



University Council

October 15, 2021

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Graduate Student Representative – Sarah Burns

Dear Colleagues:

The attached proposal from the College of Engineering for a new major in Biomedical Engineering (Ph.D.) will be an agenda item for the October 22, 2021, Full University Curriculum Committee meeting.

Sincerely,

Susan Sanchez, Chair

University Curriculum Committee

cc: Provost S. Jack Hu  
Dr. Rahul Shrivastav



**UNIVERSITY SYSTEM OF GEORGIA**

# USG Academic Degree Program Application

Released  
December 21, 2020

## Point of Contacts

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## Version Control

<i>Date</i>	<i>Changes</i>	<i>USG Approved date</i>	<i>Website update date</i>
12-18-2020	<i>Revised question 34 and 61 for clarity; Revised question 47 to include part b with the tuition comparison table for peer or competitive programs; reworded question 49 to include costs and benefits per fee; Revised question 50 related to additional costs to students; Revised question 51 to clarify the question related to indirect costs.</i>		

### NOTE:

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

^= indicates accreditation related content

### **USG Routing**

- Program was part of the Annual Academic Forecast*
- This proposal can be expedited (Nexus, established concentration with strong enrollment)*
- This proposal requires USG integrated review*

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## **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 Chemical, Materials, and Biomedical Engineering*
6. *Proposed Program Name: Biomedical Engineering (Ph.D.)*
7. *Major: Biomedical Engineering*
8. *CIP Code (6 digit): 14050101*
9. *Degree Level: Doctoral*
10. *Anticipated Implementation Semester and Year^: Fall 2022*

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 University of Georgia's Academic Forecast because it had not been submitted through the faculty governance process.

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

The field of biomedical engineering is very broad. It contributes to the advances in a variety of technical areas including biomaterials, tissue engineering, stem cells and regenerative medicine, cell and gene therapy, medical devices, bioinstrumentation, systems physiology, etc. The U.S. Bureau of Labor Statistics projects 5% growth in biomedical engineering jobs over the next 10 years, which is higher than the 4% growth

projected for all engineering jobs, and faster than the average for all occupations<sup>1</sup>. There are many engineering grand challenges that rely on biomedical engineering, such as engineering better medicines, reverse-engineering the brain, and advancing health informatics. The proposed Ph.D. program in Biomedical Engineering is committed to addressing the strategic goals and critical needs of the University of Georgia, the State of Georgia, and the United States in biomedical engineering research and education.

The state of Georgia is becoming one of the top U.S. states in biotechnology and providing a variety of incentives to attract pharmaceutical, medical device, and biotechnology companies. Such efforts for economic development are incomplete without a concomitant level of investment in degree programs which can generate an engineering workforce in support of these biomedical industries. As a public land-grant and sea-grant research university in the state of Georgia, the University of Georgia with its strengths in biomedical and chemical sciences has the liability and unique capability to implement a rigorous, broadly based biomedical engineering program to meet societal needs and become a U.S. leader in this critical discipline.

In the past decade, the University of Georgia has made tremendous progress in growing its engineering programs. With the establishment of its College of Engineering and School of Chemical, Materials, and Biomedical Engineering, the Biological Engineering B.S. and M.S. have been successfully developed and implemented for several years. The School of Chemical, Materials, and Biomedical Engineering has the infrastructure, research, and education resources and experience to further advance its biomedical engineering program to the Ph.D. level.

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

*Not applicable*

14. Specify **SACSCOC** or other accreditation organization requirements<sup>^</sup>.

Mark all that apply.

- Substantive change requiring notification only <sup>2</sup>
- Substantive change requiring approval prior to implementation <sup>3</sup>
- Level Change <sup>4</sup>

X None

## **B. STRATEGIC PLAN**

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

One of the missions of UGA is its commitment to excellence in public service, economic development, and technical assistance activities designed to address the strategic needs of the state of Georgia. The Biomedical Engineering (Ph.D.) program will fit the mission of the University of Georgia, as it provides

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<sup>1</sup> Bureau of Labor Statistics, U.S. Department of Labor, *Occupational Outlook Handbook*, Biomedical Engineers, at <https://www.bls.gov/ooh/architecture-and-engineering/biomedical-engineers.htm> (visited January 5, 2021).

<sup>2</sup> See page 22 (Requiring Notification Only) of [SACSCOC Substantive Change Policy and Procedures document](#).

<sup>3</sup> See page 17 (Requiring Approval Prior to Implementation) of [SACSCOC Substantive Change Policy and Procedures document](#).

<sup>4</sup> See page 3 (Level Change Application) of [SACSCOC Seeking Accreditation at a Higher or Lower Degree Level document](#) for level change requirements.

the necessary expertise of graduates in the high-demand areas of medical devices, pharmaceutical, and biotechnology industries. This program will support this mission of UGA by providing a well-trained workforce in biomedical engineering. In addition, this program will enhance life and physical sciences and public health programs at UGA.

This program will support the mission of the newly established School of Chemical, Materials, and Biomedical Engineering, which is housed in the College of Engineering, that will advance research with implications for public health and economic development. This major also fits in with national trends. In order to meet the immediate and growing demand from healthcare industries, many universities across the U.S. have heavily focused on biomedical engineering-related education and research. Indeed, as one of the newest engineering disciplines, the number of universities offering biomedical engineering degrees has increased from approximately 50 in 1990 to over 125 in 2020.

16. 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.”

The College of Engineering at UGA currently offers a Ph.D. in Engineering with an Area of Emphasis in Biomedical Engineering. The Area of Emphasis in Biomedical Engineering was developed as a short-term solution to allow the College of Engineering to build a graduate program when it was first formed in 2012. At that time, the only engineering Ph.D. program was Biological and Agricultural Engineering. The long-term goal was to develop free-standing Ph.D. programs once a critical mass of students was enrolled. The faculty in the School of Chemical, Materials, and Biomedical Engineering believe a critical mass has now been reached, as shown from recent growth in Ph.D. student enrollment. Upon approval of the Ph.D. program in Biomedical Engineering, the school will ask for the Area of Emphasis in Biomedical Engineering to be terminated.

### C. NEED

17. *Was this proposal and the design of the curriculum informed by talking with alumni, employers, and community representatives?*

No

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

The proposed Ph.D. program was discussed at the School of Chemical, Materials, and Biomedical Engineering Advisory Board meeting in December 2020. The board is comprised of representatives from industry (e.g., Kimberly Clark, Boehringer Ingelheim, GE Power Systems, etc.), a graduate school (Clemson University), and recent alumni. The board has expressed overall support for the creation of a new Ph.D. program and noted that this is consistent with the school’s goal to increase graduate student enrollment. Letters of support from members of the industry advisory board are included in the appendix.

18. *Does the program align with any local, regional, or state workforce strategies or plans?*

No

*Yes (If yes, please explain below)*

The state of Georgia is becoming one of the top U.S. states in biotechnology and is providing a variety of incentives to attract biotechnology and biomedical engineering companies. Such efforts for economic development are incomplete without a concomitant level of investment in degree programs which can generate an engineering workforce in support of these industries. As a public land-grant and sea-grant research university in the state of Georgia, the University of Georgia with its strengths in biological and chemical sciences has the unique capability to implement a rigorous, broadly based biomedical engineering program to meet societal needs and becomes the U.S. leader in this critical discipline.

In the past decade, the University of Georgia has made tremendous progress in growing its engineering programs. The University established a comprehensive College of Engineering in 2012 and School of Chemical, Materials, and Biomedical Engineering in 2017. Biological Engineering programs at the bachelor's and master's level were developed over 10 years ago and have been successfully implemented. Enrollment in the undergraduate program has grown to a five-year moving average of 270 students. Since the School was formed in 2017, four new faculty have been hired and have been active in biomedical engineering research and teaching. The School of Chemical, Materials, and Biomedical Engineering has the infrastructure, research and education resources, and experience to further advance its biomedical engineering program with a Ph.D. program.

19. Provide any additional evidence of regional demand for the program^ (e.g. prospective student interest survey data, community needs, letters of support from employers)

The global healthcare market reached a value of nearly \$8,452 billion in 2018, having grown at a compound annual growth rate (CAGR) of 7.3% since 2014, and is expected to grow at a CAGR of 8.9% to nearly \$11,908.9 billion by 2022. North America was the largest market for healthcare, accounting for 41.9% of the global market in 2018. According to the World Health Organization (WHO), there were 703 million persons aged 65 years or over in the world in 2019. The number of older persons is projected to double to 1.5 billion by 2050. The aging population demands more patient-centric healthcare services, which in return increases the demand for healthcare workers and agencies and is anticipated to drive market growth.

The College of Engineering at UGA currently offers a Ph.D. in Engineering with an Area of Emphasis in Biomedical Engineering. The Area of Emphasis in Biomedical Engineering was developed as a short-term solution to allow the College of Engineering to build a graduate program when it was first formed in 2012. At that time, the only engineering Ph.D. program was Biological and Agricultural Engineering. The long-term goal was to develop free-standing Ph.D. programs once a critical mass of students was enrolled. The faculty in the School of Chemical, Materials, and Biomedical Engineering believe a critical mass has now been reached, as shown from recent growth in Ph.D. student enrollment. Upon approval of the Ph.D. program in Biomedical Engineering, the school will ask for the Area of Emphasis in Biomedical Engineering to be terminated.

Anecdotal evidence obtained from current students indicates they prefer named majors as opposed to a generic major title in Engineering. Introducing a new Ph.D. major in Biomedical Engineering will help recruit more graduate students and subsequently increase research productivity. It will also enable the school to attract and retain the most talented faculty who are focused on building a strong and sustainable research program.

Many of UGA's peer and aspirational schools/departments already have named majors in their disciplines (see section 23 below) and those that do not are moving away from generalized Engineering Ph.D. programs (e.g., University of Nebraska). It is important for UGA to keep pace with other institutions to maintain competitiveness when recruiting doctoral students. Based on enrollment numbers at other universities, the increase in enrollment in engineering at the University of Georgia, and this

University's geographic location, we conservatively estimate 10-15 Ph.D. degrees conferred per year within five years.

20. *Identify the partners you are working with to create a career pipeline with this program*<sup>5</sup>.<sup>^</sup>

*Mark all that apply*

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<sup>5</sup> Provide letters of support and explain the collaboration and how partners will share or contribute resources. (Consider internal pipeline programs – “off-ramp program” Nursing to integrated health or MOUs for pathways with other USG institutions (pipelines – keep them in state for grad school if we can)



- High School CTAE
- High School STEM
- Career academies
- TCSG programs
- Other USG institutions
- Other universities
- Employers
- Community partnerships
- Professional associations
- Other (specify below)

This major was developed in conjunction with an advisory board, which included representatives from the industry, graduate schools, and recent alumni.

None

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

- No
- Yes (If yes, provide additional information about the competing program(s) below).

22. 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)

In Georgia, the Georgia Institute of Technology is the only institution in the University System of Georgia to offer a Biomedical Engineering Ph.D., through a joint department between Georgia Tech and Emory University (<https://catalog.gatech.edu/programs/biomedical-engineering-phd/>), and an

interdisciplinary Bioengineering Ph.D. program (<https://catalog.gatech.edu/programs/bioengineering-phd/>).

While Georgia Tech has a track record of producing high quality biomedical engineering graduates, there is a great need for more engineers in similar and unrelated fields. The proposed program will build on the distinctive strengths at UGA and offer students opportunities to collaborate on research projects with faculty in the College of Veterinary Medicine and the College of Pharmacy (currently, faculty in these colleges hold adjunct positions in the School of Chemical, Materials, and Biomedical Engineering). Additionally, faculty in the School of Chemical, Materials, and Biomedical Engineering actively participate in several interdisciplinary research centers that are unique to UGA such as the Regenerative Biosciences Center, the New Materials Institute, the Institute for Bioinformatics, and the Engineering Education Transformations Institute.

Additionally, multiple engineering faculty at UGA actively collaborate with Georgia Tech on large, multi-institution grants, such as the NSF funded Engineering Research Center for Cell Manufacturing Technologies. These collaborations build on complimentary expertise at both institutions and provide a comprehensive and convergent approach to addressing biomedical engineering challenges. A dedicated Biomedical Engineering (Ph.D.) program at UGA would help recruit additional students to supplement these efforts.

24. Based on the program’s study area, what is the employment outlook for occupations related to the program, according to the CIP to SOC crosswalk in the Qlik **IPEDS Application**<sup>^</sup>. 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.
- 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**.

Related Occupation	SOC code	Current Employment [Enter Year]	Projected Employment [Enter Year]	# Change	% Change	Average Annual Openings
Architectural and engineering managers	11-9041	198100	203200	5100	2.60	12500
Bioengineers and biomedical engineers	17-2031	21200	22200	1000	4.70	1400
Engineering teachers, postsecondary	25-1032	44600	48400	3800	8.60	3800

25. Using IPEDS data, list the supply of graduates in the program and related programs in the service area.<sup>^</sup>

Similar or Related Programs	CIP Code	Supply <sup>1</sup>	Competitor Institutions <sup>2</sup>
Bioengineering and Biomedical Engineering	14.0501	51 (Doctorate)	Georgia Institute of Technology


<sup>1</sup> Supply = Number of program graduates last year within the study area

<sup>2</sup> Competitors = List other institutions that offer this program or a similar program in the area (see [Question 23](#))

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?^

The Biomedical Engineering (Ph.D.) program is timely in the need to prepare professionals and experts for meeting present and emerging engineering needs for the local and regional medical device, pharmaceutical, and biotechnology industries and hospitals. The state of Georgia is becoming one of the top U.S. states in biotechnology and provides a variety of incentives to attract medical device, pharmaceutical, and biotechnology companies. According to the Georgia Power Bioscience database, Georgia is home to over 400 biotech companies that employ over 19,000 people, primarily located in Atlanta, Augusta, and Athens. Georgia ranked sixth among the fastest-growing states in bio-related occupational employment between 2012-2017 and ranks among the top 15 states for overall bio-related occupational employment. In particular, Atlanta ranks third in research facility space among all U.S. bioscience clusters. With a highly educated workforce, renowned research institutions, cutting-edge technological resources, and global access through the Atlanta International airport, Georgia attracts billions in federal and private dollars, creating some of the nation’s leading bio research centers of excellence, which promotes fast and resilient growth among bio companies. In 2019, Georgia Bio reported: “From 2007 to 2017, employment in life sciences grew by 14.9%, compared to 7.7% nationally, and 8.7% growth in private employment across all industries in the state.” The report identified 1,960 unique life science establishments that contributed 68,300 jobs and \$10 billion to Georgia’s Gross Domestic Product. Accounting for multiplier effects, the industry supports a total of approximately 194,000 jobs and contributes \$21.8 billion to Georgia’s GDP. This represents 3.7% of Georgia’s total non-farm employment and 3.7% of Georgia’s 2016 GDP. To sustain such a strong growth and technological innovation, the needs of biomedical engineering graduates which have extensive training in both life science and engineering for local and regional employers are increasing significantly. The proposed Biomedical Engineering (Ph.D.) program would immediately address these local and regional needs.

27. Using data from **O\*-Net**, identify the average salary for the related occupations identified in question 24. 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](http://onetonline.org). (Standard Occupation Code = SOC)

SOC Code (6 digit)	Average Salary (O-Net data)	Occupation specific technology skills & KSAs
11-9041	\$69.63 hourly, \$144,830 annual	<a href="https://www.onetonline.org/link/summary/11-9041.00">https://www.onetonline.org/link/summary/11-9041.00</a>
17-2031	\$43.95 hourly, \$91,410 annual	<a href="https://www.onetonline.org/link/summary/17-2031.00">https://www.onetonline.org/link/summary/17-2031.00</a>
25-1032	\$101,010 annual	<a href="https://www.onetonline.org/link/summary/25-1032.00">https://www.onetonline.org/link/summary/25-1032.00</a>

Notes:

28. Using **GOSA Earning and Learnings data**, what is the typical salary range 5 years after graduation from the program?

Average Salary	75 <sup>th</sup> Percentile	50 <sup>th</sup> Percentile	25 <sup>th</sup> Percentile
1 year after graduation			
5 years after graduation			

Provide any additional comments, if needed:

No data is available for Ph.D. engineering graduates from GOSA Earning and Learning data

29. 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 global healthcare market reached a value of nearly \$8,452 billion in 2018, having grown at a compound annual growth rate (CAGR) of 7.3% since 2014, and is expected to grow at a CAGR of 8.9% to nearly \$11,908.9 billion by 2022. North America was the largest market for healthcare, accounting for 41.9% of the global market in 2018. According to the World Health Organization (WHO), there were 703 million persons aged 65 years or over in the world in 2019. The number of older persons is projected to double to 1.5 billion by 2050. The aging population demands more patient-centric healthcare services, which in return increases the demand for healthcare workers and agencies and is anticipated to drive market growth.

#### D. CURRICULUM

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

72

31. 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)

32. Related to SACSCOC accreditation, specify if the program format of the proposed program is a^:

Format (Check 1)	50% or more of the program is delivered online
<input type="checkbox"/> Combination of on-campus and online	<input type="checkbox"/> Yes
<input type="checkbox"/> Combination of off-campus and online	<input type="checkbox"/> Yes
<input type="checkbox"/> Hybrid, combination delivery	<input type="checkbox"/> Yes

33. Is the program synchronous or asynchronous?<sup>6</sup> Mark one of the options below.

<sup>6</sup> See SACSCOC Handbook for Institutions Seeking Initial Accreditation [here](#).

*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*

34. For associate's, Nexus, and bachelor's degree proposals, which **High Impact Practices**<sup>7</sup> (HIPs) will faculty embed into the program? Mark all that apply.

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

35. 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.

(i.e. "Students will be required to participate in an externship during their third year of enrollment, in order to develop skills in... etc.").

Not Applicable

36. *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: Specify Initiative Here*

37. ^For associate's, Nexus, and bachelor's degree proposals, list the specific occupational technical skills, and KSAs identified in question 27 and show how they related to the program learning outcomes. Insert more rows as needed.

Complete this chart for the upper division or major curriculum only.

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<sup>7</sup> 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).

<sup>1</sup> Direct measures may include assessments, HIPs, exams, etc.

38. For associate's, Nexus, and bachelor's 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) <sup>1</sup>
Critical Thinking/Problem Solving		
Oral/Written Communications		
Team Work/ Collaboration		
Digital Technology		
Leadership		
Professionalism/ Work Ethic		
Career Management		
Global/Intercultural Fluency		

<sup>1</sup> Direct measures may include assessments, HIPs, exams, etc.

Alignment of Occupational KSAs <sup>1</sup>	Student Learning Outcome (s)	Direct Measure (s)	Data Source

39. How will learning outcomes for the program be assessed?^ Attach the curriculum map for the upper division or major curriculum.

The assessment of the program will be conducted by the School of Chemical, Materials, and Biomedical Engineering graduate faculty working in conjunction with the College of Engineering Director of Assessment and the College of Engineering Graduate Manager. The results of the assessment annual evaluation will be reported to the School of Chemical, Materials, and Biomedical Engineering graduate faculty and the CMBE External Advisory Board for their use in program development.

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 biomedical 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 biomedical 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 dissertation defense. An assessment rubric has been developed by the College of Engineering and is currently used for assessment of students in the Ph.D. Engineering program.

Indirect assessment of student learning outcomes will be undertaken with a student exit survey.

40. 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:** Biochemical Engineering (Ph.D.) alumni will be asked to complete a Qualtrics survey every 3 years which assesses employment and placement rates, and if their education is of value in their current position. This survey will also aid in determining specific courses and research areas in the Biochemical Engineering program that are considered the most relevant to the industry and if new areas

need to be incorporated into the program of study. The Graduate Program Manager 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 Biochemical Engineering (Ph.D.) program has identified two primary constituencies: the *biochemical engineering industry* and *biochemical engineering alumni*. The School of Chemical, Materials and Biomedical Engineering advisory board is comprised of representatives from both of these constituent groups. Each member of the board serves a three-year term; at the completion of the term each member can opt to step down from the board or commence another three-year term. 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 and apparent disparity exists between the constituencies' needs a special faculty meeting is 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.

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

Include course: prefixes, numbers, titles, and credit hour requirements

Indicate the word "new" beside new courses

Include a program of study

Minimum requirement – 72 credit hours (minimum of 28 credit hours course work; minimum of 44 credit hours research and dissertation)

A thesis master's degree from an accredited university may be accepted for up to 30 credit hours, in which case a minimum of 42 credit hours of approved course work, research, and dissertation beyond the M.S. degree would be required.

Required Advanced Engineering Core Courses (13 credit hours):

- BCHE(BIOE) 8970, Bioengineering Seminar (4 semesters, 4 credit hours)\*
- BIOE 8510, Dynamic Systems Modeling of Physiology and Pharmacology (3 credit hours)
- BIOS 7010, Introductory Biostatistics I (3 credit hours) *or*  
ENGR 8103, Computational Engineering: Fundamentals, Elliptic, and Parabolic Differential Equations (3 credit hours)
- ENGR 8910, Foundations for Engineering Research (3 credit hours)

Required Biomedical Engineering Core Courses - choose **any two** of the following (6 credit hours):

- BCHE 8150, Heterogeneous Reactor Design and Bio/Catalysis (3 credit hours)
- BIOE 8210, Multiscale Biomechanics (3 credit hours)
- BIOE 8490, Advanced Biomaterials (3 credit hours)
- BIOE 8530, Advanced Biomedical Instrumentation (3 credit hours)
- ENGR 8180, Advanced Mass Transfer (3 credit hours)

Electives (9 credit hours):

Minimum of 9 additional credit hours of course work selected with the approval of the student's Graduate Advisory Committee. At least 3 hours must be 8000-level or above, and at least 3 hours must be courses offered by the College of Engineering. The University requires that students who are accepted to the Ph.D. program directly from a B.S. degree or who switch to a Ph.D. program before earning an M.S. degree must complete an additional 4 semester hours of University of Georgia courses open only to graduate students.



Approved Electives:

- BIOE(CHEM) 6615, Soft Materials (3 credit hours)
- BIOE 6625, Tissue Engineering (3 credit hours)
- BCHE(BIOE) 6650, Animal Cell Biomanufacturing (3 credit hours)
- BIOE 6720, Human Factors and Ergonomics in Biomedical Device Design (3 credit hours) *or* BIOE 6720E, Human Factors and Ergonomics in Biomedical Device Design (3 credit hours)
- BIOE 6740, Biomaterials (3 credit hours)
- BIOE 6760, Biomechanics (3 credit hours)
- BIOE 6780, Regulations and Ethics in Biomedical Engineering (3 credit hours)
- BIOE 8120, Regenerative Medicine, Cell Manufacturing and Society (3 credit hours)
- ADSC(BIOE) 8240, Engineering Stem Cell Therapeutics (3 credit hours)
- BIOE 8980, Advanced Topics in Biological Engineering (Variable 1-3 credit hours)

Research and Dissertation (45 credit hours):

- A minimum of 42 hours of Doctoral Research (ENGR 9000) or Project-Focused Doctoral Research (ENGR 9010). Typically, students complete more than 42 credit hours with the approval of the Graduate Advisory Committee.
- 3 hours of Ph.D. Dissertation (ENGR 9300) is required on the Plan of Study.

*\* Only 3 hours of Bioengineering Seminar may apply on the Program of Study and be included in the 72-credit hour requirement. Students are strongly encouraged to continue regular attendance at speaker series presentations even if not formally registered in the seminar.*

Example Program of Study:

YEAR ONE					
<u>Fall Semester</u>		<u>Hours</u>	<u>Spring Semester</u>		<u>Hours</u>
BCHE(BIOE) 8970	Bioengineering Seminar	1	BCHE(BIOE) 8970	Bioengineering Seminar	1
BIOE 8510	Dynamic Systems Modeling of Physiology and Pharmacology	3	BIOE 8490	Advanced Biomaterials	3
ENGR 8910	Foundations for Engineering Research	3	ENGR 8103	Computational Engineering: Fundamentals, Elliptic, and Parabolic Differential Equations	3
ENGR 9000	Doctoral Research	2	ENGR 9000	Doctoral Research	2
<b>Total Credit Hours</b>		<b>9</b>	<b>Total Credit Hours</b>		<b>9</b>
<u>Summer</u>					
ENGR 9000	Doctoral Research	9			
<b>Total Credit Hours</b>		<b>9</b>			
YEAR TWO					
<u>Fall Semester</u>		<u>Hours</u>	<u>Spring Semester</u>		<u>Hours</u>
	Elective	3		Elective	3
BCHE 8150	Heterogeneous Reactor Design and Bio/Catalysis	3		Elective	3

BCHE(BIOE) 8970	Bioengineering Seminar	1	BCHE(BIOE) 8970	Bioengineering Seminar	1
ENGR 9000	Doctoral Research	2	ENGR 9000	Doctoral Research	2
<b>Total Credit Hours</b>		<b>9</b>	<b>Total Credit Hours</b>		<b>9</b>

**Summer**

ENGR 9000	Doctoral Research	9
<b>Total Credit Hours</b>		<b>9</b>

**YEAR THREE**

<b>Fall Semester</b>		<b>Hours</b>	<b>Spring Semester</b>		<b>Hours</b>
	Elective	3	ENGR 9000	Doctoral Research	6
ENGR 9000	Doctoral Research	6	ENGR 9300	Doctoral Dissertation	3
<b>Total Credit Hours</b>		<b>9</b>	<b>Total Credit Hours</b>		<b>9</b>

**E. IMPLEMENTATION**

42. Provide an enrollment projection for the next four academic years<sup>^</sup>

	Year 1	Year 2	Year 3	Year 4
Fiscal Year (Fall to Summer)	2022-23	2023-24	2024-25	2025-26
Base enrollment <sup>†</sup>		14	15	18
Lost to Attrition (should be negative)		0	0	0
New to the institution	4	5	8	10
Shifted from Other programs within your institution	15	0	0	0
<b>Total Enrollment</b>	<b>19</b>	<b>19</b>	<b>23</b>	<b>28</b>
Graduates	5	4	5	5
Carry forward base enrollment for next year	14	15	18	23

<sup>†</sup>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 Chemical, Materials, and Biomedical Engineering currently advise students enrolled in the Engineering (Ph.D.) program with an Area of Emphasis in Biomedical Engineering. In fall 2020, 19 students were enrolled in the Engineering Ph.D. with an Area of Emphasis in Biomedical Engineering; all of these students are expected to switch to the new Biomedical Engineering program.

Historical data indicate for the previous three years the college consistently recruited 4.33 new students to the Engineering Ph.D. with an Area of Emphasis in Biomedical Engineering each academic year and graduate 20-25% of current students. The school fully expects to sustain a program enrollment of at least 20 students and anticipates enrollment will increase in future years as an additional four faculty members are recruited through the current Presidential Cluster Hiring Initiatives.

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

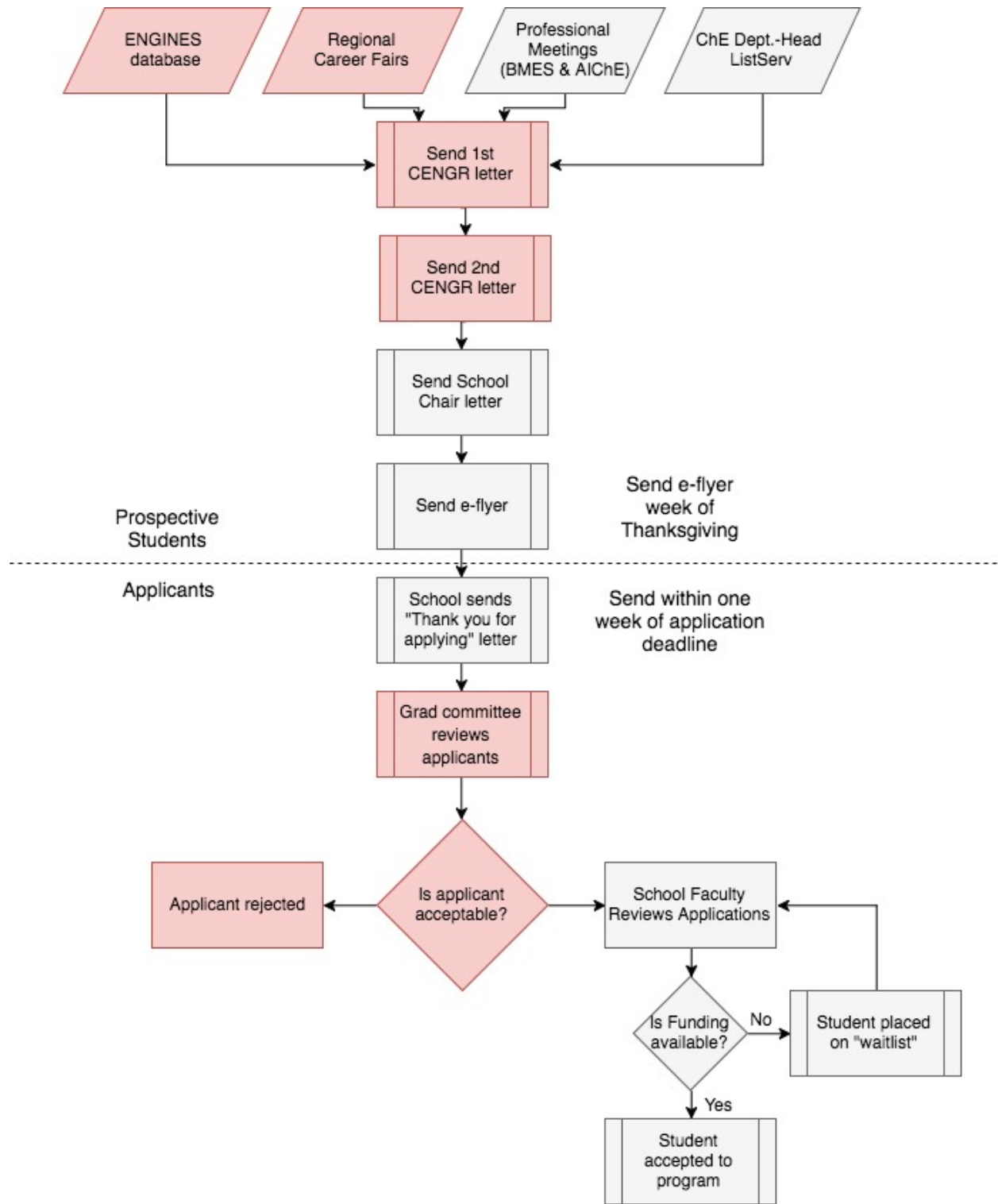
43. If projected program enrollment is not realized in year two, what actions are you prepared to take?

In the event that program enrollment is not realized, the school will increase recruitment activities by increasing social media presence, advertising in relevant print and online publications, such as *ASEE First Bell* and *Genetic Engineering & Biotechnology News*, and by proactively encouraging current undergraduate and M.S. students to pursue this Ph.D. program.

44. 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 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 Biomedical Engineering Society (BMES), the American Institute for Chemical Engineering (AIChE) and the Applied Biomedical Research Conference for Minority Students (ABRCMS), and the Biomedical Engineering Society Council of Chairs list-serv. During the past two years, the school has worked with Hybrid News who have published a number of bespoke articles about the school and its research in *Study International*. These articles have been read by almost 50,000 individuals worldwide and drives traffic to the school's website. The program will be prominently displayed on the school's newly developed website.

The flow chart for student recruitment is presented below.



45. Provide a brief marketing description for the program that can be used on the Georgia [OnMyLine website](#).

The Ph.D. in Biomedical Engineering provides maximum flexibility for students to address 21st century challenges through their studies and research. Within the biomedical engineering degree, students tackle research problems that address the need for new biomaterials for medical devices that prevent infection and coagulation, novel stem cell therapies to combat cancer, and computational models to understand disease progression and pharmacological treatments.

46. 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

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

**Dr. Raj Rao**

Department Head  
University of Arkansas  
rajrao@uark.edu  
(479) 575-4667

**Dr. Christine Schmidt**

Department Chair  
University of Florida  
schmidt@bme.ufl.edu  
(352) 273-9222

**Dr. Martine LaBerge**

Professor and Chair  
Clemson University  
laberge@clemson.edu  
(864) 656-5557

**Dr. Krishnendu Roy**

Professor and Director  
Georgia Institute of Technology  
krishnendu.roy@bme.gatech.edu  
(404) 385-6166

**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.)

47. 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

48. 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. The school will not need to create new sections of any existing courses to meet any additional demand.

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

Not applicable.

50. 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.

51. 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. The school will utilize the current resources (personnel, library, equipment, laboratory, and computing) available at the school, college, and university levels.

**F2. Faculty**<sup>^</sup> – Explain your faculty and staff plan for the program

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

a. Course Development

# of total courses in the curriculum:	<b>22</b>
# of existing courses to be part of the new program	<b>22</b>
Net number of new courses to be developed	<b>0</b>

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

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

53. Explain how **current faculty and staff** will contribute to the program.<sup>^</sup>

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

**13**

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 Chemical, Materials, and Biomedical Engineering has 10 faculty currently teaching courses that are directly related to the proposed program of study or who are performing biomedical engineering research. These faculty will be the major professors for students enrolled in the proposed Ph.D. program. An additional three faculty in the College of Engineering teach courses that will be required in the proposed program of study. No new sections of existing courses will be created and therefore, teaching loads for existing faculty will remain the same. The courses are currently part of the existing Area of Emphasis in Biomedical Engineering under the Engineering (Ph.D.) major and 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 directed 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 Biomedical Engineering that will be eliminated when the new major is approved.

- 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

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

No new courses are being developed for this major. It will not be necessary to offer new or additional sections of the courses in this program.

- 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 <i>% EFT Research, Instruction, Service</i>	Other Qualifications and Comments <i>Research Areas</i>
Elizabeth Brisbois	Assistant Professor	<b>Spring:</b> BIOE 8980, Advanced Topics in Biological Engineering, 3.0 (G)	Ph.D., Chemistry, University of Michigan, USA, 2014  M.S., Chemistry, University of Michigan, USA, 2010  B.S., Chemistry, Concordia University – Nebraska, USA, 2008  B.S.Ed., Secondary Education, Concordia University – Nebraska, USA, 2008	50% R 50% I	<ul style="list-style-type: none"> <li>• Antimicrobial and Hemocompatible Interfaces</li> <li>• Anti-inflammatory Biomaterials</li> <li>• Insulin Delivery</li> <li>• Polymer and Small Molecule Chemistry</li> <li>• Tissue Engineering and Biomaterials</li> </ul>
Eric Freeman	Assistant Professor	<b>Spring:</b> BIOE 6760, Biomechanics, 3.0 (UG/G)	Ph.D., Mechanical Engineering, University of Pittsburgh, 2012  M.S., Mechanical Engineering, University of Pittsburgh, 2009  B.S., Mechanical Engineering, Geneva College, 2006	50% R 50% I	<ul style="list-style-type: none"> <li>• Smart materials</li> <li>• Biologically-inspired materials</li> <li>• Electrophysiology</li> <li>• Model membranes</li> <li>• Drug delivery</li> <li>• Numerical methods</li> <li>• Computational mechanics</li> </ul>
Cheryl Gomillion	Assistant Professor	<b>Fall:</b> BIOE 6625*, Tissue Engineering, 3.0 (UG/G)	Ph.D., Bioengineering, Clemson University, 2010	60% R 40% I	<ul style="list-style-type: none"> <li>• Tissue Engineering &amp; Regenerative Medicine</li> <li>• Cell-Biomaterial Interactions</li> </ul>



			M.S., Bioengineering, Clemson University, 2005  B.S., Biosystems Engineering, Clemson University, 2003		<ul style="list-style-type: none"> <li>• Multi-functional Biomaterials</li> <li>• Pre-Clinical Tissue Modeling Systems</li> <li>• Cell-based Therapeutic</li> </ul>
K. Melissa Hallow	Associate Professor	<b>Fall:</b> BIOE 8510, Dynamic Systems Modeling of Physiology and Pharmacology, 3.0 (G)	Ph.D. Mechanical Engineering, Georgia Institute of Technology, 2007  B.S. Mechanical Engineering, Georgia Institute of Technology, 2002	50% R 50% I	<ul style="list-style-type: none"> <li>• Dynamic modeling of physiology</li> <li>• Pharmacology</li> <li>• Cardiovascular disease, renal disease, and diabetes progression</li> </ul>
Hitesh Handa	Associate Professor	<b>Fall &amp; Spring:</b> BCHE(BIOE) 8970, Bioengineering Seminar, 1.0 (G)  <b>Fall:</b> BIOE 6740, Biomaterials, 3.0 (UG/G)  <b>Spring:</b> BIOE 8490, Advanced Biomaterials, 3.0 (G)	Ph.D., Material Science & Engineering, Wayne State University, 2008  B.E., Poly. Sci. and Chem. Tech., Delhi University, India, 2002	60% R 40% I	<ul style="list-style-type: none"> <li>• Biomaterials for Medical Device Applications</li> <li>• Nitric Oxide Releasing Materials</li> <li>• Blood-Material Interactions</li> <li>• Antimicrobial and Hemocompatible Materials</li> <li>• Wound Healing Material</li> </ul>
Jim Kastner	Associate Professor	<b>Fall (Alternate years):</b> BCHE 8150, Heterogeneous Reactor Design and Bio/Catalysis, 3.0 (G)  <b>Fall (Alternate years):</b> ENGR 8180, Advanced Mass Transport, 3.0 (G)	Ph.D., Applied Biology, Georgia Institute of Technology, 1993  M.S., Chemical Engineering, Mississippi State University, 1987  B.S., Chemical Engineering (Magna Cum Laude) and Biochemistry (Cum Laude), Mississippi State University, 1984 (CHE) and 1983 (BCHM)	60% R 40% I	<ul style="list-style-type: none"> <li>• Biochemical engineering</li> <li>• Environmental, nanostructured and chemical catalysts</li> <li>• Enhanced biomass pyrolysis and gasification processes</li> </ul>
Caner Kazanci	Associate Professor	<b>Fall:</b> ENGR 8103, Computational Engineering: Fundamentals, Elliptic, and Parabolic Differential Equations, 3.0 (G)	Ph.D., Mathematical Sciences, Carnegie Mellon University, 2005  M.S., Mathematical Sciences, Carnegie Mellon University, 2000  B.S., Mathematics, Bilkent University in Ankara, Turkey, 1999	50% R 50% I	<ul style="list-style-type: none"> <li>• Biological and ecological modeling, simulation and analysis.</li> <li>• Numerical analysis, dynamical systems.</li> <li>• Ecological network analysis (ENA), ecological thermodynamics.</li> <li>• Stochastic modeling tools, individual based modeling.</li> </ul>

					<ul style="list-style-type: none"> <li>• Collective behavior of large biochemical reaction networks, the relation between network structure and system dynamics.</li> </ul>
William Kisaalita	Professor	<p><b>Fall:</b> BIOE 6720, Human Factors and Ergonomics in Biomedical Device Design, 3.0 (UG/G)</p> <p>ENGR 8910, Foundations for Engineering Research, 3.0 (G)</p>	<p>Ph.D., Chemical Engineering, University of British Columbia, Canada, 1987</p> <p>M.A.Sc., Bio-Resource Engineering, University of British Columbia, Canada, 1982</p> <p>B.Sc. (Eng) (Hons), Mechanical Engineering, Makerere University, Uganda, 1979</p>	50% R 50% I	<ul style="list-style-type: none"> <li>• Tissue engineering</li> <li>• Cell-surface interaction</li> <li>• Assays for high throughput screening (HTS)</li> <li>• Renewable energy utilization with emphasis on biogas-powered cooling</li> <li>• Global service learning</li> </ul>
Jason Locklin	Professor	<p><b>Fall:</b> BIOE 6615, Soft Materials, 3.0 (UG/G)</p>	<p>Ph.D., University of Houston, 2004</p> <p>M.S., Chemistry, University of Alabama, 2002</p> <p>B.S., Chemistry, Millsaps College, 1999</p>	50% R 25% I 25% A	<ul style="list-style-type: none"> <li>• Organic thin films</li> <li>• Polymers</li> <li>• Soft materials</li> <li>• Smart surfaces</li> <li>• Interfacial characterization</li> <li>• Organic electronics</li> </ul>
Ross Marklein	Assistant Professor	<p><b>Fall:</b> BIOE 6780 Regulations and Ethics in Biomedical Engineering, 3.0 (UG/G)</p> <p><b>Spring:</b> BIOE 6740 Biomaterials, 3.0 (UG/G)</p>	<p>Ph.D., Bioengineering, University of Pennsylvania, 2012</p> <p>B.S., Biomedical Engineering, Georgia Institute of Technology, 2007</p>	50% R 50% I	<ul style="list-style-type: none"> <li>• Cell Manufacturing</li> <li>• Single Cell Analysis</li> <li>• High Content Imaging</li> <li>• Biomaterials</li> <li>• Tissue Engineering/Regenerative Medicine</li> <li>• Stem Cell Biology</li> </ul>
Luke Mortensen	Associate Professor	<p><b>Fall:</b> ADSC(BIOE) 8240 Engineering Stem Cell Therapeutics, 3.0 (G)</p>	<p>Ph.D., Biomedical Engineering, University of Rochester, 2011</p>	85% R 15% I	<ul style="list-style-type: none"> <li>• Intravital imaging</li> <li>• Multi photon microscopy</li> <li>• Confocal microscopy</li> <li>• Laser ablation</li> <li>• Cell therapy</li> <li>• Regenerative medicine</li> </ul>
James Warnock	School Chair and Professor	<p><b>Spring:</b> BCHE(BIOE) 6650 Animal Cell Biomanufacturing, 3.0 (UG/G)</p> <p>BIOE 8120, Regenerative Medicine, Cell Manufacturing and Society, 3.0 (G)</p>	<p>Ph.D. Chemical Engineering, University of Birmingham, UK, 2003</p> <p>M.Sc., Biochemical Engineering, University of Birmingham, UK, 1999</p> <p>B.Sc., Biological Science, University of Wolverhampton, UK, 1998</p>	12.5% R 12.5% I 75% A	<ul style="list-style-type: none"> <li>• Cell and Gene Manufacturing</li> <li>• Tissue Engineering</li> <li>• Workforce Development</li> </ul>

Clifton Brock Woodson	Associate Professor	<b>Spring:</b> CVLE(MCHE) 8160, Advanced Fluid Mechanics, 3.0 (G)	Ph.D., Civil Engineering, Georgia Institute of Technology, 2005  M.S., Civil Engineering, Georgia Institute of Technology, 1999  B.S., Civil Engineering, Georgia Institute of Technology, 1998	50% R 50% I	<ul style="list-style-type: none"> <li>• Environmental Fluid Mechanics;</li> <li>• Mixing and Transport Processes</li> <li>• Coastal Oceanography</li> <li>• Biophysical Interaction in the Ocean</li> <li>• Fisheries</li> <li>• Climate Change</li> <li>• Sustainable Use of Marine Ecosystems</li> </ul>
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\*Course change in progress

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

a. *How many new faculty will be needed for this program over the next four years?*

Explanation: No additional faculty are required to offer the degree program. However, the School of Chemical, Materials, and Biomedical Engineering have been authorized to recruit four new faculty over the next two fiscal years as part of the Presidential Cluster Hiring Initiatives. These new faculty members will be part of the Dynamics of Infectious Diseases cluster (2) and the Precision One Health cluster (2).

55. *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:**

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

- Main campus
- Satellite campus: Specify Here
- Other: Specify Here
- 100% Online

57. Will new or renovated facilities or space be needed for this program over the next four years?

- No
- Yes (*If yes, complete the table below, inserting additional rows as needed*).

**Capital Costs for Needed Facilities and Space**

---

Facility/Space Name	Gross Square Footage	Start Up Costs	Ongoing Costs	Est. Occupancy Date	Funding Source
<b>New Construction</b>					
<b>Renovations and Infrastructure*</b>					
<b>Purchases: Land, Buildings etc.</b>					
<b>Lease space</b>					
<b>TOTAL Cost</b>		<b>\$0</b>	<b>\$0</b>		

\*Include the name of the building or location being impacted and what will need to be done.  
 Infrastructure includes new systems such as: water, electrical, IT networks, HVAC etc.

58. Discuss the impact of construction or renovation on existing campus activities and how disruptions will be mitigated. Explain how existing programs benefit from new facilities and/or space(s) and changes to existing space.

*Not applicable*

59. Will any existing programs be negatively impacted (e.g. lose classroom or office space) by proposed facility changes? If so, discuss how the impacts of these changes will be mitigated. ^

*No*

60. Are any of these new facilities or major renovations listed in the table above (**Question 57**) **NOT** included in the institution-level facilities master plan?

*N/A*

61. Will any of the following types of space be required: instructional, fine arts, meeting, study, or dedicated office?

No (Move to Question 63).

Yes (*If yes, complete question 62. Insert additional rows as needed.*)

62. 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)				
Wet Labs (STEM related)				
Dedicated Offices				
Fine Arts Spaces <sup>1</sup>				
Classrooms				
Meeting Rooms				
Student Study Space				
Other (Specify)				

<sup>1</sup>Fine arts spaces can include theatres, recital halls, visual arts studios, performing arts centers, recording studios, design labs, and other performance venues.

63. Are there facility needs related to accreditation? ^ Are there any accreditation standards or guidelines that will impact facilities/space needs now or in the future? If so, please describe the projected impact.  
N/A

**F4. Technology**

64. 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				
<b>Total Technology Costs</b>		<b>0</b>	<b>0</b>	

**G. RISKS AND ASSUMPTIONS**

65. 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 a concentration with a robust enrollment. Therefore, there is no assumed risk in implementing it as a major.

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

The school is assuming that students currently enrolled in the Ph.D. in Engineering with an Area of Emphasis in Biomedical Engineering will transfer to the new major.

**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
ADSC(BIOE) 8240	3	Engineering Stem Cell Therapies	An overview of stem cell therapy and strategies to enhance therapeutic applications of cells in human disease. The course will emphasize the basic biology of stem cells, methods for “engineering” cell behavior, animal models of disease, and methods of analysis.	E
BCHE 8150	3	Heterogeneous Reactor Design & Bio/Catalysis	Kinetics and reactor design of heterogeneous reactions; i.e., reactions in which the substrate (reactant) and bio/catalyst are initially in two separate phases. Simulation of processes using heterogeneous catalysis. The course will briefly introduce homogenous kinetics and methods of chemical catalyst characterization, preparation, and mechanisms of action.	R
BCHE(BIOE) 8970	1	Bioengineering Seminar	Seminar series on broad topics in biochemical, chemical, materials, and medical-related engineering disciplines.	R
BIOE(CHEM) 6615	3	Soft Materials	Introduction to soft condensed matter, including the general aspects of chemistry, physical properties, structure and dynamics, and applications of soft materials (including polymers, colloids, liquid crystals, amphiphiles, gels, and biomaterials). Emphasis is placed on the molecular forces related to self-assembly.	E
BIOE 6625	3	Tissue Engineering	The fundamentals of science and engineering design related to replacement organs and tissues.	E
BCHE(BIOE) 6650	3	Animal Cell Biomanufacturing	Biochemical engineering concepts related to large-scale animal cell biotechnology and scalable manufacturing of cellular products, such as recombinant proteins, monoclonal antibodies, viral vaccines, therapeutic cells, and gene therapy vectors. Working in small groups, students will address a range of contemporary problems.	E
BIOE 6720	3	Human Factors and Ergonomics in Biomedical Device Design	Introduction of the application of human factors and ergonomics in the design of biomedical devices as well as the regulatory framework for device pre-market approval.	E
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.	E
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.	E

BIOE 6780	3	Regulations & Ethics in Biomedical Engineering	Ethical issues in biomedical engineering; responsible conduct of research, concepts of good lab and clinical practices, ethical issues, and case studies. Food and Drug Administration (FDA) regulatory pathways and approval procedures. Commercialization and technology transfer.	E
BIOE 8120	3	Regenerative Medicine, Cell Manufacturing & Society	Designed to introduce advanced students working in cell biology and regenerative medicine research to ethical, policy, and social issues relevant to the field, specifically stem cell research.	E
BIOE 8210	3	Multiscale Biomechanics	Designed for students to study advanced concepts in multiscale biomechanics at the molecular and cellular levels. Advanced biomolecular and cellular biomechanics topics will be covered. Students will learn advanced theoretical and advanced experimental topics related to biomechanics.	R
BIOE 8490	3	Advanced Biomaterials	Advanced concepts of biomedical engineering, materials science, and chemistry, including interactions between materials and blood/bacteria/cells/tissues and the development of biomaterials, their clinical applications, and animal models used to evaluate biomaterials.	R
BIOE 8510	3	Dynamic Systems Modeling of Physiology and Pharmacology	Mathematical and computation techniques for dynamic modeling of physiological and pharmacologic systems across multiple scales from intracellular to tissue to organ level. Lectures provide biological background and describe classical and more recent models. Hands-on exercises in Matlab are used to develop skills in generating, analyzing, and utilizing systems models.	R
BIOE 8530	3	Advanced Biomedical Instrumentation	The study of advanced concepts in biomedical instrumentation from a systems viewpoint. Advanced physiological and electro-physiological concepts will be covered in this course. Students will learn advanced theoretical and advanced biomedical instrumentation concepts.	R
BIOS 7010	3	Introductory Biostatistics I	Introductory statistics with applications to medical and biological problems. Topics to be covered include biostatistical design in health research, data collection and management, and introductory concepts and methods of statistical data analysis.	R
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.	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 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 9000	Variable	Doctoral Research	Research while enrolled for a doctoral degree under the direction of faculty members.	R
ENGR 9010	Variable	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

September 3, 2021

Dr. James Warnock  
School of Chemical, Materials and Biomedical Engineering  
University of Georgia,  
Athens, GA

Dear James,

It is my pleasure to provide this letter in support of your proposal for a new PhD degree program in biochemical engineering/biomedical engineering. As you are aware, I have had the privilege of serving on the Advisory Board for the School of Chemical, Materials and Biomedical Engineering for 6 years. This new program will be an excellent addition to the academic programs already offered to students.

I am currently employed by Danimer Scientific and have worked in the industry for 13 years. My current role at Danimer is multifaceted, I serve as Senior Director of R&D, Director of Analytical Services, and Director of the Athens Research Center. Danimer is biopolymer company that produces sustainable solutions for customers using renewable resources to replace single-use plastics. As a long-time supporter of UGA and a PhD alumnus, I believe the addition of these degrees will be very impactful for Danimer. We have recently hired 7 bachelor level Engineers in these departments and have supported 3 master's students over the last several years. Adding these programs will allow Danimer to tap into an even more qualified skillset and continue to grow our mission to mitigate plastic pollution.

It is my hope that the proposed degree program(s) will be approved by the University and the Board of Regents prior to the fall 2022 semester. I am happy to provide additional input as needed and please do not hesitate to contact me.

Best regards,



Joe Grubbs, PhD  
Senior Director of R&D  
Director of Athens Research Center  
Director of Analytical Services

September 8, 2021

School of Chemical, Materials and Biomedical Engineering  
University of Georgia  
Athens, GA 30602

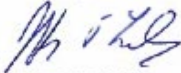
Dear James Warnock:

It is my pleasure to provide this letter in support of your proposal for a new PhD degree program in biomedical engineering. As you are aware, I have had the privilege of serving on the Advisory Board for the School of Chemical, Materials and Biomedical Engineering for nearly 6 years. This new program will be an excellent addition to the academic programs already offered to students.

I am a Senior Fiber Optic Engineer at Intuitive and I have been with the company for over seven years, with over ten years of experience working in the field of biomedical engineering. Since 1995, Intuitive has advanced minimally invasive care as one of the pioneers of robotic-assisted surgery through our da Vinci surgical system. We have thousands of employees in multiple offices around the world including our campus in Peachtree Corners, Georgia. We typically recruit highly qualified candidates in biomedical engineering for roles in systems engineering, test engineering, and clinical engineering. The addition of the PhD degree program in biomedical engineering combined with the reputation of the University of Georgia will provide Intuitive with a great institution to pursue top talent for advancing minimally invasive care.

It is my hope that the proposed degree program will be approved by the University and the Board of Regents prior to the fall 2022 semester. I am happy to provide additional input as needed and please do not hesitate to contact me.

Sincerely,



Jeffrey T. LaCroix  
Senior Fiber Optics Engineer

INTUITIVE



September 9, 2021

Dr. James Warnock  
School of Chemical, Materials and Biomedical Engineering  
University of Georgia  
Athens, GA

Dear James:

It is my sincere pleasure to provide this letter in support of your proposal for the new Ph.D. degree program in biomedical engineering. As you are aware, I have had the privilege of serving on the Advisory Board for the School of Chemical, Materials and Biomedical Engineering for the past six years. I fully expect that this new program will be an excellent addition to the academic programs already offered to students at the University of Georgia.

I am the McQueen-Quattlebaum Professor of Bioengineering at Clemson University, where I have been involved with both undergraduate and graduate education and research in various areas of biomedical engineering for over 30 years. As a research-focused discipline, I consider a Ph.D.-degree program to be an essential component of a successful academic department in biomedical engineering. This advanced degree program will not only help you attract and retain the best students and faculty, but it will also look more appropriate for proposal review committees for funding agencies that your faculty will be soliciting grants from in support of their research programs.

It is my hope that the proposed degree program in biomedical engineering will be promptly approved by the University and the Board of Regents and be ready for implementation for the fall 2022 semester. Please do not hesitate to contact me if additional input is desired.

Best regards,

A handwritten signature in black ink that reads "Robert A. Latour". The signature is written in a cursive style.

Robert A. Latour, Ph.D.  
McQueen-Quattlebaum Professor  
Director, SC BioCRAFT BET Core Facilities  
Department of Bioengineering  
501-2 Rhodes Engineering Research Center  
Clemson University, Clemson, SC 29634  
Office Tel: 864-656-5552  
Email: LatourR@clemson.edu

**Department of Bioengineering**  
301 Rhodes Engineering Research Center, Clemson University, Clemson, SC, USA 29634-0905  
864-656-3051 (O), 864-656-4466 (fax)

August 31, 2021

Dr. James Warnock  
School of Chemical, Materials and Biomedical Engineering  
University of Georgia,  
Athens, GA

Dear James,

It is my pleasure to provide this letter in support of your proposal for a new PhD degree program in biomedical engineering. As you are aware, I have had the privilege of serving on the Advisory Board for the School of Chemical, Materials and Biomedical Engineering for the past year and I look forward to serving the students in the future. This new program will be an excellent addition to the academic programs already offered to students.

I have been working in the biotech sector for 9 years and am currently the Assistant Vice President of Research and Development for Organogenesis. In this role, I lead both the research and product development project for the company at our 3 locations in Canton MA, La Jolla CA, and Birmingham AL. Organogenesis has been a pioneer and leader in the regenerative medicine space and continues to lead the market with robust product development spanning from 510K devices to Biologics.

The development and training of Biomedical Engineering advanced degree candidates is directly applicable to biotech companies in the Regenerative Medicine space. In fact, many of our current employees hold graduate degrees in Biomedical Engineering, including myself.

It is my hope that the proposed degree program(s) will be approved by the University and the Board of Regents prior to the fall 2022 semester. I am happy to provide additional input as needed and please do not hesitate to contact me.

Best regards,

*Katie Mowry*

Katie Mowry, Ph.D.  
AVP, Research and Development  
Organogenesis



The University of Georgia®

College of Pharmacy

September 17, 2021

Dr. James Warnock  
School of Chemical, Materials and Biomedical Engineering  
University of Georgia,  
Athens, GA

Dear James,

It is my pleasure to write a letter in support of your proposal for new PhD degree programs in biochemical engineering and biomedical engineering. As you are aware, I have had the privilege of serving on the Advisory Board for the School of Chemical, Materials and Biomedical Engineering for four years. Privileged to watch the development and growth of the school, I am enthusiastic about the addition of new PhD programs.

Currently, I hold the position of Clinical Professor in the UGA College of Pharmacy. However, I was the Founding Campus Dean for the AU/UGA Medical Partnership. The development of the Medical Partnership coincided with the establishment of the College of Engineering. Medicine and engineering are facilitative sciences increasingly important in many areas of research already present at the University of Georgia and important for the State of Georgia. By extending education to the PhD level, opportunities for innovative research with community and academic partners in Athens, Atlanta, and throughout Georgia will increase. A core reason for adding the Medical Partnership and the College of Engineering, besides increased numbers of physicians and engineers for Georgia, has been extending and broadening research.

It is my hope that the proposed degree programs will be approved by the University and the Board of Regents prior to the fall 2022 semester. I am happy to provide additional input as needed. Please do not hesitate to contact me.

Very truly yours,

*Barbara L. Schuster, MD*

Barbara L. Schuster, MD, MACP, FRCP (Edin)  
Clinical Professor, College of Pharmacy  
Founding Campus Dean, AU/UGA Medical Partnership



August 30, 2021

Dr. James Warnock  
School of Chemical, Materials and Biomedical Engineering  
University of Georgia,  
Athens, GA

Dear James,

It is my pleasure to provide this letter in support of your proposal for a new PhD degree program in both Biochemical Engineering and Biomedical Engineering. As you are aware, I have had the privilege of serving on the Advisory Board for the School of Chemical, Materials and Biomedical Engineering since the inception of the board. This new program will be an excellent addition to the academic programs already offered to students.

Info on my background is as follows:

I am currently the Global Product Development Manager at Tencate Geosynthetics where I have been working since 2000. I have worked in Textile Development using high performance polymers to create fabrics in related applications for 28 years.

TenCate is the world's leader in Geosynthetic solutions for civil and environmental structures.

With the recent discovery and increasing data that plastics micronize over time; we have a mandate for sustainability that provides biopolymer solutions. The advancement of academia and work in these related fields will have far reaching implications above and beyond the medical field. Much of the initial research will migrate into our materials that provide support for civil structures. These solutions are moving toward plant-based polymers and away from the traditional cracking of crude oil. The advancement of academia precedes industry and is vital.

It is my hope that the proposed degree programs will be approved by the University and the Board of Regents prior to the fall 2022 semester. I am happy to provide additional input as needed; please do not hesitate to contact me.

Best regards,

A handwritten signature in blue ink, appearing to read "D. M. Jones", written over a horizontal line.

David M. Jones

Global Product Development Project Manager

## Documentation of Approval and Notification

**Proposal:** Major in Biomedical Engineering (Ph.D.)

**College:** College of Engineering

**Department:** School of Chemical, Materials, and Biomedical Engineering

**Proposed Effective Term:** Fall 2022

Department:

- School of Chemicals, Materials, and Biomedical Engineering Chair, Dr. James Warnock, 2/16/21

School/College:

- College of Engineering Dean, Dr. Don Leo, 2/16/21

Graduate School:

- Vice Provost for Graduate Education and Dean of the Graduate School, Dr. Ron Walcott, 4/14/21

Additional Support:

- Danimer Scientific Senior Director of Research and Design, Dr. Joe Grubbs, 9/3/21
- Intuitive Senior Fiber Optics Engineer, Jeffrey LaCroix, 9/8/21
- Clemson University SC BioCRAFT BET Core Facilities Director, Dr. Robert Latour, 9/9/21
- Organogenesis Assistant Vice President of Research and Development, Dr. Katie Mowry, 8/31/21
- AU/UGA Medical Partnership Founding Campus Dean, Dr. Barbara Schuster, 9/17/21
- Tencate Geosynthetics Global Product Development Project Manager, David Jones, 8/30/21