presentations; Peer and faculty evaluation;
Team Work/ Collaboration	Ability to perform efficiently in an interdisciplinary team as a member or as a leader to create a collaborative environment	Group projects; Peer and faculty evaluations; Case studies or simulations for complex problems.
Digital Technology	Ability to perform efficiently in an interdisciplinary team as a member, integrate concepts, and techniques to solve challenging mechanical engineering problems.	Hands-on projects involving digital technologies; Examinations such as programming skills; Faculty evaluation during the research meetings; Industry certifications
Leadership	Ability to perform efficiently in an interdisciplinary team as a leader.	Group projects for leadership roles; Peer evaluation on the leadership skills; Faculty evaluations; Leadership activities and workshops
Professionalism/ Work Ethic	Ability to identify problems and develop economically feasible solutions through critical thinking, scientific knowledge, etc.	Faculty evaluation; Self-assessment; Mentor evaluations; Career development activities; Graduate surveys.

Career Management	Demonstrate the ability to effectively communicate experimental results orally with a range of audiences and exhibit efficient writing skills	Career assessments; Career development activities; Alumni surveys; Internships and co-op experiences; Mentor evaluation.
Global/Intercultural Fluency	Ability to identify problems and develop economically feasible solutions through critical thinking, scientific knowledge, engineering tools, and systematic approaches related to advanced mechanical engineering field	Self-assessment; Faculty evaluations; Study abroad experiences; Cross-cultural projects via international collaboration; Cultural diversity and inclusion training

38. How will outcomes for graduates of the program be assessed?
(Outcomes may include employment and placement rates, student or employer surveys, or other assessments of graduate outcomes)

Alumni Survey: The Mechanical Engineering (M.S.) alumni will be asked to complete a Qualtrics survey every 3 years, which assesses employment and placement rates and the value of their education in their current position. This survey will also aid in determining specific courses and research areas in the mechanical engineering program that are considered the most relevant to the industry and whether new areas need to be incorporated into the program of study. The Graduate Coordinator will collect the survey responses and the School Chair will tabulate the results and report them to the faculty at the annual faculty meeting. This is an indirect assessment of all learning outcomes.

Advisory Board Focus Group: The Mechanical Engineering (M.S.) program has identified two primary constituencies: the *mechanical engineering industry* and *mechanical engineering alumni*. The School of Environmental, Civil, Agricultural, and Mechanical Engineering advisory board is comprised of representatives from both of these constituent groups. Focus groups are performed during the annual advisory board meeting every three years to ensure graduate outcomes are consistent with industry needs and that outcomes are being attained. The results of the focus groups are reviewed by the School Chair to determine alignment with industry needs and satisfactory attainment. If an obvious disparity exists between the constituencies' needs, a special faculty meeting will be scheduled. Program faculty review feedback from the focus groups and draft an appropriate response based on constituent needs. This will be sent to the advisory board who will determine if the response is acceptable or if further revisions are needed.

39. List the entire course of study required to complete the academic program.

The M.S. in Mechanical Engineering requires a minimum of 32 semester hours in the program of study, which consists of:

- A minimum of 23 semester hours of coursework, which must include:
  - 21 hours of graduate-level coursework, including
    - 9 hours selected from the Emphasis course list
    - 12 hours from UGA courses open only to graduate students and exclusive of directed study (ENGR 8900 Directed Study in Engineering), thesis (ENGR 7300, Master's

    Thesis) and research (ENGR 7000, Master's Research, and ENGR 7010, Project-Focused Masters Research)
  - 1 hour of ENGR 8950, Graduate Seminar
  - 1 hour of GRSC 7001, GradFIRST: First-year Research and Scholarship Training Seminar
- A minimum of 6 hours of master's research (ENGR 7000, Master's Research) or project-based research (ENGR 7010, Project-Focused Masters Research). A typical student's research hours will exceed this minimum; however, at most 6 hours of ENGR 7000 or ENGR 7010 may be listed on the program of study.
- 3 hours of thesis preparation and writing (ENGR 7300, Master's Thesis)

In this M.S. program, all coursework is selected consistent with specific degree and emphasis area requirements in coordination with the Student's Faculty Advisor and approved by the student's Advisory Committee on the Program of Study. To receive the M.S. degree, each student is required to present a satisfactory research proposal approved by the student's advisory committee and the graduate coordinator and pass a final examination and defense of the research thesis.

Emphasis course list

- BIOE 6740, Biomaterials (3 credit hours)
- BIOE 6760, Biomechanics (3 credit hours)
- CVLE(MCHE)(LAND) 6660, Sustainable Building Design (3 credit hours)
- CVLE(MCHE) 8160, Advanced Fluid Mechanics (3 credit hours)
- CVLE(MCHE) 8350, Nonlinear Finite Element Analysis (3 credit hours)
- CVLE(MCHE) 8640, Advanced Strength of Materials (3 credit hours)
- ELEE 6210, Linear Systems (3 credit hours)
- ELEE 6220, Feedback Control Systems (3 credit hours)
- ELEE 6230, Sensors and Transducers (3 credit hours)
- ELEE 6235, Industrial Control Systems (3 credit hours)
- ELEE 6260, Introduction to Nanoelectronics (3 credit hours)
- ELEE 8310, MEMS Design (3 credit hours)
- ENGR 6350, Introduction to Finite Element Analysis (3 credit hours)
- ENGR 6670, Quality Engineering (3 credit hours)
- ENGR 6920, Theory of Design (3 credit hours)
- ENGR 8103, Computational Engineering: Fundamentals, Elliptic, and Parabolic Differential Equations (3 credit hours)
- ENGR 8180, Advanced Mass Transfer (3 credit hours)
- ENGR 8220, Microfluidic Transport Phenomena (3 credit hours)
- ENGR 8270, Computational Nanomechanics (3 credit hours)
- ENVE 6230, Energy in Nature, Civilization, and Engineering (3 credit hours)
- ENVE 6250, Energy Systems and the Environment (3 credit hours)
- ENVE 6530, Energy and Environmental Policy Analysis (3 credit hours)
- ENVE 6550, Environmental Life Cycle Analysis (3 credit hours)
- INFO 6150, Engineering Informatics (3 credit hours)
- MCHE 6310-6310L, Introduction to Vehicle Dynamics (3 credit hours)
- MCHE 6360, Robotic Manipulators (3 credit hours)
- MCHE 6380, Solid Mechanics (3 credit hours)

- MCHE 6390, Advanced Mechanical Vibration (3 credit hours)
- MCHE 6400, Air Pollution Engineering (3 credit hours)
- MCHE 6430, Introduction to Tribology (3 credit hours)
- MCHE 6500, Advanced Thermal Fluid Systems (3 credit hours)
- MCHE 6530, Combustion and Flames (3 credit hours)
- MCHE 6580, Computational Fluid Dynamics (CFD) (3 credit hours)
- MCHE 6590, Fluid Mechanics II (3 credit hours)
- MCHE 6650, HVAC Systems for Buildings and Industry (3 credit hours)
- MCHE 6850, Advanced Manufacturing Processes (3 credit hours)
- MCHE 6860, Advanced Vehicle Manufacturing (3 credit hours)
- MCHE 8170, Advanced Heat Transfer (3 credit hours)
- MCHE 8250, Combustion Science (3 credit hours)
- MCHE 8380, Continuum Mechanics (3 credit hours)
- MCHE 8500, Technical Foundations of Energy for Policy Practitioners (3 credit hours)
- MCHE 8650, Aerosol Science and Engineering (3 credit hours)
- MCHE 8850, Gas Dynamics (3 credit hours)
- MIST 6550, Energy Informatics (3 credit hours)

E. IMPLEMENTATION

40. Provide an enrollment projection for the next four academic years

	Year 1	Year 2	Year 3	Year 4
Fiscal Year (Fall to Summer)	2024-25	2025-26	2026-27	2027-28
Base enrollment[1]		11	28	33
Lost to Attrition (should be negative)	0	-2	-2	-2
New to the institution	4	30	35	40
Shifted from Other programs within your institution	17	0	0	0
Total Enrollment	21	39	61	71
Graduates	10	11	28	33
Carry forward base enrollment for next year	11	28	33	38

[1]Total enrollment for year 1 becomes the base enrollment for year 2

a. **Discuss the assumptions informing your enrollment estimates (i.e. for example, you may highlight anticipated recruiting targets and markets, if and how program implementation will shift enrollment from other programs at the institution, etc.)**

Graduate faculty in the School of Environmental, Civil, Agricultural, and Mechanical Engineering currently advise students enrolled in Engineering (M.S.) with an Area of Emphasis in Mechanical Engineering. In Fall 2023, 21 students were enrolled in Engineering (M.S.) with the Area of Emphasis in Mechanical Engineering; these students are expected to switch to the new M.S. in Mechanical Engineering program once it is established.

Historical data indicate that for the previous three years the college has consistently recruited around 30 new students to Engineering (M.S.) with the above area of emphasis each academic year and graduate 40-50% of current students. The school fully expects to sustain a program enrollment of around 30 students for the new M.S. in Mechanical Engineering and anticipates enrollment will increase in future years as additional faculty members are being recruited through the current Presidential Cluster Hiring Initiative.

b. If projections are significantly different from enrollment growth for the institution overall, please explain.

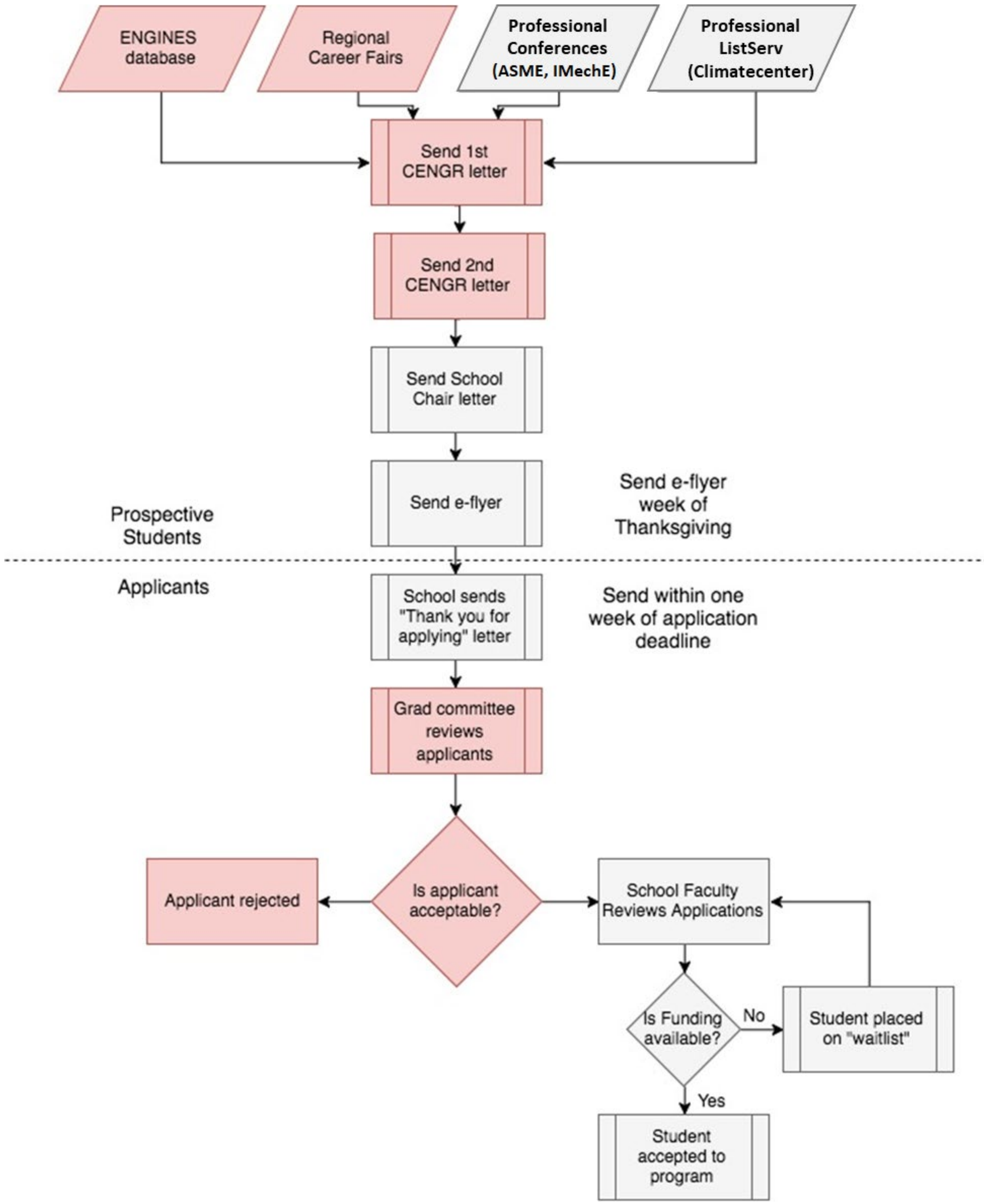
Not applicable.

41. If projected program enrollment is not realized in year two, what actions are you prepared to take?

In the event that program enrollment is not realized, the School of ECAM will increase recruitment activities by increasing social media presence, advertising in relevant print and online publications such as the College of Engineering, American Society of Mechanical Engineering (ASME), Institute of Mechanical Engineers (IMechE), National Society of Professional Engineers (NSPE), Advanced Manufacturing & Processing Society (AMPs), Society of Automotive Engineering (SAE), Society of Experimental Mechanics (SEM), Society of Engineering Science (SES) etc., websites, and by proactively encouraging current undergraduate students to pursue this M.S. program.

42. Discuss the marketing and recruitment plan for the program. Include how the program will be marketed to adult learners and underrepresented and special populations of students. What resources have been budgeted for marketing the new program?

The School of ECAM will utilize a number of avenues to market the new program and recruit students, including the ENGINES database of prospective engineering graduate students, regional career fairs, professional meetings including the American Society of Mechanical Engineering (ASME), Institute of Mechanical Engineers (IMechE), National Society of Professional Engineers (NSPE), Advanced Manufacturing & Processing Society (AMPs), Society of Automotive Engineering (SAE), Society of Experimental Mechanics (SEM), Society of Engineering Science (SES), American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE) and the Student Aerospace Initiative (SAI) American Physics Society (APS), American Society of Education Engineers (ASEE), and a variety of professional listservs, such as Climatecenter. The program will be prominently displayed on the school's website. The flow chart for student recruitment is presented below.



43. Provide a brief marketing description for the program that can be used on the Georgia OnMyLine website.

Embark on a transformative journey with the M.S. in Mechanical Engineering program at the University of Georgia (UGA). Rooted in excellence and innovation, this cutting-edge curriculum equips students with a comprehensive skill set, encompassing mechanical systems, thermal systems, manufacturing, and design. Whether you aspire to advance your career in the transportation industry, contribute to energy system innovation, or pioneer groundbreaking research in emerging fields, this program offers unrivaled opportunities to excel.

At UGA, faculty believe in fostering a collaborative and supportive learning environment. Engage with distinguished faculty and expert mentors as you navigate your academic and research pursuits, while benefiting from a wealth of interdisciplinary resources and initiatives. Empowered by UGA's state-of-the-art facilities and global connectivity, you'll be well-prepared to embrace the dynamic challenges of today's engineering landscape. Join us at UGA, and become a driving force in the future of mechanical engineering. Embrace a world of possibilities and unlock your potential with our transformative M.S. program. Apply now and elevate your engineering journey at UGA.

44. If this proposal is for a Doctorate program, provide information below for at least three external and one USG reviewer of aspirational or comparative peer programs.

Not applicable.

***Note**: External reviewers must hold the rank of associate professor or higher in addition to other administrative titles.*

***Note**: It is the responsibility of the institution proposing the doctoral degree program to attain external reviews and submit those reviews to their proposal.*

F. RESOURCES

F1. Finance^: Complete and submit the Excel budget forms and the questions below

(Do not cut and paste in the excel budget template into this document, submit the Excel budget templates separately.)

45. Are you requesting a differential tuition rate for this program? (masters, doctoral, and professional programs only)

☒ No (Move to answer question 48)

☐ Yes (If yes, answer questions 47a & 47b)

a. What is the differential rate being requested? The rate below should reflect the core tuition plus the differential, i.e. the tuition rate being advertised to the student.

In-State per Semester: $Enter Amount

Out-of-State per Semester: $Enter Amount

b. Provide tuition and mandatory fee rates assessed by competitive/peer programs per full-time student per semester. Please complete the table below:

Institution name	Link to institution's tuition & fee website	In-state tuition	Out-of-state tuition	In-state fees	Out-of-state fees

46. If existing funds are being reallocated, describe the impact on existing programs and the plan to mitigate these impacts.

Neither faculty nor staff hiring or reassignments are necessary, as the courses and program materials are already being offered as an Area of Emphasis under the Engineering (M.S.) degree. The school will not need to create new sections of any existing courses to meet additional demand.

47. If student fees are being charged (excluding mandatory fees), explain the cost and benefit to students, per fee.

Not applicable.

48. Are there any additional financial costs that students will have to take on as part of this program, but not assessed directly by the institution? (e.g. software licenses, equipment, travel, etc.) If so, please describe these costs and what strategies you have considered to decrease the student's financial burden?

No additional costs to students are anticipated.

49. How does the institution plan for and fund increased indirect costs associated with the growth in students anticipated in the proposed program? Consider costs such as student advisement, student support services, tutoring, career services, additional library materials, technology, or other infrastructure.

All resources needed for the program are pre-existing, as it is already being offered as an Area of Emphasis under the Engineering (M.S.) degree. The School of ECAM will utilize the current resources (personnel, library, equipment, laboratory, and computing) available at the school, college, and university levels.

F2. Faculty^ – Explain your faculty and staff plan for the program

50. Discuss how existing courses may be incorporated into this new program:

a. Course Development

# of total courses in the curriculum:	**42**
# of existing courses to be part of the new program	**42**
Net number of new courses to be developed	**0**

b. Comment on the costs and workload related to the new course development.

All courses are currently being offered. No new courses are being proposed or developed as part of the program and therefore, no new resources are needed to cover instructional costs.

51. Explain how <u>current faculty and staff</u> will contribute to the program.

a. How many faculty will be re-directed to this program from existing programs?

The faculty currently teaching the courses in the existing Area of Emphasis in Mechanical Engineering under Engineering (M.S.) will be teaching the same courses under the Mechanical Engineering (M.S.).

b. **If this program is approved, what will be the new teaching load and distribution of time for the current faculty members? How will existing staff be impacted?**

The School of Environmental, Civil, Agricultural, and Mechanical Engineering has 27 faculty currently teaching courses that are directly related to the proposed program of study or who are performing mechanical engineering research. These faculty will be the major professors for students enrolled in the proposed M.S. program and are the same professors currently serving as major professors for students in the Area of Emphasis in Mechanical Engineering. The teaching loads for existing faculty will remain the same. The courses, currently offered as part of the existing Areas of Emphasis under the Mechanical Engineering (M.S.) degree, will now be offered as part of the new major. Existing staff will not be impacted by the creation of the new major.

c. **List the faculty that will be redirected from their current teaching load assignments to support this new program.**

No faculty will be redirected from their current teaching assignments. The proposed degree will incorporate courses that are currently taught by existing, qualified faculty as part of the Area of Emphasis in Mechanical Engineering.

d. **Explain who will be teaching the existing courses that are being released so faculty can teach a new program course. Additionally, please discuss the fiscal implications associated with course releases and redirections of faculty.**

Not applicable; all courses are already being offered. This major will evolve a current area of emphasis to an independent major, named in a way to keep current with national trends.

e. **What costs are included in your budget for course development? (Consider professional development, course development time buy out, overload pay, and re-training)**

Not applicable.

f. **Attach your SACSCOC roster for the proposed program. Include in parentheses the individual with administrative responsibility for the program and whether listed positions are projected new hires and/or currently vacant.**

Faculty Name	**Rank**	**Courses Taught**	**Academic Degrees**	**Current Workload** *% EFT Research,*	**Other Qualifications and Comments** *Research Areas*

				Instruction, Service	
Camelio, Jaime	Full Professor	MCHE xxx	Ph.D., Mechanical Engineering, University of Michigan, 2002	30(R) 10(I) 60(S)	• Intelligent manufacturing systems • Cyber physical security for manufacturing systems – vulnerability mapping, mitigation technologies • Data mining and statistical learning applications for manufacturing processes and systems, process monitoring, diagnosis, prognosis, and control
Chorzepa, Mi Geum	Associate Professor	CVLE(MCHE) 8350 Nonlinear Finite Element Analysis, 3 (G), CVLE(MCHE) 8640 Advanced Strength of Materials, 3 (G)	Ph.D., Structural Engineering, Washington University in St. Louis, 2008	50(R) 50(I)	• Structural Analysis & Design • Nonlinear Finite Element Analysis • Nuclear Safety Related Structures • Containment Structures • Steel Plate Structures • Cryogenic Structures • Sustainable Building Design • Progressive Collapse Analysis • Materials Modeling • Forensic Engineering • Structural Repair Composite MaterialsEarthquake Engineering
Davis, Benjamin	Associate Professor	MCHE 6390 Advanced Mechanical Vibrations, 3 (G)	Ph.D., Mechanical Engineering, Duke University, 2008	50(R) 50(I)	• Structural Analysis & Design • Structural Vibration • Acoustics • Acoustic-Structure Interaction • Nonlinear Dynamics • Flow-Induced Vibration • Fluid-Structure Interaction • Elastic Stability
Freeman, Eric	Associate Professor	BIOE 6760 Biomechanics, 3 (G), ENGR 6350 Introduction to Finite	Ph.D., Mechanical Engineering, University of Pittsburgh, 2012	60(R) 40(I)	• Microfluidics • Modeling • Electrophysiology • Drug Delivery • Bioinspiration • Smart Materials • Droplet Mechanics • Soft Materials

		Element Analysis, 3 (G) ENGR 8220 Microfluidic Transport Phenomena, 3 (G) MCHE 6380 Solid Mechanics, 3 (G)			
Gattie, David	Associate Professor	ENVE 6250 Energy Systems and the Environment, 3 (UG/G), MCHE 8500, Technical Foundations of Energy for Policy Practitioners, 3 (G)	Ph.D., Ecology, University of Georgia, 1993	50(R) 50(I)	• Energy systems and environmental issues • Power generation • Energy policy
Haidekker, Mark	Full Professor	ELEE 6220 Feedback Control Systems, 3(G)	Ph.D., Computer Science – University of Bremen, Germany, 1998	50(R) 50(I)	• Biosensing and bioimaging; instrumentation •
Handa, Hitesh	Associate Professor	BIOE 6740 Biomaterials, 3 (G)	Ph.D., Material Science & Engineering, Wayne State University, 2008	60(R) 40(I)	• Biomaterials for Medical Device Applications • Nitric Oxide Releasing Materials • Blood-Material Interactions • Antimicrobial and Hemocompatible Materials • Wound Healing Materials

Hilten, Roger	Assistant Professor of Practice	ENGR 6670 Quality Engineering, 3(G)	Ph.D. Bio and Ag Engineering, 2012	10(R) 10(I) 80(S)	• Design and Innovation
Hu, S. Jack	Full Professor and Provost		Ph.D., Mechanical Engineering, University of Michigan, 1990	100(S)	• Manufacturing Systems • Assembly and materials joining • Smart manufacturing
Kastner, James	Associate Professor	ENGR 8180 Advanced Mass Transfer, 3 (G)	Ph.D., Applied Biology, Georgia Institute of Technology, 1993	60(R) 40(I)	• Biochemical engineering • Environmental, nanostructured and chemical catalysts • Enhanced biomass pyrolysis and gasification processes •
Kazanci, Caner	Associate Professor	ENGR 8103 Computational Engineering: Fundamentals, Elliptic, and Parabolic Differential Equations, 3 (G)	Ph.D., Mathematical Sciences, Carnegie Mellon University, 2005	50(R) 50(I)	• Biological and ecological modeling, simulation and analysis. • Numerical analysis, dynamical systems. • Ecological network analysis (ENA), ecological thermodynamics. • Stochastic modeling tools, individual based modeling. • Collective behavior of large biochemical reaction networks, the relation between network structure and system dynamics.
Kisaalita, William	Full Professor	ENGR 8910, Foundations for Engineering Research, 3(G)	Ph.D. in Chemical Engineering, University of British Columbia	60(R) 40(I)	• Microtissue engineering • Development engineering •
Lawrence, Thomas	Professor of Practice	CVLE(MCHE)(LAND) 6660, Sustainable Building Design, 3(G) MCHE 6650, HVAC Systems for	Ph.D., Mechanical Engineering, Purdue University, 2004	22(R) 60(I) 18(S)	• Green buildings • Smart grid and building energy management • HVAC systems • Energy informatics

		Buildings and Industry, 3(G)			
Leo, Donald	Full Professor and Dean	MCHE 6390, Advanced Mechanical Vibrations, 3 (G)	Ph.D., Mechanical and Aerospace Engineering, University of Buffalo, 1995	100(S)	• Smart Materials • Biomolecular Materials
Li, Ke	Associate Professor	ENVE 6550, Environmental Life Cycle Analysis, 3(G)	Ph. D., Environmental Engineering, Michigan Technological University, 2003	50I 50(I)	• Environmental engineering • Water/wastewater treatment and sustainability
Mani, Sudhagar	Full Professor	MCHE 8710, Engineering Properties of Animal and Plant Materials: Form and Function, 3(G)	Ph.D., Chemical and Biological Engineering, University of British Columbia, Canada, 2005	50(R) 50(I)	• Biological and chemical process modeling, simulation & optimization • Sustainable biomass feedstock supply logistics system • Novel biomass densification, torrefaction and thermal conversion technologies • Techno-Economic Analysis (TEA) and Life Cycle Assessment (LCA) • Novel routes to produce nano-size cellulose, chemicals & bio-composites
Mativo, John	Full Professor		Ph.D., Mechanical Engineering, University of Dayton, 2020	50(R) 50(I)	• Energy • Mechanics • Mechatronics • STEM Education K-16
Morkos, Beshoy	Associate Professor	MCHE 6850, Advanced Manufacturing Processes, 3 (G) MCHE 6860, Advanced Vehicle	Ph.D., Mechanical Engineering, Clemson University, 2012	50(R) 50(I)	• Computational Design • System Representation and Reasoning • Model Based System Engineering • Manufacturing Resource Optimization and Operations • Complex System Design • Cyber-Physical-Social Systems in Manufacturing

		Manufacturing, 3			• Human-AI interaction in Design and Manufacturing
Pidaparti, Ramana	Full Professor	ENGR 6560 Engineering Design Optimization, 3 (G); ENGR 8900 Directed Study in Engineering, 1-3	Ph.D., Aeronautics & Astronautics, Purdue University, 1989	50(R) 50(I)	• Design engineering and innovation • Computational mechanics • Drug delivery devices • STEM education
Rao, Haygriva	Professor of Practice	INFO 6150 Engineering Informatics, 3 (G)	PGD, Knowledge Engineering, National University of Singapore, 2001	100(I)	• AI and Machine Learning
Rotavera, Brandon	Associate Professor	MCHE 6500, Advanced Thermal Fluid Systems, 3 (G) MCHE 6530, Combustion and Flames, 3 (G) MCHE 8250, Combustion Science, 3 (G) MCHE 8850, Gas Dynamics, 3 (G)	Ph.D., Interdisciplinary Engineering, Texas A&M University, 2012	60(R) 40(I)	• Biofuels • Sustainable Energy • Combustion • Thermodynamics, • Lasers/Optics • Physical Chemistry • Chemical Kinetics • Fluid Dynamics • Spectroscopy • Gas Chromatography • Mass Spectrometry
Saleh, Rawad	Associate Professor	MCHE 6400, Air Pollution Engineering, 3(G)	Ph.D., Environmental Engineering, Duke University, 2010	50I 50(I)	• Atmospheric Aerosols • Gas-particle Interaction • Aerosol optical properties • Combustion emissions • Air quality and climate modeling

		ENGR 8990, Advanced Topics in Engineering			• Chemical Transport Modeling
Schramski, John	Associate Professor	ENVE 6230, Energy in Nature, Civilization & Engineering, 3(G)	Ph.D., Ecology, University of Georgia, 2006	60(R) 40(I)	• Energy systems • Ecosystem energetics • Thermodynamics • Theoretical ecology • Complex network analysis • Ecological network theory • Energy Supply and Demand • Environmental Energy Systems • Sustainable Use of Global Ecosystems • Food Security • Natural Resources Engineering
Shao, Yunli	Assistant Professor	ELEE 6210, Linear Systems (3)(G) ELEE 6220, Feedback Control Systems (3)(G)	Ph.D., Mechanical Engineering, University of Minnesota, 2019	50(R) 50(I)	• Dynamic systems and control • Optimal control • Connected and automated vehicles • Intelligent transportation systems • Automotive systems
Song, Kenan	Associate Professor	MCHE 6850, Advanced Manufacturing Processes (3)(G)	Ph.D., Mechanical Engineering, 2014	50(R) 50(I)	• Advanced manufacturing • Advanced materials • Composite engineering • Energy devices • Biomedical scaffolds
Sun, Hongyue	Associate Professor	MCHE 4440 Design and Control of Production Systems (3)(UG)	Ph.D., Industrial Engineering, Virginia Tech, 2017	50(R) 50(I)	• Advanced manufacturing • Process modeling, monitoring, diagnosis, and control • Data analytics for manufacturing processes and systems, occupational safety and health
Wang, Xianqiao	Associate Professor	ENGR 8270, Computational Nanomechanics, 3(G)	Ph.D. Mechanical Engineering, George Washington University, 2011	50(R) 50(I)	• Brain mechanics • Mechanics of architectured materials and structures • Materials design by machine learning and AI

		MCHE 8330, Continuum Mechanics, 3(G)			• Mechanics of cell and nanoparticle interactions • 2D materials • Multiscale modeling and simulations
Yang, Jidong	Associate Professor	ENGR 8990, Advanced Topics in Engineering, 3(G)	Ph.D., Civil Engineering, University of South Florida,	50(R) 50(I)	• Transportation Engineering and Planning • Sustainable and Resilient Infrastructure Systems • Smart Mobility Systems • Statistical and Econometric Models • Data Mining and Machine Learning Methods • Computer Vision and Artificial Intelligence Applications

52. Explain your plan for new faculty and staff for the program:

The faculty are already in place, and the courses are being offered under the existing Area of Emphasis in Mechanical Engineering under the Engineering (M.S.). This proposal is only to move the program content from an area of emphasis to an independent major.

53. How many new staff will be needed for this program over the next four years?

0

a. Discuss why new or additional staff resources are needed. Consider staff needs, support services (i.e. advisement, faculty support, etc.)

No new staff or staff resources will be required for the proposed major.

F3. Facilities – complete the questions below

54. Where will the program be offered?^ Mark all that apply

☒ Main campus

☐ Satellite campus: Specify Here

☐ Other: Specify Here

☐ 100% Online

If the program is 100% online and will use only existing faculty, remaining facilities questions can be skipped.

55. Complete the table below. Specify if these spaces are existing or new in the table below. If new, provide the semester and year of completion.

Space	New Space (ASF)	Use Existing Space (as is) (ASF)	Use Existing Space (Renovated) (ASF)	Semester/ Year of Occupancy
Dry Labs (STEM related)	10,000		Fall/2018; Spring/2022; Fall/2022	10,000
Wet Labs (STEM related)	2,000		Fall/2018/Spring/ 2022; Fall/2022	2,000
Dedicated Offices	6,000		Fall/2018; Spring/2022; Fall/2022	6,000
Fine Arts Spaces[1]				
Classrooms	4,000		Fall/2018; Fall/2022; Spring/2022	4,000
Meeting Rooms	300		Fall/2022	300
Student Study Space	500		Fall/2018; Spring/2022; Fall/2022	500
Other (Specify)				

[1]Fine arts spaces can include theatres, recital halls, visual arts studios, performing arts centers, recording studios, design labs, and other performance venues.

56. If the anticipated program includes labs or "other" specialized spaces, please describe specific requirements for these rooms, including equipment.

There are no new laboratories needed for this program, since all laboratories are already established as a part of the M.S. in Engineering with an Area of Emphasis in Mechanical Engineering. These existing laboratories and facilities and their locations are listed on the UGA College of Engineering web pages at: https://engineering.uga.edu/facilities. Specifically:

In the Driftmier Engineering Center:

- The Materials Testing and Heat Transfer Laboratory in Driftmier 1301
- The Systems Simulation Laboratory in Driftmier 1304

- The Systems Design Laboratory in Driftmier 1310
- The Mechanical, Thermal, and Fluid Systems Laboratory in Driftmier 1311
- The Design and Discovery Lab in Driftmier 1350
- The Process Automation Laboratory in Driftmier 1355
- The Measurement Systems Laboratory in Driftmier 1361

In I-STEM 1:
- The Advanced Manufacturing Laboratories 1022, 1048, and 2036

In I-STEM 2:
- Advanced Manufacturing and Materials Laboratory in 1230
- Sensing and Perception Laboratory in 1239 and 1239A

In Boyd Research and Education Center, 7th Floor:
- Advanced Mobility/E-Mobility Laboratory: 701 and 702
- Design Informatics and Computational Engineering: 706
- Smart Mobility and Infrastructure Laboratory: 714

In Whitehall/Engineering Education and Research Campus (EERC):
- Large-scale research and testing facility for all engineering disciplines; educational venue

57. What building(s) will be used to accommodate these programs? Please indicate specific building areas or room numbers where possible. If new construction, leasing, or land acquisition is required, please describe those plans.

No new buildings are needed for this program, since all offices and laboratories needed are already established as a part of the M.S. in Engineering with an Area of Emphasis in Mechanical Engineering. The Driftmier Engineering Center will be used for delivering all courses offered under the new program as well as provide offices for existing faculty and students. In addition, the following existing office spaces will be used outside Driftmier:

In I-STEM 1:
- Offices in rooms 1022, 1048, 2036, 2036A, 2036B, 2040A, and 2040B

In I-STEM 2:
- Offices in rooms: 1250, 1252, and 1254
- Offices in rooms: 2208, 2209, 2210, 2211, 2221, 2250, 3211, 3212, 3213, 3214, 3215, and 3221

In Riverbend North:
- Offices in rooms: 125A, 155C, and 155E

In Riverbend South:
- Office in room: 191

In Boyd, 7th Floor:
- Offices in 708A, 708B, 708C, 708D, 716, 717A, 716B

58. **What is the anticipated cost of facilities investments necessary during the first 4 years of the program? What is the planned funding source for initial facilities needs?**

Not applicable.

F4. Technology

59. **Identify any major equipment or technology integral to program start-up and operations. List any equipment or assets over $5,000 (cumulative per asset) needed to start-up and run the program (insert rows as needed)**

	Technology and Equipment	Start-up Costs	On-going Costs	Est. Start Date of Operations/Use
1				
2				
3				
4				
5				
6				
Total Technology Costs		**0**	**0**	

G. RISKS AND ASSUMPTIONS

60. **In the table below, list any risks to the program's implementation over the next four years. For each risk, identify the severity (low, medium, high), probability of occurrence (low, medium, high), and the institution's mitigation strategy for each risk. Insert additional rows as needed. (e.g. Are faculty available for the cost and time frame).**

Risk	Severity	Probability	Risk Mitigation Strategy

This major is currently offered as an area of emphasis with a robust enrollment. Therefore, there is no assumed risk in implementing it as a major.

61. **List any assumptions being made for this program to launch and be successful (e.g. SACSCOC accreditation request is approved, etc.).**

The school has successfully developed an M.S. Engineering program with Areas of Emphasis in Mechanical Engineering and Electrical Engineering. Student enrollment in the current program is strong and continues to increase. This successful experience together with current resources would ensure the success of the proposed M.S. in Mechanical Engineering.

H. INSTITUTION APPROVAL

Have you completed and submitted the signature page?

APPENDIX I

Use this section to include letters of support, curriculum course descriptions, and recent rulings by accrediting bodies attesting to degree level changes for specific disciplines, and other information.

Course Descriptions

Course Prefix/Number	Credit Hours	Course Title	Course Description	Required /Elective
BIOE 6740	3	Biomaterials	Biomaterials and groundwork for topics such as mechanical, chemical, and thermal properties of replacement materials and tissues. Implantation of materials in the body is studied for the biological point of view.	S
BIOE 6760	3	Biomechanics	The application of engineering principles to solid mechanics and to body dynamics is discussed. The student should understand the mechanics of the musculoskeletal system.	S
CVLE(MCHE)(LAND) 6660	3	Sustainable Building Design	Design features and technologies contained in sustainable (green) building design and the process to create a green building to include commercial and residential construction. Topics include energy and water, construction materials, site work, indoor environmental quality, and how design practices fit into the overall picture of developing a more sustainable society.	S
CVLE(MCHE) 8160	3	Advanced Fluid Mechanics	A mathematical treatment of fluid mechanics using tensors with emphasis on viscosity, momentum balance in laminar flow, equations of change, velocity distribution in laminar and turbulent flow, interphase transport, macroscopic balance, and polymeric liquids. Analytical and numeric methods for solving fluid mechanic problems will be used.	S
CVLE(MCHE) 8350	3	Nonlinear Finite Element Analysis	The formulations and numerical solution of nonlinear problems in structural, mechanical, and biological/biomedical engineering by finite element methods. Both geometric and material nonlinearities will be studied. Students are expected to learn how to use a finite element analysis tool and complete a practical engineering project.	S

CVLE(MCHE) 8640	3	Advanced Strength of Materials	Provides students with the essential knowledge necessary to analyze structural/mechanical systems and components as well as the ability to interpret analysis results. Basic concepts and tools for analyzing engineering problems (elasticity equations, equilibrium, compatibility, etc.) will be emphasized as well as the mathematical formulations.	S
ELEE 6210	3	Linear Systems	Time and frequency domain analysis of linear systems, convolution, fourier series, and fourier transforms with applications	S
ELEE 6220	3	Feedback Control Systems	The analysis and design of continuous and discrete time, and linear feedback control systems.	S
ELEE 6230	3	Sensors and Transducers	Fundamentals of the sensing process, transducers and their environments and the measurement problem. Transducer types and modeling. Displacement, motion, pressure, fluid-flow, temperature measurements.	S
ELEE 6235	3	Industrial Control Systems	Introduces basic concepts of industrial automation, modeling, and control of industrial processes. It introduces various elements in industrial automation, including pneumatic and hydraulic valves and actuators. Controller programming (such as PID and PLC) and tuning will be covered. Practical components include hardware selection, software design, and system integration.	S
ELEE 6260	3	Introduction to Nanoelectronics	Recent advances in nanoelectronics, including the novel properties and device structures when classical transport is replaced by quantum transport as the device size is reduced down to nanometer scale. Introduction of new fabrication and characterization techniques developed for these nanoscale devices.	S
ELEE 8310	3	MEMS Design	Exploration of the world of microelectromechanical systems (MEMS) through awareness of material properties, microfabrication technologies, structural behavior, sensing techniques, actuation schemes,	S

			fluid behavior, electronic circuits, and feedback systems. Lectures will be augmented with homework assignments and design projects.	
ENGR 4350/6350	3	Finite Element Analysis (F)	Fundamental finite element theory for the solution of engineering problems. Geometrical modelling techniques, element selection, and tests for accuracy. Emphasis on problems in structural mechanics and elasticity.	S
ENGR 6560	3	Engineering Design Optimization	The design of better products and processes is a fundamental goal of all engineering. Fundamental concepts of optimization techniques that can be used for a variety of engineering components or systems.	S
ENGR 6670	3	Quality Engineering	Introduces fundamentals, principles, and techniques of quality engineering through a toolkit that includes project management, quality management, and quality improvement for products and processes. Throughout the course, students get hands-on experience in exploring, understanding, and developing quality management tools and strategies to address real-world industrial challenges.	S
ENGR 6920	3	Theory of Design	Design is structured process found in numerous professions. The theory of design provides a scientific basis for this structured process and provides principles for optimizing the design outcome. Two axioms of design, the independence axiom and the information axiom, and their applications in several disciplines will be investigated.	S
ENGR 8103	3	Computational Engineering: Fundamentals, Elliptic, and Parabolic Differential Equations	The use of computational mathematics to develop models, evaluate data, and make predictions of relevance to engineering. Numerical differentiation and integration, numerical solutions of algebraic, ordinary, elliptic and parabolic differential equations, error analysis, and programming techniques are examined in the context of engineering applications.	S
ENGR 8110	3	Informatics in Engineering and	The philosophical and theoretical basis of informatics, with applications in civil	S

		Environmental Systems	engineering, environmental engineering, and the environmental sciences. Readily available software will be used throughout the course. Specific applications will depend on the needs of the students in the course.	
ENGR 8130	3	Statistical Learning and Data Mining	Explores statistical learning methods and techniques with an emphasis on their applications in engineering. The focus will be on the classic and modern statistical and machine-learning methods, including linear and logistic regression, discriminant analysis, k-nearest neighbors, tree-based methods, support vector machines, principal components analysis, manifold learning, clustering methods, and artificial neural networks.	R
ENGR 8180	3	Advanced Mass Transfer	Basic laws of mass transport will be derived. Advanced mass transport will focus on molar flux, Fick's law, binary diffusion, two phase transfer, convective mass transfer, mass transfer coefficients, and mass transfer with chemical reaction. A project will be assigned requiring numerical solution of governing mass transport equations.	R
ENGR 8220	3	Microfluidic Transport Phenomena	A mathematical description of transport and exchange at smaller length scales. Topics include channel flow, transport laws, diffusion and dispersion, surface tension dominated flows, and charged species flows.	S
ENGR 8270	3	Computational Nanomechanics	Computational nanomechanics has been emerging as a fundamental engineering analysis tool for designing nanodevices and for predicting intriguing phenomena at the nanoscale. The basic knowledge of computational nanomechanics, such as force fields, interatomic potentials, statistical quantities, and program coding skills. Students are encouraged to develop a molecular dynamics program by themselves, learn and utilize analytical software to solve nanomechanics problems, and investigate fundamental questions in nanoscience.	S

ENGR 8825	3	Bioinspired Design and Analysis	This course offers a unique interdisciplinary advanced design experience, and provides an opportunity to learn the bio-inspired design, develop competence as innovators, and gain the necessary tools and experience.	S
ENGR 8910	3	Foundations for Engineering Research	The philosophy of engineering research, research and design methodologies, review of the departmental research programs and related training goals, and writing and presenting thesis and dissertation proposals and grant proposals	R
ENGR 8950	1x4	ECAM Graduate Seminar	Presentations/discussions related to engineering research, teaching, design, and service presented by students, faculty, and industry leaders.	R
ENGR 8990	3	Advanced Topics in Engineering - Deep Learning and Engineering Applications	Introduces modern deep learning methods and architectures (e.g., convolutional neural networks (CNNs) and recurrent neural networks (RNNs), energy-based models) with an emphasis on their engineering applications. The focuses of the course will be on major advancements in deep learning in recent years. The core ideas and principles of deep learning will be discussed. Both supervised and self-supervised learning will be covered with an emphasis on vision applications, including image classification, object detection, and image segmentation.	S
ENGR 9000	3	Doctoral Research	Research while enrolled for a doctoral degree under the direction of faculty members.	R
ENGR 9010	3	Project-Focused Doctoral Research	Project-focused research while enrolled for the Ph.D. degree under the direction of faculty members. This course is for students who are performing sponsored research specifically devoted toward completing project deliverables important to project sponsors that may not be directly related to Ph.D. dissertation research.	R
ENGR 9300	Variable	Doctoral Dissertation	Dissertation writing under the direction of the major professor.	R
ENVE 6550	3	Environmental Life Cycle Analysis	An in-depth look at life cycle analysis (LCA), the existing models and analytical methodologies, and their	S

			applications. Conducting Life Cycle Analyses for small scale items such as individual manufactured products up through larger scaled engineered system items such as an engineered structure, transportation system, etc.	
INFO 6150	3	Engineering Informatics	Provides instruction and insights into data, theory, and application of machine learning algorithms and skills to apply these algorithms to real world datasets and applications in Engineering. The course also provides hands-on experience through project work.	S
MCHE 6310	3	Introduction to Vehicle Dynamics	Course focuses on the dynamics and controls of land vehicles. Activities include a physical understanding of automotive vehicle dynamics such as simple lateral, longitudinal, and ride quality models; a design of ground vehicles for directional stability and control; tire mechanics and their effects on vehicle performance; and a synthesis of the steering mechanism and suspension system. Digital simulation of vehicle dynamics using computers will be conducted.	S
MCHE 6360	3	Robotics Manipulators	Derivation of kinematic equations and inverse kinematic solutions for robotic manipulators; general models for robot arm dynamics and dynamic coefficients for multiple degrees of freedom robot arms with parallel and serial structures; and control of single- and multiple-link manipulators and how to design simple feedback control laws.	S
MCHE 6380	3	Solid Mechanics	A continuation of Strength of Materials. An introduction to elasticity, continuum mechanics, and 3-D stress transformations. Asymmetrical bending of beams, torsion of general cross-section bars, and energy methods are discussed.	S
MCHE 6390	3	Advanced Mechanical Vibration	Modeling and analysis of multi-degree-of-freedom vibrating systems, including free and forced response of both undamped and damped systems. Lumped parameter and distributed parameter systems will be studied. Application of time domain and	S

			frequency domain techniques to the design and analysis of complex mechanical systems.	
MCHE 6400	3	Air Pollution Engineering	The course builds on concepts in thermodynamics, transport phenomena, and physical chemistry to introduce the formation of particulate and gaseous pollutants and their effect on air quality. Special focus will be on engineering design strategies to control pollutants associated with energy generation (power plants) and utilization (on-road vehicles) systems.	S
MCHE 6430	3	Introduction to Tribology	The study of friction, wear, lubrication, and the design of bearings from the consideration of engineering and materials science.	S
MCHE 6500	3	Advanced Thermal Fluid Systems	Advanced study of concepts in thermodynamics and fluid dynamics applied to thermofluid systems, including gas turbines, compressors, wind turbines, and rocket nozzles. Design analysis of pumps, fans, and wind turbines. Introduction to high-speed compressible flow, shock wave physics, and propulsion devices.	S
MCHE 6530	3	Combustion and Flames	Fundamentals of thermodynamics, fluid dynamics, and mass transfer in laminar and turbulent flames in combustion systems. Introduction to chemical kinetics, explosions, supersonic combustion, deflagration and detonation, and ignition dynamics. Introduction to combustion in stationary gas turbines for power generation, internal combustion engines, and combustion systems in jet engines.	S
MCHE 6580	3	Computational Fluid Dynamics	The course outlines how numerical data analyses are used to predict the fluid dynamics and thermal interactions between fluids and their surroundings. Fundamental concepts in modeling are first presented, then students compare CFD results to laboratory data. Students then apply their CFD skills to a more detailed project.	S
MCHE 6590	3	Fluid Mechanics II	Analysis of both internal and external viscous incompressible flows. Specific examples include pipe flow, flow	S

			between parallel plates, restriction flow meters, boundary layer flow, the Blasius equation, drag force, and lift force. An introduction to computational fluid dynamics, with application to the course topics, is also covered.	
MCHE 6650	3	HVAC Systems for Buildings and Industry	A study of the system concepts, sizing, design, and equipment used for the heating, ventilation, and air conditioning systems in buildings (commercial and residential) as well as industrial applications.	S
MCHE 6860	3	Advanced Vehicle Manufacturing	Advanced analysis of ground and spaceflight vehicle manufacturing and assembly processes. Emphasis placed on the design, analysis, and manufacturing of automotive (e.g., passenger vehicles) and rocket spaceflight vehicle systems. Details the quantitative and qualitative components of manufacturing, material selection, material treatment, identification of processes used to manufacture, methods for quality control, and factory performance metrics as it relates to ground and space vehicular systems.	S
MCHE 8170	3	Advanced Heat Transfer	Conduction, convection, and radiation heat transfer will be covered from an analytical and applications viewpoint. Computer tools for solving heat transfer problems will be emphasized. Projects will involve the analyses of a research-related or design-related heat transfer problem involving at least two of the three heat transfer modalities.	S
MCHE 8250	3	Combustion Science	Fundamental concepts related to the use of combustion as a source of transportation energy and advanced combustion technologies. Topics include mathematics of combustion, characteristics and structure of flames, chemical thermodynamics/thermochemistry, chemical kinetics, potential energy surfaces, collision theory, and molecular structure of hydrocarbons and biofuels.	S
MCHE 8380	3	Continuum Mechanics	Continuum mechanics is concerned with the deformations and motions of continuous material media under the	S

			influence of external effects. This course will present various classic theories of solid and fluids. The theory of continuous media- the basic laws of motion and constitutive theory-will be discussed.	
MCHE 8500	3	Technical Foundations of Energy for Policy Practitioners	An in-depth study of the technical foundations appropriate and necessary for preparing practitioners to engage in the complex and diverse challenges of 21st-century energy policy development at state, national, and international levels. This will range from basic principles of energy conversion to analytical methods for translating technical energy concepts into implementable policy frameworks. All energy resources will be covered, with a particular focus on electric power generation.	S
MCHE 8650	3	Aerosol Science and Engineering	The tools required to analyze aerosol systems both as pollutants and vehicles for drug delivery. We start with fundamental aerosol concepts (size statistics, motion, thermodynamics, gas-particle interactions, coagulation, optical properties), and then use these concepts to investigate topical applications (pollution formation and control, aerosol-climate interactions, pharmaceutical aerosols).	S
MCHE 8850	3	Gas Dynamics	This course is concerned with the physics of gas flows in propulsion devices, including gas turbine and rocket engines. Emphasis is placed on fluid mechanics and thermodynamics, including compressible flow, shock waves, and supersonic wind tunnels. Specific topics include inlets and nozzles, combustors and afterburners, and rocket engine design and performance.	S
MCHE(CHEM) 8970	3	Combustion Science	Fundamental concepts related to the use of hydrocarbons and biofuels as a source of transportation energy for advanced combustion technologies. Topics include chemical bonding, theory/mathematics of combustion, chemical thermodynamics, chemical	S

			kinetics, potential energy surfaces, collision theory, ignition dynamics, pollutant formation, and related topics applied to combustion.	
MIST 6550	3	Energy Informatics	Energy Informatics involves analyzing, designing, and implementing systems to increase the efficiency of energy demand and supply systems. This requires the collection and analysis of data used to optimize energy distribution and consumption networks. Students will leverage the necessary information systems competencies and multi-disciplinary knowledge to increase societal energy efficiency.	S

Documentation of Approval and Notification

Proposal: Mechanical Engineering (M.S.)

College: College of Engineering

Department: School of Environmental, Civil, Agricultural, and Mechanical Engineering

Proposed Effective Term: Fall 2024

School/College:

- College of Engineering Curriculum Committee Chair, Dr. John Brocato, 12/7/23
- School of Environmental, Civil, Agricultural, and Mechanical Engineering Chair, Dr. Bjorn Birgisson, 12/7/23
- College of Engineering Assistant Dean for Academic and Faculty Affairs, Dr. Mable Fok, 12/7/23
- College of Engineering Dean, Dr. Donald Leo, 12/7/23
- Graduate School Associate Dean, Dr. Anne Shaffer, 2/7/24