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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 Biochemical 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

USG Academic Degree Program Application

Released
December 21, 2020

Point of Contacts

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Version Control

Date	*Changes*	*USG Approved date*	*Website update date*
12-18-2020	*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.*		

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*

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: Biochemical Engineering (Ph.D.)*
7. *Major: Biochemical Engineering*
8. *CIP Code (6 digit): 14430100*
9. *Degree Level: Doctoral*
10. *Anticipated Implementation Semester and Year^: Fall 2022*
11. *Was this program listed in the most recent Academic Forecast?*
    ☐ *Yes*
    X 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 proposed Ph.D. program in Biochemical 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 biochemical engineering research and education. The field of biochemical engineering is very broad. It contributes to the advances in a variety of technical areas including fermentation, metabolic engineering, synthetic biology, pharmaceutical production, bio-based materials, tissue engineering, food science, and bioenergy. The industrial biotechnology sector, the traditional territory of biochemical engineering, is estimated at a market value of over $100 billion per year in the United States with a growth rate over 10%. Additionally, the US Bureau of Labor Statistics projects 5.6% growth in chemical engineering jobs in the pharmaceutical and medical manufacturing between 2019 and 2029, which is higher than the 4% growth projected for all engineering jobs. There are many grand challenges involving biochemical engineering such as healthcare, energy, and the environment. The positive impact of biochemical engineering on human life has been increasing.

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

One of the missions of the University of Georgia 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 Biochemical Engineering (Ph.D.) program will fit the mission of the University of Georgia as it provides the necessary expertise of graduates in the high-demand areas of pharmaceutical, biotechnology, and other industries. This program will support this mission of UGA by providing a well-trained workforce in biochemical engineering. In addition, this program will enhance life and physical sciences and public health programs at UGA.

This program will also support the mission of the newly established School of Chemical, Materials, and Biomedical Engineering, a unit of the College of Engineering that advances research with implications for public health and economic development. It also enhances the mission of the New Materials Institute at the University of Georgia that was established in 2018 (https://newmaterials.uga.edu/). A letter of support from Dr. Jason Locklin, Director of the New Materials Institute, is included in the appendix.

The Ph.D. in Biochemical Engineering also aligns with national trends. In order to meet the immediate and growing demand from pharmaceutical and biotechnology industries, many universities across the U.S. have changed their chemical engineering programs into chemical and biomolecular engineering, chemical and biological engineering, or chemical and biochemical engineering to highlight their programs on biochemical engineering-related education and research. In addition, a few universities such as UC Davis and New Jersey Institute of Technology have standalone biochemical engineering programs.

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." This proposed Ph.D. program is in line with the UGA strategic plan (https://provost.uga.edu/_resources/documents/UGA_Strategic_Plan_2020_-_October_30_2012.pdf). The University of Georgia has successfully fulfilled its strategic goal of establishing comprehensive engineering programs in the past ten years. The proposed Biochemical Engineering (Ph.D.) program is a natural extension of UGA's existing bachelor's and master's degree programs in Biochemical Engineering, and the unique strengths in biological science at the University of Georgia.

The College of Engineering at UGA currently offers a Ph.D. in Engineering with an Area of Emphasis in Biochemical Engineering. The biochemical engineering emphasis was developed 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. was Biological and Agricultural Engineering. The long-term goal was to develop free-standing Ph.D. program once a critical mass of students were enrolled. The faculty in the School of Chemical, Materials, and Biomedical Engineering believe that critical mass has now been reached, as shown from recent enrollment growth. Upon approval of the Ph.D. program in Biochemical Engineering, the school will ask for the Area of Emphasis in Biochemical Engineering to be terminated.

[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.

Anecdotal evidence obtained from current students indicates they prefer named majors as opposed to generic major titles in Engineering. Introducing a new Ph.D. major in Biochemical 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. It is important for UGA to keep pace with other institutions to maintain competitiveness when recruiting doctoral students.

The Biochemical Engineering (Ph.D.) program utilizes 22 existing courses in the program of study as either required or elective courses. This includes doctoral research (ENGR 9000), project-focused doctoral research (ENGR 9010) and doctoral dissertation (ENGR 9300). No new courses will be included in the Biochemical Engineering (Ph.D.) program.

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.

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 pharmaceutical 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 manufacturing 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 biochemical 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. Biochemical Engineering programs at the bachelor's and master's level were developed over 10 years ago and have been successfully implemented. In that period, new faculty have been hired and have been active in biochemical engineering research. The School of Chemical, Materials, and Biomedical Engineering has the infrastructure, research and education resources, and experience to further advance its biochemical 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)

    According to Georgia Power Bioscience database, Georgia is home to over 400 biotech companies that employ over 19,000 individuals, primarily located in Atlanta, Augusta, and Athens. Georgia ranks 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 bioresearch 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 strong growth and technological innovation, local and regional employers need biochemical engineering graduates with extensive training in both life science and engineering. The proposed Biochemical Engineering (Ph.D.) program would address these local and regional needs.

Letters of support are included in the Appendix.

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

☐ 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. 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.

[4] 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)

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)*

According to data obtained from U.S. News and World Report, there are 128 Chemical Engineering graduate programs in the U.S. higher education institutions in the Southeast that offer a Ph.D. in Chemical Engineering or similarly named program (e.g., chemical and biomolecular engineering, etc.) include Georgia Institute of Technology, Clemson University, the University of Florida, Auburn University, the University of Alabama, Duke University, North Carolina State University, the University of Tennessee, and Vanderbilt University. These programs provide students with an opportunity to conduct research and take courses in areas traditionally associated with chemical engineering, such as catalysis, reaction kinetics, complex fluid dynamics, microelectronics, microfluidics, nanotechnology, polymers, sustainable development, pulp and paper, separations, CO_2 capture, solar energy, thermodynamics, MEMS, environmental science, reaction engineering, biofuels, air quality, systems engineering and modeling, and process synthesis and control. In contrast, the proposed program at UGA will be focused exclusively on biochemical engineering processes, and research areas will include sustainable and renewable biofuels and bioenergy, bio-based and biodegradable polymers, fermentation, metabolic engineering and synthetic biology, biopharmaceuticals, and biocatalysis and biomanufacturing. Hence, the proposed Ph.D. program in Biochemical Engineering at UGA is unique and is demonstrably different from the programs offered at other higher education institutions in the Southeast. Furthermore, if UGA is to maintain its regional, national, and international competitiveness, it is imperative to introduce the new Ph.D. degree program to attract both highly qualified faculty and graduate students to the institution.

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^**. 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.

a. Click **here** for US and Georgia occupation projections.
b. 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.
c. For a custom Georgia geography, request a Jobs EQ report from **USG Academic Affairs office.**

Related Occupation	SOC code	Current Employment [2019 US]	Projected Employment [2029 US]	# Change	% Change	Average Annual Openings
Architectural and engineering managers	11-9041	198,100	203,200	5,100	2.60	12,500
Chemical engineers	17-2041	32,600	34,000	1,400	4.40	2,000
Engineers, all other	17-2199	170,100	172,300	2,200	1.30	10,300
Engineering teachers, postsecondary	25-1032	44,600	48,400	3,800	8.60	3,800

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

Similar or Related Programs	CIP Code	Supply[1]	Competitor Institutions[2]

[1] Supply = Number of program graduates last year within the study area

[2] 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?^

Students majoring in Biochemical Engineering, as well as related biological and chemical sciences and engineering disciplines, would benefit from the proposed program, as existing courses will be restructured to include material to support the program. This program will attract to the state and to the institution graduate students whose main interests are in biochemical engineering and biotechnology.

In the United States, there are few specific Biochemical Engineering (Ph.D.) programs. In order to meet the immediate and growing demand from students and employers, many universities across the U.S. have changed their chemical engineering programs into chemical and biomolecular engineering, chemical and biological engineering, or chemical and biochemical engineering to emphasize their focuses on biochemical engineering related education and research and to be more attractive to the increasing demand of biochemical engineers. The University of Georgia is unique in the United States in its ability to deliver broadly-based instructional and research-oriented degree programs and adapt quickly to the rapidly changing discipline of biochemical engineering. This program will add new dimensions to existing programs in engineering as well as biological and chemical sciences and accelerate the adoption of discoveries into practice. The University of Georgia's reputation and impact on economic development will be enhanced in the region and nation. Based on enrollment number at other universities, the increase in enrollment in engineering at the University of Georgia, and this University's geographic location, the department estimates 10-15 Ph.D. degrees conferred per year within 5 years.

During the past 5 years, an average of 13.8 students have been enrolled in Biological & Agricultural Engineering (Ph.D.) and an average of 8.75 students have been advised by faculty from the School of Chemical, Materials, and Biomedical Engineering. Given these numbers, it is anticipated that 9 students currently enrolled in Biological and Agricultural Engineering (Ph.D.) will change their major to Biochemical Engineering (Ph.D.). Additionally, 4 students are currently enrolled in Engineering (Ph.D.) with an Area of Emphasis in Biochemical Engineering; all these students are expected to switch to the new Biochemical Engineering major.

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. (Standard Occupation Code = SOC)

SOC Code (6 digit)	Average Salary (O-Net data)	Occupation specific technology skills & KSAs
11-9041	$71.89 hourly, $149,530 annual	https://www.onetonline.org/link/summary/11-9041.00
17-2041	$52.18 hourly, $108,540 annual	https://www.onetonline.org/link/summary/17-2041.00
17-2199	$49.70 hourly, $103,380 annual	https://www.onetonline.org/link/summary/17-2199.00
25-1032	$103,600 annual	https://www.onetonline.org/link/summary/25-1032.00

Notes:

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

Average Salary	75th Percentile	50th Percentile	25th 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?^*

A. The job outlook for students graduating from this program is extremely promising. According to data provided by Georgia Bio, an independent, non-profit 501(c)(3) trade association, employment in the bio-industry in Georgia grew by 14.9% from 2007 to 2017 compared with 7.7% national growth. During this same period, the number of bio-industry establishments grew by 32% in Georgia and supports a total of approximately 194,000 jobs and contributes $21.8 billion to Georgia's GDP (https://gabio.org/).

D. CURRICULUM

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

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
☐	Combination of on-campus and online	☐ Yes
☐	Combination of off-campus and online	☐ Yes
☐	Hybrid, combination delivery	☐ Yes

33. *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*

34. For associate's, Nexus, and bachelor's degree proposals, which **High Impact Practices**[6] (HIPs) will faculty embed into the program? Mark all that apply.
☐ First-Year Experiences
☐ Common Intellectual Experiences
☐ Learning Communities
☐ Writing-Intensive Courses

[5] See SACSCOC Handbook for Institutions Seeking Initial Accreditation **here**.
[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).

☐ 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.

Not applicable

36. *Does the program take advantage of any USG initiatives?*

Alignment of Occupational KSAs [1]	Student Learning Outcome (s)	Direct Measure (s)	Data Source

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

[ ] eCampus *[ ] Georgia Film Academy*

[ ] FinTECH *[ ] Other: Specifiy 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.
[1] 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)[1]
Critical Thinking/ Problem Solving		
Oral/ Written Communications		
Team Work/ Collaboration		
Digital Technology		
Leadership		
Professionalism/ Work Ethic		
Career Management		
Global/ Intercultural Fluency		

[1] Direct measures may include assessments, HIPs, exams, etc.

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 and develop research objectives through critical thinking and systematic approaches to disciplinary knowledge to address research questions related to Biochemical Engineering.

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. Demonstrate written (to publish) and oral (to present) communication skills pertinent to the disciplinary field of Biochemical Engineering.

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.

c. Apply disciplinary knowledge to address research questions related to Biochemical Engineering.

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.

Direct assessment of the student learning outcomes will be performed by the Graduate Advisory Committee members during each student's dissertation defense. An assessment rubric has been developed by the College of Engineering and is currently used for assessment of students in the Engineering (Ph.D.) 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 32 credit hours course work; minimum of 40 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.

No new courses will be developed to support this degree proposal.

Required Advanced Engineering Core Courses (10 credit hours):

- BCHE(BIOE) 8970, Bioengineering Seminar (4 semesters, 4 credit hours)
- ENGR 8103, Computational Engineering: Fundamentals, Elliptic, and Parabolic Differential Equations (3 credit hours)
- ENGR 8910, Foundations for Engineering Research (3 credit hours)

Required Biochemical Engineering Core Courses - choose any three of the following (9 credit hours):

- BCHE 8150, Heterogeneous Reactor Design and Bio/Catalysis (3 credit hours)
- BCHE 8210, Fermentation Engineering Laboratory (3 credit hours)
- BCHE 8350, Sustainable Process Engineering (3 hours)
- CVLE(MCHE) 8160, Advanced Fluid Mechanics (3 credit hours)
- ENGR 8180, Advanced Mass Transfer (3 credit hours)
- MCHE 8170, Advanced Heat Transfer (3 credit hours)

Electives (13 credit hours):
Minimum of 13 additional credit hours of course work selected with the approval of the student's Graduate Advisory Committee. At least 1 hour 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:

- BCHE 6510, Biochemical Engineering
- BCHE 6520, Design of Biochemical Separations Processes

- BCHE 6550, Bioprocess Design and Simulation
- BCHE(BIOE) 6650, Animal Cell Biomanufacturing
- BCHE 6655, Metabolic Engineering and Synthetic Biology
- BCHE 6710, Bioelectrochemical Engineering
- BCMB(BCHE) 6030L, Bioprocess Technology
- BCHE 8220, Advanced Metabolic Engineering and Synthetic Biology
- BCHE 8350, Sustainable Process Engineering
- BIOE(BCHE) 8610, Bioelectroanalytical Techniques
- BCHE 8980, Advanced Topics in Biochemical Engineering

Research and Dissertation (40 credit hours):

- A minimum of 37 hours of Doctoral Research (ENGR 9000) or Project-Focused Doctoral Research (ENGR 9010). Typically, students complete more than 37 credit hours with the approval of the Graduate Advisory Committee.
- 3 hours of Doctoral Dissertation (ENGR 9300) is required on the Plan of Study.

Example Program of Study:

YEAR ONE					
Fall Semester		**Hours**	**Spring Semester**		**Hours**
BCHE(BIOE) 8970	Bioengineering Seminar	1	BCHE(BIOE) 8970	Bioengineering Seminar	1
ENGR 8103	Computational Engineering: Fundamentals, Elliptic, and Parabolic Differential Equations	3	BCHE 8210	Fermentation Engineering Lab	3
ENGR 8910	Foundations for Engineering Research	3	ENGR 8XXX	Engineering Elective	3
ENGR 9000	Doctoral Research	2	ENGR 9000	Doctoral Research	2
Total Credit Hours		**9**	**Total Credit Hours**		**9**
Summer					
ENGR 9000	Doctoral Research	9			
Total Credit Hours		**9**			

YEAR TWO					
Fall Semester		**Hours**	**Spring Semester**		**Hours**
	Elective	3			
BCHE 8150	Heterogeneous Reactor Design and Bio/Catalysis	3		Elective	3
BCHE(BIOE) 8970	Bioengineering Seminar	1	BCHE 8350	Sustainable Process Engineering	3
ENGR 9000	Doctoral Research	2	BCHE(BIOE) 8970	Bioengineering Seminar	1
			ENGR 9000	Doctoral Research	2
Total Credit Hours		**9**	**Total Credit Hours**		**9**
Summer					
ENGR 9000	Doctoral Research	9			
Total Credit Hours		**9**			

YEAR THREE					
Fall Semester		**Hours**	**Spring Semester**		**Hours**
	Elective	3	ENGR 9000	Doctoral Research	6
ENGR 9000	Doctoral Research	6	ENGR 9300	Doctoral Dissertation	3
Total Credit Hours		**9**	**Total Credit Hours**		**9**

E. IMPLEMENTATION

*42. Provide an enrollment projection for the next four academic years^*

	Year 1	Year 2	Year 3	Year 4
Fiscal Year (Fall to Summer)	2022-23	2023-24	2024-25	2025-26
Base enrollment[1]		12	12	13
Lost to Attrition (should be negative)		0	0	0
New to the institution	2	3	5	9
Shifted from Other programs within your institution	13	0	0	0
Total Enrollment	15	15	17	22
Graduates	3	3	4	5
Carry forward base enrollment for next year	12	12	13	17

[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 Chemical, Materials, and Biomedical Engineering currently advise students enrolled in two Ph.D. programs: Biological and Agricultural Engineering (BAEN) and Engineering with a Biochemical Engineering Area of Emphasis. During the past 5 years, an average of 13.8 students have been enrolled in the BAEN program and an average of 8.75 students have been advised by CMBE faculty. Given these numbers, it is anticipated that 9 students currently enrolled in the program will change their major to the Ph.D. in Biochemical Engineering. Additionally, 4 students are currently enrolled in the Engineering Ph.D. with a Biochemical Engineering Area of Emphasis; all these students are expected to switch to the new Biochemical Engineering program.

Historical data indicate that the college consistently recruits 2-4 new students to the BAEN and the Engineering Ph.D. with a Biochemical Engineering Area of Emphasis each academic year and graduate 20-25% of current students. The school fully expects to sustain a program enrollment of at least 15 students and hopes enrollment will increase in future years if the school is able to recruit additional faculty.

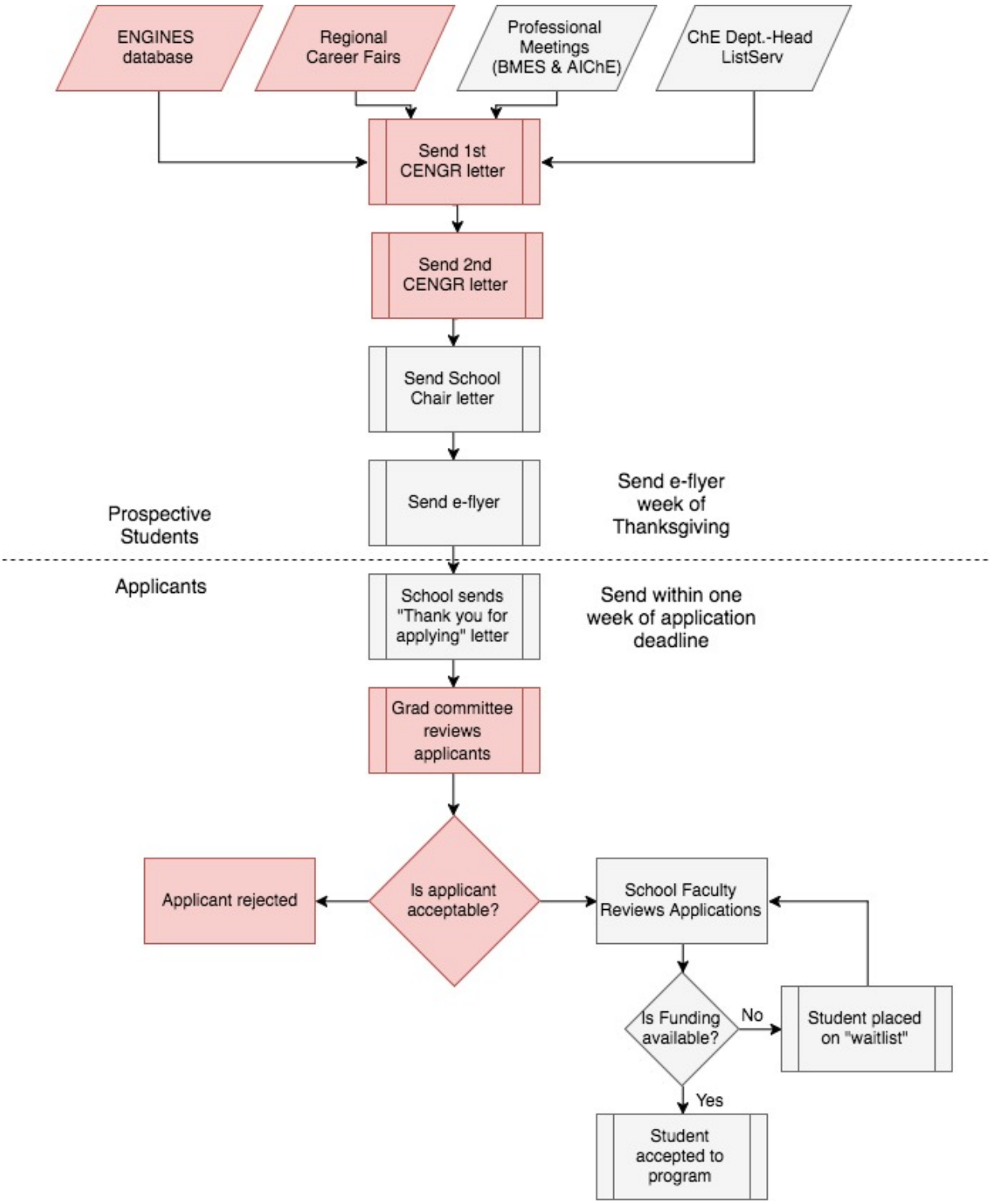
b. *If projections are significantly different than enrollment growth for the institution overall, please explain.*

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 master'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 Chemical Engineering department head 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.


ENGINES database
Regional Career Fairs
Professional Meetings (BMES & AIChE)
ChE Dept.-Head ListServ
Send 1st CENGR letter
Send 2nd CENGR letter
Send School Chair letter
Send e-flyer
Send e-flyer week of Thanksgiving
Prospective Students
Applicants
School sends "Thank you for applying" letter
Send within one week of application deadline
Grad committee reviews applicants
Is applicant acceptable?
Applicant rejected
School Faculty Reviews Applications
Is Funding available?
No
Student placed on "waitlist"
Yes
Student accepted to program

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

The Ph.D. in Biochemical Engineering provides maximum flexibility for students to address 21st century challenges through their studies and research. Students tackle research problems that address the need for sustainable biofuels and bio-based plastics, and advance technologies to produce high-value chemicals and biopharmaceuticals.

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. Jason Keith
Dean,
Mississippi State University
keith@bagley.msstate.edu
(662) 325-7183

Dr. Mark Riley
Associate Dean for Research
University of Nebraska
Mriley3@unl.edu
(402) 472-3386

Dr. Donald Morelli
Chairperson and Professor
Michigan State University
dmorelli@egr.msu.edu
(517) 884-1603

Dr. Chris Jones
School Chair
Georgia Institute of Technology
cjones@chbe.gatech.edu
(404) 385-1683

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.
Existing and authorized faculty lines budgeted for instruction will be utilized to cover the program instructional costs. Since the required and elective courses are already offered, no reallocation of existing resources is required.

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

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?
N/A

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^ – 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: **21**
# of existing courses to be part of the new program **21**
Net number of new courses to be developed **0**

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.^

a. How many faculty will be re-directed to this program from existing programs?
10

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 eight faculty currently teaching courses that are directly related to the proposed program of study or who are performing research in the area of biochemical engineering. These faculty will be the major professors for students enrolled in the proposed Ph.D. program. No new sections of existing courses will be created and therefore, teaching loads for existing faculty will remain the same. Existing staff will not be impacted by the creation of the new degree program.

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 because the courses are currently offered as the area of emphasis and will now be offered as part of the major. The proposed degree will incorporate courses that are currently taught by existing, qualified faculty.

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.

N/A. The faculty will teach the existing courses they have been teaching, but the courses will now be redirected to satisfy requirements in this new major.

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** *% EFT Research, Instruction, Service Administration*	**Other Qualifications and Comments** *Research Areas*
Mark Eiteman	Professor	**Fall:**	Ph.D., Chemical Engineering,	50% R 50% I	• Metabolic engineering

		BCHE 6520, Design of Biochemical Separations Processes, 3.0 (UG/G) **Spring:** BCHE 6510, Biochemical Engineering, 3.0, (UG/G) BCHE 8210, Fermentation Engineering Laboratory, 3.0 (G)	University of Virginia, 1991 M.S., Chemical Engineering, University of Virginia, 1988 B.S., Chemical Engineering, Summa cum laude, Virginia Tech, 1986		• Bioprocess engineering • Fermentation technology
Hitesh Handa	Associate Professor	**Fall & Spring:** BCHE 8970, Bioengineering Seminar, 1.0 (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	• Biomaterials for Medical Device Applications • Nitric Oxide Releasing Materials • Blood-Material Interactions • Antimicrobial and Hemocompatible Materials • Wound Healing Materials
Jim Kastner	Associate Professor	**Fall (Alternate years):** BCHE 8150, Heterogeneous Reactor Design and Bio/Catalysis, 3.0 (G) **Fall (Alternate years):** ENGR 8180, Advanced Mass Transfer, 3.0 (G)	Ph.D. in Applied Biology, Georgia Institute of Technology, 1993 M.S. in Chemical Engineering, Mississippi State University, 1987 B.S. in Chemical Engineering (Magna Cum Laude) and Biochemistry (Cum Laude), Mississippi State University, 1984 (CHE) and 1983 (BCHM)	60% R 40% I	• Biochemical engineering • Environmental, nanostructured and chemical catalysts • Enhanced biomass pyrolysis and gasification processes
Caner Kazanci	Associate Professor	**Fall:** 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	50% R 50% I	• Biological and ecological modeling, simulation and analysis. • Numerical analysis, dynamical systems.

			B.S., Mathematics, Bilkent University in Ankara, Turkey, 1999		• 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.
William Kisaalita	Professor	**Fall:** ENGR 8910, Foundations for Engineering Research, 3.0 (G)	Ph.D., Chemical Engineering, University of British Columbia, Canada, 1987 M.A.Sc., Bio-Resource Engineering, University of British Columbia, Canada, 1982 B.Sc.(Eng) (Hons), Mechanical Engineering, Makerere University, Uganda, 1979	50% R 50% I	• Tissue engineering • Cell-surface interactions • Assays for high throughput screening (HTS) • Renewable energy utilization with emphasis on biogas-powered cooling • Global service learning
Sudhagar Mani	Professor	**Fall:** BCHE 6550, Bioprocess Design and Simulation, 3.0, (UG/G) **Spring (Alternate Years):** BCHE 8350, Sustainable Process Engineering, 3.0 (G) **Spring (Alternate Years):** MCHE 8170, Advanced Heat Transfer, 3.0 (G)	Ph.D., Chemical and Biological Engineering, University of British Columbia, Canada, 2005 M.Tech., Dairy & Food Engineering, Indian Institute of Technology, India, 2000 B.E., Agricultural Engineering, TamilNadu Agricultural University, India, 1998	60% R 40% I	• Bioenergy
Ramaraja Ramasamy	Associate Dean for	**Fall:**	Ph.D., Chemical Engineering,	12.5% R 12.5% I	• Electrochemical energy

	Academic Affairs and Professor	BIOE(BCHE) 8610, Bioelectroanalytical Techniques, 3.0 (G) **Spring:** BCHE 6710 Bioelectrochemical Engineering	University of South Carolina, 2004 B.Tech., Chemical and Electrochemical Engineering, Central Electro Chemical Research Institute, India, 2001	75% A	• Biological electrochemistry • Bionanocomposite materials
James Warnock	School Chair and Professor	**Spring:** BCHE(BIOE) 6650 Animal Cell Biomanufacturing	Ph.D. Chemical Engineering, University of Birmingham, UK, 2003 M.Sc., Biochemical Engineering, University of Birmingham, UK, 1999 B.Sc., Biological Science, University of Wolverhampton, UK, 1998	12.5% R 12.5% I 75% A	• Cell and Gene Manufacturing • Tissue Engineering • Workforce Development
Clifton Brock Woodson	Associate Professor	**Spring:** 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	• Environmental Fluid Mechanics; • Mixing and Transport Processes • Coastal Oceanography • Biophysical Interactions in the Ocean • Fisheries • Climate Change • Sustainable Use of Marine Ecosystems
Yajun Yan	Professor	**Fall:** BCHE 6655, Metabolic Engineering and Synthetic Biology, 3.0 (UG/G) **Spring:** BCHE 8220 Advanced Metabolic Engineering and Synthetic Biology, 3.0 (G)	Ph.D., Chemical and Biological Engineering, SUNY-Buffalo, 2008 M.S., Biochemical Engineering, Beijing University of Chemical Technology, 2002 B.S., Biochemical Engineering, Beijing University of	60% R 40% I	• Metabolic Engineering • Protein Engineering • Biofuels and Renewable Chemicals

			Chemical Technology, 1999		

54. Explain your plan for <u>new</u> faculty and staff for the program:
    a. *How many new faculty will be needed for this program over the next four years? 0*
    Explanation: The School of Chemical, Materials, and Biomedical Engineering currently has sufficient faculty to offer all the courses required for this program.

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.)

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
New Construction					
Renovations and Infrastructure*					
Purchases: Land, Buildings etc.					
Lease space					
TOTAL Cost		**$0**	**$0**		

*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.

N/A

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?
No

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[1]				
Classrooms				
Meeting Rooms				
Student Study Space				
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.

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.
No

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				
Total Technology Costs		**0**	**0**	

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 Biochemical Engineering will transfer to the new major. The department also assumes that students enrolled in the Ph.D. in Biological and Agricultural Engineering that are conducting research related to biological systems 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
BCHE 6510	3	Biochemical Engineering	Design and analysis of enzymatic and microbial biological reaction systems.	E
BCHE 6520	3	Design of Biochemical Separations Processes	Unit operations used for biological processing including filtration, centrifugation, cell disruption, isolation, purification, and polishing.	E
BCHE 6550	3	Bioprocess Design and Simulation	Design and modeling of chemical/bioprocess systems, including unit operations and reactor design principles. Process simulation and process economics applied to chemical/bioprocessing systems. Plant layout and process safety of bio/chemical plants will be included.	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
BCHE 6655	3	Metabolic Engineering and Synthetic Biology	Theories and applications of cellular metabolism, genetic engineering, protein engineering, and metabolic engineering through experiential learning.	E
BCHE 6710	3	Bioelectrochemical Engineering	The study of electron transfer interaction in biological systems. Topics include redox biochemistry, bio-energetics and thermodynamics, kinetics, transport processes in bio-electrochemical systems, and engineering of bio- electrochemical systems.	E
BCHE 8150	3	Heterogeneous Reactor Design and 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 8210	3	Fermentation Engineering Laboratory	Advanced fermentation principles through the development of mathematical models, design of experiments, and interpretation of results.	R
BCHE 8220	3	Advanced Metabolic Engineering and Synthetic Biology	Advanced concepts and techniques of metabolic engineering and synthetic biology that enable the fast development of microbial cell factories.	E
BCHE 8350	3	Sustainable Process Engineering	Process sustainability, sustainable concepts, waste minimization, cleaner production, principles of green engineering, industrial ecology, recycling, circular economy, life cycle thinking and analysis, life cycle approaches (cradle to grave), inventory	R

			analysis, impact assessments, sustainability metrics–energy, carbon, water, and ecological footprints.	
BIOE(BCHE) 8610	3	Bioelectroanalytical Techniques	Analyze and design chemical and biological systems relevant to the chemical, biomedical, biotechnological, and pharmaceutical industries using bioanalytical and electroanalytical techniques.	E
BCHE(BIOE) 8970	1	Bioengineering Seminar	Seminar series on broad topics in biochemical, chemical, materials, and medical-related engineering disciplines.	R
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.	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
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.	R

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

danimer scientific
A Biotechnology Company

140 Industrial Blvd
Bainbridge, GA 39817
danimer.com|229-243-7075

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

TENCATE
GEOSYNTHETICS

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,

David M. Jones

Global Product Development Project Manager

New Materials Institute
Riverbend Research South, Room 104
220 Riverbend Road
Athens, Georgia 30602
TEL 706-542-2359 | FAX 706-583-3804
jlocklin@uga.edu
newmaterials.uga.edu

9/16/2021

James N. Warnock, Ph.D.
Chemical, Materials and Biomedical Engineering | *Professor & Founding School Chair*
Environmental, Civil, Agricultural and Mechanical Engineering | *Interim School Chair*

Dr. Warnock,

I am writing this letter in strong support for the Ph.D. programs both in Biochemical Engineering and Biomedical Engineering. These degree programs will accelerate our ability to recruit the best graduate students to our research programs and will have a direct impact on the scholastic and commercialization development activities within the New Materials Institute at the University of Georgia.

The New Materials Institute was founded in 2017 and is an Institute under the Vice President of Research that spans many different colleges at the University of Georgia. The New Materials Institute's mission is to encourage and facilitate integrative, collaborative research at the fundamental, test bed and systems levels that results in new materials based on green engineering principles. Many of our faculty currently have graduate students from Engineering, but it is my opinion that this number will continue to be limited until these new degree offerings are in place.

Again, the New Materials Institute strongly supports the proposals for these graduate programs, and with their implementation, we will be able to accelerate our scholarship and technology development. I am very much looking forward to supporting these programs for years to come.

Sincerely,

Jason Locklin
Director
New Materials Institute
University of Georgia
706-542-2359
jlocklin@uga.edu

Documentation of Approval and Notification

Proposal: Major in Biochemical 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:

- AU/UGA Medical Partnership Founding Campus Dean, Dr. Barbara Schuster, 9/17/21
- Danimer Scientific Senior Director of Research and Design, Dr. Joe Grubbs, 9/3/21
- Tencate Geosynthetics Global Product Development Project Manager, David Jones, 8/30/21
- New Materials Institute Director, Dr. Jason Locklin, 9/16/21