Brothers, Sheila C.

From: Cramer, Aaron M.
Sent: Monday, December 16, 2019 12:06 PM
To: Bird-Pollan, Jennifer; Brothers, Sheila C.; Ett-Mims, Joanie; Woolery, Stephanie L.
Cc: Pienkowski, David
Subject: NEW BS: Biomedical Engineering
Attachments: New BME Undergraduate Degree Form 25 November 2019.pdf

Proposed New BS in Biomedical Engineering

This is a recommendation that the University Senate approve, for submission to the Board of Trustees, the establishment of a new BS degree: Biomedical Engineering, in the F. Joseph Halcomb III, M.D. Department of Biomedical Engineering within the College of Engineering.

Rationale: Biomedical engineering is a multidisciplinary field that applies engineering principles and design methods to improve the interaction and integration of engineering with medicine and biological sciences for improving human health and solving healthcare challenges. The proposed program addresses institutional needs for growth in the number and diversity of engineering students and societal needs for excellent, affordable, and available healthcare technology. The program is unique with respect to existing Biomedical Engineering programs because of the close collaboration with the College of Design and the pervasive emphasis on design thinking. The program uses that shared first-year-engineering curriculum followed by foundational engineering courses and then upper-level Biomedical Engineering courses. The program culminates in a two-semester interdisciplinary capstone design project. The College of Engineering has committed the necessary resources to establish this program. Accreditation will be sought from the Accreditation Board for Engineering and Technology. Classes of 30-40 students are anticipated.

Aaron

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PROPOSAL FOR NEW UNDERGRADUATE DEGREE PROGRAM

Office of Strategic Planning and Institutional Effectiveness (OSPIE). *The new program approval process begins when a contact persons submits a "Notification of Intent" (NOI) and substantive change checklist (available HERE) to OSPIE. Units have six months from the point of NOI submission to the time when the completed proposal is approved by Senate. After the NOI is submitted, a contact person should begin working to complete this form. Contact persons should work with OSPIE to identify the program's degree designation and CIP, as well as to solicit a letter of administrative feasibility from the Provost (per SR 3.2.3.A.2).*

Pre-proposal. *The CPE requires that a pre-proposal be submitted after a proposed program has achieved approval at the college level. Answers to questions identified with a * by the question number on this form will be used by OSPIE staff to submit the pre-proposal to the CPE (Council on Postsecondary Education).*

Form structure. *This form has two sections. The first half (white background) contains information required by the University Senate and Registrar's office and the second half (beige/brown background) contains information required by two external entities, the CPE and SACSCOC (Southern Association of Colleges and Schools Commission on Colleges). Although only the first half is required for University Senate approval, every question must be answered to receive CPE approval. Please do not leave any area blank, but instead write "not applicable" wherever that is the appropriate response.*

Approval process. *Once approved at the college level, your college will send the proposal to the appropriate Senate academic council (possibly HCCC and/or UC) for review and approval. Once approved at the academic council level, the academic council will send your proposal to the Senate Council office for additional review via a committee and then to the SC and Senate. (The contact person listed on the form will be informed when the proposal has been sent to committee and other times as appropriate.) Once approved by the Senate, the Senate Council office will submit the proposal for it to be placed on an agenda for the Board of Trustees. After approval by the Board, OSPIE will ensure the proposal is submitted to the CPE for final approval. Generally, a new program proposal must have received approval from the Senate by early spring (February or March) in order for the new program to be effective for the following fall semester.*

INFORMATION REQUIRED BY UNIVERSITY SENATE		
1. Basic Information: Program Background and Overview		
1a	Home College: *Engineering*	
1b	Home Educational Unit (school, department, college[1]): *F. Joseph Halcomb III, M.D. Department of Biomedical Engineering*	
1c*	Office of Strategic Planning and Institutional Effectiveness (OSPIE) (Please contact OSPIE (OSPIE@L.uky.edu) for help with questions in this section.)	
	Date of contact with OSPIE:	*4/27/18*
	☒ Appended to the end of this form is a PDF of the reply from OSPIE.	
	☒ Appended to the end of this form is a letter of administrative feasibility from the Provost.	
	☒ Appended to the end of this form is a letter(s) of administrative feasibility from the dean(s) of the college(s) offering the degree.	
	CIP Code (confirmed by OSPIE): *14.0501*	

[1] Only interdisciplinary undergraduate degrees may be homed at the college level.

	Degree Type (BA, BS, etc.)[2] : *BS*		
	Is this degree designation on the CPE's list of degree designations[2]?	Yes ☒	No ☐
	If "No," please provide an explanation for OSPIE's use in external reporting purposes.		
1d*	Major Name (Interior Design, Social Work, etc.): *Biomedical Engineering*		
1e	Is there a specialized accrediting agency related to this program?	Yes ☒	No ☐
	If "Yes," name: *ABET*		
	Do you intend to seek accreditation from this agency?	Yes ☒	No ☐
1f	Was this particular program ever previously offered at UK but subsequently suspended?	Yes ☐	No ☒
	If "Yes," describe. *(300 word limit)*		
1g*	Requested effective date: ☒ Semester after approval. OR ☐ Specific Date[3]: _____		
1h	Anticipated date for granting first degree(s): *2024*		
1i*	Contact person name: *David Pienkowski*	Email: *pienkow@uky.edu*	Phone: *8-1667*

2. Program Overview

2a*	Provide a brief description of the proposed program. *(300 word limit)*
	Biomedical engineering (BME) is a multidisciplinary field that applies engineering principles and design methods to improve the interaction and integration of engineering with medicine and biological sciences for improving human health and solving healthcare challenges. *The proposed 4-year Bachelor of Science (BS) in BME undergraduate program is designed for students who aspire to engineer novel treatments, devices, materials, technologies, or processes to improve human healthcare. Students seeking careers in industry, the healthcare professions, government agencies, or graduate studies in BME are candidates for this program.* *The proposed curriculum provides students with a unique set of qualitative and quantitative healthcare problem definition, analysis, and solution skills. This program uses the shared freshman-engineering curriculum, and offers students the flexibility to select among a variety of foundational engineering courses beginning in the 3rd semester and a variety of upper-level BME courses in the senior year. A novel 2-semester interdisciplinary Capstone Senior Design project focused on creative engineering solution of an actual healthcare issue posed by collaborating industrial and/or healthcare partners completes the curriculum. BME and Product Design courses jointly created by BME and College of Design faculty, are integral to semesters 4 to 8 of the proposed program and are intended to instill "design-thinking" in students.* *The proposed curriculum is distinct from other BS BME programs due to these integral design-thinking courses and experiences within the proposed curriculum. These design-thinking experiences balance left-brain oriented technical materials with right-brain creative approaches to cultivate crucial abilities needed to: 1) communicate empathetically with all stakeholders in a design cycle; 2) frame healthcare challenges into engineering problems; and 3) design, prototype, build, test, refine. and implement solutions that solve contemporary healthcare challenges problems and meet all user needs.*

[2] Visit http://dataportal.cpe.ky.gov/cpedegreedesignations.aspx for the CPE's list of approved degree designations.
[3] Programs are effective for the fall semester following approval. No program will be made effective until all approvals, up through and including Board of Trustees and CPE approval, are received.

2b	List the program objectives of the proposed program. These objectives should deal with the specific institutional and societal needs that the program will address, such as how students will benefit from the program, both tangibly and intangibly. (Please note that "program objectives" are different from "student learning outcomes.") *(300 word limit)*
	The objective of the proposed program is to develop creative future leaders in biomedical technology. The proposed program addresses University needs for growth in number and diversity of engineering students as well as societal needs for excellent, affordable, and available healthcare technology. *The proposed program will benefit:* *Students: biomedical engineering is among the largest undergraduate engineering programs at major universities, but UK has no undergraduate BME program. The proposed program will benefit UK students by providing them: 1) a new choice of major, 2) a unique multidisciplinary curriculum due to cross-fertilization between the Colleges of Engineering, Design, and others, and 3) new career opportunities enabled by design-thinking inherent to this technology-based program.* *UK: this program offers a strategic response to forecasted applicant declines because it will attract new students that are otherwise outside of UK's market. UK's graduate BME program will benefit from an increased pool of candidates. Because BME is typically composed of relatively equal numbers of men and women, the proposed program will substantially increase the number of women engineers in the College of Engineering.* *Region: healthcare expenditures consume a large and growing portion of the world's economies. While advancing healthcare technology is partially responsible for these costs, it is also partially the solution. The proposed BME program powered by design-thinking offers a unique approach to educating the next generation of professionals who will creatively apply learned technologies to establish a new healthcare landscape. Close collaboration between the Colleges of Engineering, Design, Medicine, etc. embodied in the proposed program, offers the potential for graduates to create a Lexington-based biomedical design hub. This will put Lexington on the map as the "go-to" place for creative new healthcare design and product ideas. This may in turn bring new manufacturing facilities to the Lexington area.*
2c*	List the intended student learning outcomes (SLOs) for the proposed program. Address one or more of the five areas of learning (1. broad, integrative knowledge; 2. specialized knowledge; 3. intellectual skills; 4. applied learning; and 5. civic learning). Include the SLO for the Graduation Composition and Communication Requirement (GCCR). (*300 word limit) (More detailed information will be addressed in a subsequent question.)*
	Students who successfully complete the proposed program will be able to apply STEM-based knowledge using design-thinking to creatively address human healthcare challenges. They will gain the ability to design new biomedical technologies within system constraints (i.e., anatomic, physiologic, economic, ethical, manufacturing, regulatory, safety, etc.). Graduates will be able to apply newly acquired skills to advance biomedical technology and benefit society by providing increased healthcare technology efficacy, greater accessibility, or equivalent efficacy/accessibility at lower cost. *Student learning outcomes will be those specified by ABET (Table 1). Students will demonstrate program acquired broad integrative knowledge by proving their ability to frame healthcare challenges into engineering problems and analyze qualitative facts using quantitative engineering relationships. Levels of skill acquisition will be assessed by: 1) oral and written examinations, 2) design studio performance, and 3) senior design project quality. Faculty administering these evaluations will require minimum standards of competency that exceed the breadth & depth of standards required of undergraduate engineering students*

	minoring in biomedical engineering, but less than the standards required of graduate students seeking a master's degree. *Biomedical engineering requires a high level of oral and written communication skills with technical, clinical, and lay personnel. Proposed program graduates must be able to author components of scientific and clinical manuscripts, prepare effective oral presentations using text and visual aids, and make substantive written contributions to patent applications, technical reports, patient consent forms, etc. Communication skills acquired in WRD 110 & 111 will be applied and refined in BME 421 when students prepare oral and written reports documenting their senior project design. Faculty and senior design project industry sponsors will help students refine WRD 110 & 111 acquired communication skills in BME 421.*
2d	Describe the rationale and motivation for the program. Give reference to national context, including equivalents in benchmark institutions. *(150 word limit)*
	The U.S spent 17.1% of its Gross National Product on healthcare in 2014 (19.9% by 2025). Advancing BME technology, while partially responsible for this cost, is also a partial solution. BME educational programs are centric to efforts focused on better healthcare at lower cost. *Biomedical and bioengineering programs report large enrollments in the top 10 (US News & World Report) engineering schools. Recently published BME undergraduate enrollments are: Georgia Tech (1,300), Hopkins (480), MIT (149), Duke (263), Stanford (graduate only), UC San Diego (~2,500), UC Berkely (400), Rice University (~200), University Michigan (~200), University Pennsylvania (~300). UK is not "late to the party" but defines a "new party" and sets the standard for excellence amid inevitable subsequent imitators. Our competitive educational marketplace advantage will be sustained by capitalizing on strengths from close academic collaboration and geographic proximity between UK Colleges of Engineering, Design, Medicine, etc. and the biomedical industry.*
2e	Describe the proposed program's uniqueness within UK. *(250 word limit)*
	There is no undergraduate biomedical engineering degree program at UK. Undergraduate engineering students may choose to major in one of the existing engineering programs and minor in BME or they may choose to major in Biosystems and Agricultural Engineering. Neither offers the intensive educational curriculum needed to understand the life science foundations of the human body together with the engineering tools needed to engage this life science field and develop practical solutions to healthcare challenges based upon creative "design-thinking" skills. *The proposed program is unique among BME programs due to the formal classroom and studio design-based courses interwoven among a biomedical engineering curriculum. The proposed program will incorporate novel collaboration with biomedical industry partmers facing actual device, process, or material design challenges. Such challenges will require students to employ newly acquired design and engineering skills to creatively address their senior capstone project. Students will gain "co-op-like" experiences during their senior design coursework.*
2f	Describe the target audience. *(150 word limit)*
	Target audience for the proposed BME undergraduate curriculum includes students seeking a career based upon development of creative application of technology to improve human healthcare. Specifically targeted groups include: a) high school STEM (science, technology, engineering, math) majors considering careers in medicine, dentistry, or law, b) high-school students contemplating a career in engineering, but who have not yet been exposed to the field of biomedical engineering, and c) entering engineering students who are uncommitted to a particular field of engineering.

2g*	Does the program allow for any tracks (a.k.a. options)?	Yes ☐	No ☒
	If "Yes," name the track(s). *(Specific course requirements will be described in a subsequent section.)*		
	Track #1:		
	Track #2:		
	Track #3:		
	Track #4:		
	Track #5:		
	Track #6:		
2h	Does the program require a minor?	Yes[4] ☐	No ☒
	If "Yes," what is the name of the minor?		
2i	Describe how the proposed program will be administered, including admissions, student advising, retention, etc. *(150 word limit)*		
	See attached addendum		
2j	Are multiple units/programs collaborating to offer this program?	Yes ☒	No ☐
	If "Yes," please discuss the resource contribution(s) from each participating unit/program. *(150 word limit) (Letters of support will be addressed in subsequent sections.)*		
	The proposed curriculum, while academically based in the F. Joseph Halcomb III, M.D. Department of Biomedical Engineering, is a collaborative effort with UK's College of Design (CoD). Amid the technical and core courses in the proposed program, students will also take selected Product Design (PRD) courses from the 4th semester onward. These product design courses are intended to instill creative "design-thinking" skills amid the student's engineering curriculum. PRD courses in the proposed program will be selected from among the new course offerings concurrently proposed by the CoD. CoD faculty will actively engage in classroom lectures and hands-on studio courses required of students in the proposed BS in BME program. CoD faculty will also co-mentor (with BME faculty) BME students during their senior design project (BME 420 & 421). BME faculty will reciprocate by collaborating with CoD faculty to help teach specific PRD courses appropriate to both disciplines.		
2k	List all UK programs[5] which the proposed program could be perceived as replicating. Give a rationale for why this is not duplication, or is a necessary duplication. *(250 word limit)*		
	None		
2l	The faculty of record is the faculty body responsible for ALL aspects of the program, including courses, credit hours, rigor, changes to the program, etc. Please identify the program's *faculty of record* by choosing ONE of the four scenarios below. For more information on each faculty of record scenario, visit http://www.uky.edu/Faculty/Senate/Forms/UndegDegPgm_Help.html.		
	☒	Scenario 1	
	OR		
	☐	Scenario 2	
	OR		

[4] If "Yes," in conjunction with the submission of this form to the home unit, you must also fill out the form for a new minor and submit it to the home unit.

[5] You must include a letter of support from any other program's home unit. Please convert the letter to a PDF and append to the end of this form.

	☐	Scenario 3
	OR	
	☐	Scenario 4
	If Scenarios 2, 3, or 4 are chosen, please provide describe/list/name the members of the faculty of record and describe the voting rights of members of the faculty of record. Include the process and standards for identifying the program director, as well as adding and deleting members of the faculty of record. *(150 word limit)*	
2m	Will the program have an advisory board[6]?	Yes ☒ No ☐
	If "Yes," please describe the standards by which the faculty of record will select members of the advisory board, the duration of service on the board, and criteria for removal. *(150 word limit)*	
	The F. Joseph Halcomb, III M.D Department of Biomedical Engineering has maintained an external advisory board since 1995. The advisory board is composed of individuals from industry, government, academia, alumni of our program, or others with ties to biomedical engineering who are committed to the success of this department. *The board meets annually during the fall semester for a 2-day retreat and occasionally during the spring semester. This retreat includes a review of existing programs, planned curriculum changes, and other academic activities. Existing advisory board members or departmental faculty members nominate candidates for the BME advisory board. Board members are appointed by the chair for a 3-year term. Removal from the advisory board occurs by: a) term expiration, b) self-generated request, c) majority vote of existing board members for failure to engage in requested advisory board activities or loss of interest in contributing to the mission of the department.*	
	If "Yes," please list below the number of each type of individual (as applicable) who will be involved in the advisory board.	
	1	Faculty within the college who are within the home educational unit.
	1	Faculty within the college who are outside the home educational unit.
	1	Faculty outside the college who are within the University.
	1	Faculty outside the college and outside the University who are within the United States.
		Faculty outside the college and outside the University who are outside the United States.
	1	Students who are currently in the program.
	1	Students who recently graduated from the program.
	6	Members of industry.
		Community volunteers.
		Other. Please explain:
	12	**Total Number of Advisory Board Members**

3. Delivery Mode	**UK DLP and eLearning Office [7]**

[6] An advisory board includes both faculty and non-faculty who are expected to advise the faculty of record on matters related to the program, e.g. national trends and industry expectations of graduates.

[7] For questions about alternative delivery modes, please contact UK's Distance Learning Programs and e-Learning office (URL above).

3a*	Initially, will any portion of the proposed program's core courses be offered via distance learning[8]?					Yes ☐	No ☒
	If "Yes," please indicate below the percentage of core courses that will be offered via distance learning.						
(check one)	1% - 24% ☐	25% - 49% ☐	50% - 74% ☐	75 - 99% ☐	100% ☐		
3b*	If *any* percentage of the program will be offered via the alternative learning formats below, check all that apply, below.						
	☐	Distance learning.					
	☐	Courses that combine various modes of interaction, such as face-to-face, videoconferencing, audio-conferencing, mail, telephone, fax, email, interactive television, or World Wide Web.					
	☐	Technology-enhanced instruction.					
	☐	Evening/weekend/early morning classes.					
	☐	Accelerated courses.					
	☐	Instruction at nontraditional locations, such as employer worksite.					
	☐	Courses with multiple entry, exit, and reentry points.					
	☐	Modularized courses.					
3c	Give pedagogical rationale for the use of alternative delivery modes in the proposed program. Consider the aspects below and elaborate as appropriate. *(200 word limit)* • Synchronous and asynchronous components. • Balance between traditional and non-traditional aspects. • Hybrid elements.						

4. UK Resources			
4a*	Will the program's home educational unit require new or additional faculty?	Yes ☒	No ☐
	If "Yes," provide a plan to ensure that appropriate faculty resources are available, either within UK or externally, to support the program. Note whether the new and additional faculty will be part-time or full-time faculty. If "No," explain why. *(150 word limit)*		
	No new faculty members will be needed for the first two years of the proposed program. One new faculty member will be needed in year three and an additonal new faculty member will be needed in year four. Both faculty will be full time members of the BME department. Two additional (four total) will be needed after year four of the program as student enrollment reaches the currently projected 40 students per year. Resources for these faculty will be obtained from revenues derived from undergraduate tuition. The College of Engineering is committed to growing the biomedical engineering program.		
	If "Yes," when will the faculty be appointed? *(150 word limit)*		
	One faculty member will be appointed in year three of the proposed program, a second faculty member will be appointed in year four. Two additional faculty will be appointed after the fourth year of the program.		
4b	Will the program's home educational unit require additional non-faculty resources, e.g. classroom space, lab space, or equipment?	Yes ☒	No ☐
	If "Yes," provide a brief summary of additional non-faculty resources that will be needed to implement this program over the next five (5) years. If "No," explain why. *(150 word limit)*		
	Implementation of the proposed new program will require additional classroom, laboratory, and studio space beginning in year 4 of the proposed program. The College of Engineering is committed to growing the biomedical engineering program.		

[8] Per the Southern Association of Colleges and Schools Commission on Colleges (SACS) definition of distance education, distance education is a formal educational process in which the majority of the instruction (interaction between students and instructors and among students) in a course occurs when students and instructors are not in the same place. Instruction may be synchronous or asynchronous.

4c	Will the program include courses from another educational unit(s)?	Yes ☒	No ☐
	If "Yes," list the courses and identify the other educational units and subunits that have approved the inclusion of their courses. *(150 word limit)*		
	BIO 148, 152 — *Biology* *CHE 105, 107* — *Chemistry* *CME 200, 320* — *Chemical and Materials Eng.* *EE 211,305* — *Electrical Eng.* *EM 221, 302, 331* — *Mechanical Eng.* *ME 340* — *Mechanical Eng.* *PHY 231, 232, 241, 242* — *Physics* *PGY 412g* — *Physiology* *MA 113, 114, 213, 214* — *Mathemathics* *PRD/BME 170, 350, 371, 372, 451* — *College of Design* *PRD 272* — *College of Design* *STA 381* — *Statistics* *WRD 110 & 111* — *Writing, Rhetoric & Digital Communications*		
	If "Yes," append to the end of this form a letter of support from the appropriate educational unit chair/director from whose unit individual courses will be used. A letter must include the following: • Demonstration of true collaboration between multiple units[9]; • Impact on the course's use on the home educational unit; and • Verification that the chair/director has consent from the faculty members of the unit.		

[9] Show evidence of detailed collaborative consultation with such units early in the process.

4d	Fill out the faculty roster below for full-time and part-time faculty teaching major core courses in the proposed program.

NAME	**COURSES TAUGHT**	**ACADEMIC DEGREES AND COURSEWORK**	**OTHER QUALIFICATIONS AND COMMENTS**
List name & identify faculty member as "F" (full-time) or "P" (part-time).	Include term; course prefix, number and title; & credit hours. Identify courses as D, UN, UT or G.	List relevant courses taught, including institution and major.	Note qualifications and comments as they pertain to courses taught.
Babak Bazrgari (F)	*Fall, BME 541 (3 cr., G)*	*same, UK*	*Primary faculty Department of BME*
Abhijit Patwardhan (F)	*Fall BME 405 (3 cr. UT)*	*same, UK*	*Primary faculty Department of BME*
David Pienkowski (F)	*Spring, BME 201,302,330*	*same, UK*	*Primary faculty Department of BME*
Elaine Duncan (P)	*Fall BME 302 (3 cr., D)*	*same, UK*	*Adjunct faculty Department of BME*
Babak Bazrgari (F)	*Spring BME 440 (3 cr.,UT)*	*same, UK*	*Primary faculty Department of BME*
Guigen Zhang (F)	*Fall BME 488 Spring 435*	*same, UK*	*Primary faculty Department of BME*
Sridhar Sunderam (F)	*Fall BME 505, 515 (3 crG)*	*same, UK*	*Primary faculty Department of BME*
Sridhar Sunderam (F)	*Spring BME 579 (3 cr., G)*	*same, UK*	*Primary faculty Department of BME*
Guoqiang Yu (F)	*Spring BME 530 (3 cr., G)*	*same, UK*	*Primary faculty Department of BME*
supplement 4d has full BME faculty rosterl	*present form*	*prohibits full faculty list*	
F = full time P= part time	D = developmental UN = undergraduate nontransferable UT = undergraduate transferable G = graduate		

5. Assessment – Program Assessment and Student Learning Outcomes (SLOs)	
5a	Referring to program objectives, student benefits, and the target audience (questions 2b and 2f), explain how the *program* will be assessed, which is different from assessing student learning outcomes. Include how the faculty of record will determine whether the program is a success or a failure. List the benchmarks, the assessment tools, and the plan of action if the program does not meet its objectives. *(250 word limit)*
	The biomedical engineering faculty of record will gauge the successfulness of the proposed program by evaluating the following metrics: a) number of program applicants, b) applicant rejection rate, c) program-year mean student within-major grade point average, d) 4 and 5-year graduation rate, e) number of job offers per graduate, f) percentage of job offers originating from senior project design sponsors. *Success of the program after the 6th year of operation will be evaluated using the following benchmarks: a) 40 or more new applicants per year, b) 75% or greater acceptance rate, c) mean 3.2 GPA within major per year, d) 4-year graduation rate > 75%; 5-year graduation rate > 90%.* *If the program does not meet these benchmarks, then the BME faculty will appoint an ad hoc committee to interview: a) accepted applicants who did not matriculate, b) matriculated students who did not meet the required GPA, c) students who changed majors, d) students who withdrew from the degree program and college. Information obtained from these interviews will be used to define the measures needed to obtain these benchmarks.*
5b	*(related to section 14)* Append an assessment plan[10] for the SLOs to the end of this form. *(Click HERE for a sample assessment plan.)*
5c	Explain how the curriculum achieves the program level student learning outcomes by describing the relationship between the overall curriculum or the major curricular components and the program objectives. *(300 word limit)*
	The objective of the proposed program is to produce graduates with the ability to develop, communicate, and implement creative new solutions to contemporary challenges in human healthcare technology using engineering-based skills. FORM INCONSISTENCY - 5C TEXT NOT ITALICIZED - NO AUTHOR CONTROL OVER FONT STYLE The proposed curriculum achieves this program level student learning outcome by developing creative design-thinking abilities simultaneously with competency in STEM (science, technology, engineering, math) courses and the ability to integrate these skills to solve healthcare challenges. The proposed program has three main components: 1) foundational math, science (including biology), design and engineering courses, 2) biomedical engineering courses applying these foundational courses to healthcare, and 3) 2 senior design courses requiring cumulative skill application to real-world human healthcare problems. Student learning outcomes pertaining to creativity, STEM, and learned skills application will be assessed throughout the curriculum in design studios, STEM coursework, and during the senior design project, respectively. Students will demonstrate knowledge of STEM subjects, and will creatively apply theories, concepts and analytical methods to formulate and solve human healthcare problems. Culmination of proposed program acquired skills will be manifested and refined in the outcomes of the senior design project. This 2-semester mandatory course sequence requires students, under BME and CoD faculty supervision, to work with industry representatives to understand and formulate an engineering approach to an actual biomedical product design challenge and to provide a sound, creative, ethically and economically feasible solution to that problem. This solution is to be communicated in a variety of means including one-on-one discussions,

[10] An assessment plan is typically a tabular grid that illustrates the artifacts, rubrics, assessment team, and periods of assessment for the SLOs.

	group presentations, technical reports, conference proceedings/abstracts, and potentially peer-reviewed (scientific, clinical, or patent) publications.
5d	Append a PDF of the program's course map[11] to the end of this form. *(Click HERE for a sample curricular map.)*
5e	*(related to 2c)* Based on the SLOs from question 2c, which components will be evaluated, i.e. course mapping? For each student learning outcome identify in which courses it is covered in the curriculum and note whether employers, students, alumni, and/or faculty outside of the program were involved in the development of student learning outcomes. *(300 word limit).*
5f	When will components be evaluated? Identify the review cycle for each student learning outcome. (e.g, every semester or each year) *(150 word limit)*
	Biomedical engineering faculty will evaluate program components at the end of program year 2, 3 and 4, and trienially thereafter. BME faculty will evaluate attainment of program effectiveness determined by prescribed student learning outcomes manifested by homework assignments, exam scores, course project quality, oral questioning, and participation in optional research coursework. The process to be followed will be analogous to that employed to evaluate current master's and PhD students in biomedical engineering. The undergraduate student population will be divided by the number of faculty and each faculty member will report on the past academic year's progress of each assigned student.
5g	When will the data be collected? (This may or may not be different from when the assessment is *conducted*.) *(150 word limit)*
	Data will be collected continually and BME faculty will evaluate program components at the end of program year 2, 3 and 4 and triennially therafter. Annual program evaluation will be performed by the biomedical engineering faculty in mid-May each year. These evaluations will also be reviewed by the biomedical engineering external advisory board (12 members) when this group convenes each September. The first comprehensive program review will be conducted after the first full cycle of the program (mid-May of 2024 when the first group of students receives the proposed new degree). Subsequent comprehensive program reviews will be conducted after each 6th year of the program preparatory to ABET review. ABET, the Accreditation Board for Engineering and technology, is a nonprofit organization that accredits post-seconary education programs in applied and natural science, computing, engineering and engineering technology.
5h	How will the data be collected? *(150 word limit)*
	Administrative assistants from the department of biomedical engineering will collect emails, Excel grade files, graded assignment sheets, and progress evaluation forms provided by BME faculty regarding student learning outcomes manifested by homework assignments, exam scores, course project quality, oral questioning, and participation in optional research coursework. Assistants will prepare summaries of these learning outcomes categorized as unsatisfactory, fair, good, or excellent based upon established grading standards. This information will be presented to the proposed direcctor of undergraduate studies and then assimilated into formal reports for the BME faculty.
5i	What will be the benchmarks and/or targets to be achieved? *(150 word limit)*
	Benchmarks for student success will be: a) within-year Grade Point Averages of at least 3.2, b) a rating of "good" or better on 70% of homeworks, exams, course project quality, oral questions, class project or optional research performance.
5j	What individuals or groups will be responsible for data collection? *(150 word limit)*

[11] Course mapping (or "curricular mapping") is a representation of how faculty intend to approach and assess each of the student learning outcomes identified for the courses for the degree program, with an emphasis on courses required for all degree candidates. It is a master chart that indicates which objectives are being met, to what extent, and how often. This identifies whether an objective is "introduced," "developed," and/or "mastered" within a given course; it may be helpful also to chart any classroom-based assessment measures used to demonstrate that claim.

	Course instructors of record will collect and de-identify course data, then share data with the director of undergraduate studies who will prepare summaries for the BME faculty, and when necessary, College of Design faculty.
5k	How will the data and findings be shared with faculty? *(150 word limit)*
	Summaries of student learning outcomes will be placed on password protected share drives and made available to biomedical engineering faculty, and as appropriate, College of Design faculty. Printed copies or Power Point images of this information, de-identified to preserve student anonymity, will be prepared and presented to the BME advisory Board Meeting (early each Fall semester) and to the BME faculty during their annual program review meeting (end of Spring semester). BME faculty, and when appropriate, College of Design faculty, will review this information.
5l	How will the data be used for making programmatic improvements? *(150 word limit)*
	Systematics deficiencies in student learning outcomes will be noted and the BME faculty provide suggestions for improvements. Courses associated with lower than expected grades or student learning outcomes will be evaluated by the faculty and remediation efforts will be implemented.
5m	What are the measures of teaching effectiveness? *(150 word limit)*
	Measures of teaching effectiveness include demonstration of student abilities to achieve ABET specified educational outcomes (Table 1).
5n	What efforts to improve teaching effectiveness will be pursued based on these measures? *(150 word limit)*
	The department chair or the director of undergraduate studies will attend classes taught by the Instructor of Record in which sub-standard student learning outcome metrics are discovered. BME faculty, and as necessary other faculty, will provide recommendations for curriculum modification or teaching improvement as necessary.
5o	What are the plans to evaluate students' post-graduate success? *(150 word limit)*
	Post graduate student success will be evaluated by measuring: a) students achieving professional positions in biomedical engineering, b) number of job offers received by each student, c) duration of employment at each position, d) promotions received, e) patents issued with graduate as named inventor, e) publications listing graduate as co-author, and f) products created by graduate.

6. Miscellaneous

6a	Is there anything else about the proposed program that should be mentioned? *(150 word limit)*
	The proposed BS in BME program is the first of a planned series of academic educational collaborations between UK's College of Design and UK's Department of Biomedical Engineering. To provide additional career opportunities for students, increase enrollment, and meet societal needs for creative solutions to healthcare challenges, dual bachelor's, bachelor's/master's and dual master's degree programs with these two units will be developed in succeeding years based upon successes obtained from the proposed bachelor's program in Product Design and the proposed bachelor's program in Biomedical Engineering.

7. Specific Course Requirements. [S, R]

UK Core Requirements

		Course Prefix and Number	Number of Credit Hours
7a	I. Intellectual Inquiry (one course in each area)		
	Arts and Creativity	*EGR 101 & 103*	*3*
	Humanities	*elective Spring Year 2*	*3*
	Social Sciences	*elective Fall Year 3*	*3*
	Natural/Physical/Mathematical	*PHY 231/*	*4*

7b	II. Composition and Communication		
	Composition and Communication I	CIS or WRD 110	3
	Composition and Communication II	CIS or WRD 110	3
7c	III. Quantitative Reasoning (one course in each area)		
	Quantitative Foundations	*MA 113*	*4*
	Statistical Inferential Reasoning	*STA 381*	*3*
7d	IV. Citizenship (one course in each area)		
	Community, Culture and Citizenship in the USA	*elective Spring Year 3*	*3*
	Global Dynamics	*elective Spring Year 4*	*3*
7e		**Total UK Core Hours:**	*35*

7f	**Graduation Composition and Communication Requirement (GCCR)**	
7f.i	How will the GCCR be delivered in the proposed program? For each box checked, list the prefix and number for the relevant course(s), including any cross-listing(s).	
	☒ Single course within the program's home unit.	*BME 421 note author uncorrectable error embedded in form 3rd line item 7b - should be WRD 111*
	☐ Multiple courses within the program's home unit.	
	☐ Single course from outside[12] the program's home unit.	
	☐ Multiple courses from outside[11] the program's home unit.	
	☐ Combination of course(s) from inside and outside[11] the program's home unit.	

7f.ii	Course	Prefix & Number	Course Status[13]
	Course #1	*BME421*	New
	Course #2 (☒ Not applicable.)		Select one....
	Course #3 (☒ Not applicable.)		Select one....
	Course #4 (☒ Not applicable.)		Select one....

7f.iii	Provide a narrative regarding this program's GCCR, for inclusion in the Bulletin.
	Biomedical engineering is a multidisciplinary field requiring effective oral and written communications with individuals of widely varying backgrounds. Pedagogical instruction provided in WRD 110 and WRD 111 will culminate with critically reviewed oral and written assignments during the senior design project.

7g	**College-level Requirements**
	How will college-level requirements be satisfied?

[12] You must include a letter of support from the other unit. The letter must address delivery mechanisms and resources allocated for the specified GCCR course(s). Please convert the letter to a PDF and append to the end of this form.

[13] Use the drop-down list to indicate the current status of the course, i.e. if the course is an existing course that will not be changed, if the course is an existing course that will be changed, or if the course is a new course.

	☒ Standard University college requirement	List course(s): *MA 113, 114, 213, 214; PHY 231, 232, 241,242; CHE 105, 107; EGR 101, 102, 103; BIO 148, 152, WRD 110, 111, STA 381*
	OR	
	☐ Specific course(s)	List course(s):

Use the grids below to list core courses, electives, courses for a track, etc.
Use the course title from the Bulletin or from the most recent new/change course form.

7h*	**Program Major Core Courses.** (Required for all students in the program and includes pre-major and pre-professional courses. Check the appropriate box to describe the course as either "program core" or "pre-major/pre-professional".)			
Prefix & Number	Course Title	Type of Course	Credit Hrs	Course Status[13]
BME 201	*Introduction to Biomedical Engineering*	☐ Pgm Core ☒ Pre-major/prof	*3*	New
BME 302	*Design Strategies for Biomedical Engineering*	☒ Pgm Core ☐ Pre-major/prof	*3*	New
BME 330	*Experimental Methods in Biomed Engineering*	☒ Pgm Core ☐ Pre-major/prof	*3*	New
BME 435	*Computer Modeling of Complex Systems*	☒ Pgm Core ☐ Pre-major/prof	*4*	New
EGR 101	*Engineering Exploration I*	☐ Pgm Core ☒ Pre-major/prof	*1*	Existing
STA 381	*Engineering Statistics - A Conceptual Approach*	☒ Pgm Core ☐ Pre-major/prof	*3*	Existing
PGY 412g	*Physiology*	☒ Pgm Core ☐ Pre-major/prof	*4*	Existing
PRD/BME372	*User Experience & Interface for Product Design*	☒ Pgm Core ☐ Pre-major/prof	*1*	New
PRD/BME371	*Ergonomics*	☒ Pgm Core ☐ Pre-major/prof	*1*	New
BME 420	*Senior Design Project in Biomedical Engineering*	☒ Pgm Core ☐ Pre-major/prof	*3*	New
BME 421	*Senior Design Project in Biomedical Engineering II*	☒ Pgm Core ☐ Pre-major/prof	*3*	New
PRD 272	*Introduction to User Experience for Product Design*	☒ Pgm Core ☐ Pre-major/prof	*2*	New
PRD/BME350	*Materials and Processes*	☒ Pgm Core ☐ Pre-major/prof	*3*	New
EGR 102	*Fundamentals of Engineering Computing*	☐ Pgm Core ☒ Pre-major/prof	*2*	Existing
MA 113,114	*Calculus I and II*	☐ Pgm Core ☒ Pre-major/prof	*8*	Existing

MA 213,214	*Calculus III and IV*	☐ Pgm Core ☒ Pre-major/prof	*7*	Existing
PRD/BME451	*Integrated Entrepreneurship in Product Design*	☒ Pgm Core ☐ Pre-major/prof	*2*	New
PRD/BME170	*Human Anatomy for Design*	☒ Pgm Core ☐ Pre-major/prof	*3*	New
CHE105	*General College Chemistry I*	☐ Pgm Core ☒ Pre-major/prof	*4*	Existing
PRD 271	*Introduction to ErgonomicsI*	☒ Pgm Core ☐ Pre-major/prof	*3*	New
CHE 107	*General College Chemistry II*	☒ Pgm Core ☐ Pre-major/prof	*3*	Existing
EGR 103	*Engineering Exploration II*	☐ Pgm Core ☒ Pre-major/prof	*2*	Existing
PHY 231	*General University Physics*	☐ Pgm Core ☒ Pre-major/prof	*4*	Existing
PHY 241	*General University Physics Laboratory*	☐ Pgm Core ☒ Pre-major/prof	*1*	Existing
PHY 232	*General University Physics*	☐ Pgm Core ☒ Pre-major/prof	*4*	Existing
PHY 242	*General University Physics Laboratory*	☐ Pgm Core ☒ Pre-major/prof	*1*	Existing
WRD110 &111	*Composition and Communication I& II*	☐ Pgm Core ☒ Pre-major/prof	*6*	Existing
PRD/EGR250	*Computer Aided Design: SolidworksI*	☒ Pgm Core ☐ Pre-major/prof	*2*	New
BIO 148	*Introductory Biology I*	☐ Pgm Core ☒ Pre-major/prof	*3*	Existing
BIO 152	*Principles of Biology II*	☐ Pgm Core ☒ Pre-major/prof	*3*	Existing
		Total Core Courses Credit Hours:	*37*	

7i	Is there any narrative about pre-major or pre-professional courses for the program that should be included in the Bulletin? If "Yes," note below. (150 word limit)	Yes ☒	No ☐
	Pre-major coursework in the Bachelor of Science in Biomedical Engineering program provides students with essential skills in biology, chemistry, math, physics and communication needed for biomedical engineering.		
7j	Is there any narrative about core courses for the program that should be included in the Bulletin? If "Yes," note below.	Yes ☐	No ☒

Program Guided Electives[14] (Guided electives for all students in the program.) ☒ **Not Applicable**

[14] Program guided electives are available to all students in the program and are organized as groups of elective courses, from which a student chooses one (or two, or three, etc.).

7k*	Does the program include any guided electives? (If "No," indicate & proceed to 7n.)	Yes ☒	No[15] ☐
7l	Is there any narrative about guided electives courses that should be included in the Bulletin? If "Yes," note below. (150 word limit)	Yes ☒	No ☐
	Guided engineering electives (9 credit hours total) provide students with foundational engineering skills needed for biomedical engineering coursework. Students choose 3 of 8 electives, among which is EE 211 or EE 305 (but not both) These guided engineering electives equip students with basic engineering skills needed in subsequent basic and advanced biomedical engineering courses.		
7m*	Using the grid provided, list the guided electives below.		

Prefix & Number	Course Title	Credit Hrs	Course Status
	Guided engineering electives (choose 3 courses/9 credit hours from the following list of courses)		Select one....
EE 305	*Electronic Circuits and Electronics*	*3*	Existing
EM 221	*Statics*	*3*	Existing
EM 302	*Mechanics of Deformaable Solids*	*3*	Existing
EM 313	*Dynamics*	*3*	Existing
CME 200	*Process Principles*	*3*	Existing
CME 320	*Engineering Thermodynamics*	*3*	Existing
ME 340	*Introduction to Mechanical Systems*	*3*	Existing
EE 211	*Circuits I*	*3*	Existing
			Select one....
			Select one....
	Basic BME Electives (choose 3 courses/9 credit hours from the following)		Select one....
BME 405	*Introduction to Biomedical Signal Processing*	*3*	Existing
BME 470	*Biosolid Mechanics*	*3*	Existing
BME 472	*Human Biomechanics*	*3*	Existing
BME 481g	*Selected Topics in Biomedical Engineering (may not be repeated)*	*3*	Existing
BME 485	*Fundamentals of Biofluid Mechanics*	*3*	Existing
BME 488	*Fundamentals of Biomaterials*	*3*	Existing
	Advanced BME electives (choose 2 courses/6 credit hours from among the following list of courses)		Select one....
BME 508	*Cell Mechanics and Mechanobiology*	*3*	Existing
BME 515	*Modeling of Physiologic Systems*	*3*	Existing
BME 530	*Biomedical Instrumentation*	*3*	Existing
BME 540	*Mechanical Modeling of Human Motion*	*3*	Existing
BME 395	*Independent Research in Biomedical Engineering (may not be repeated)*	*3*	Existing

[15] If "No," proceed to question 7n.

			Select one....
			Select one....
			Select one....
			Select one....
			Select one....
			Select one....
			Select one....
			Select one....
			Select one....
			Select one....
	Total Credit Hours as Guided Electives:	*9*	

7n*	**Program Free Electives[16].** (Free electives for all students in the program, which includes general elective hours required by college and/or University (e.g. UK Core) for degree completion.)	☒ **Not Applicable**
7o*	What is the total number of credit hours in free electives?	*0*
7p	Provide a narrative, including course prefixes, about free electives courses that will be included in the Bulletin. (150 word limit)	

7q	**Courses for a program's track(s).** Check the appropriate box to describe the course as either "a core course for the track" or "an elective course for the track." *(Click HERE for a template for additional tracks[17].)*			☒ **Not Applicable**
	Track name:			
Prefix & Number	Course Title		Credit Hrs	Course Status
		☐ Track Core ☐ Track Elective		Select one....
		☐ Track Core ☐ Track Elective		Select one....
		☐ Track Core ☐ Track Elective		Select one....
		☐ Track Core ☐ Track Elective		Select one....
		☐ Track Core ☐ Track Elective		Select one....
		☐ Track Core		Select one....

[16] Program free electives are available to all students in the program and the choice of which course(s) to take is up to the student. The courses are not grouped and are sometimes described as "student must take three courses at the 400-level or above."

[17] Append a PDF with each track's courses to the end of this form.

		☐ Track Elective		
		☐ Track Core ☐ Track Elective		Select one....
		☐ Track Core ☐ Track Elective		Select one....
		☐ Track Core ☐ Track Elective		Select one....
		☐ Track Core ☐ Track Elective		Select one....
		Total Credit Hours Track:		

7r	Is there any narrative about courses for a track that should be included in the Bulletin? If "Yes," note below. (150 word limit)	Yes ☐	No ☒

7s	Total Credit Hours Required by Level. (below)				
	100-level: *32*	200-level: *36*	300-level: *29*	400-level: *25*	500-level: *6*

7t	What is the total number of credit hours required for the degree? (e.g. 120, 126)	*128*
	If an explanation about the total credit hours is necessary, use the space below. *(150 word limit)*	
	The Bachelor of Science in Biomedical Engineering program offers a purpose-driven blend of science, math, engineering, and product design courses intended to provide students with the ability to develop creative approaches to implementing program-acquired technical skills addressing contemporary healthcare challenges. The depth and breath of learning required to achieve this goal requires 128 credit hours of coursework.	

8. Degree Plan

8a	Create a degree plan for the proposed program by listing in the table below the courses that a typical student would take each semester. If multiple tracks are available, click HERE for a template for additional tracks. Append a PDF with each track's semester-by-semester program of study to the end of this form.			
	YEAR 1 - FALL:	*MA 113, PHY 231, PHY 241, CIS/WRD 110, EGR 101, EGR 102*	**YEAR 1 - SPRING:**	*MA 114, CHE 105, CIS/WRD 111, EGR 103, BIO 148*
	YEAR 2 - FALL :	*MA 213, PHY 232, PHY 242, BIO 152, BME 201, guided engineering elective I*	**YEAR 2 - SPRING:**	*MA 214, CHE 107, PRD/BME 170, PRD 272, guided engineering elective II, UK Core (humanity)*
	YEAR 3 - FALL:	*BME 302, BME 435, guided engineering elective III, PRD/BME 250, PRD/BME 371, UK Core III (social sciences)*	**YEAR 3 - SPRING:**	*STA 381, BME 330, PRD/BME 350, BME basic elective I, PRD 372, UK Core IV (citizenship)*
	YEAR 4 - FALL:	*BME 420, PRD/BME 451, BME basic elective II, BME advanced elective I, PGY 412g*	**YEAR 4 - SPRING:**	*BME 421, BME basic elective III, BME basic elective IV, BME advanced elective II, UK Core (global dynamics)*

8b	With reference to the degree plan above, explain how there is progression in rigor and complexity in the courses that make up the program. *(150 word limit)*
	Coursework rigor, complexity, and skills required increase each semester, culminating the senior year when learned skills are applied in upper level biomedical engineering coursework and the senior design project. Basic science, math, and engineering courses taken during the freshman and sophomore years provide the foundation for basic engineering coursework that increases in complexity. Escalating course numbers in the proposed curriculum reflect advancing academic rigor and complexity.

9. Approvals/Reviews

Information below about the review process does not supersede the requirement for individual letters of support from educational unit administrators and from educational subunit administrators.

		Reviewing Group Name	**Date Approved**	**Contact Person Name/Phone/Email**
9a	(Within College)			
		Department	*4/2/18*	*David Pienkowski / 8-1667 / pienkow@uky.edu*
		Department	*4/2/18*	*Guigen Zhang / 3-7217 / guigen.bme@uky.edu*
		College	*12/21/18*	*Kim Anderson / 7-1864 / kimberly.anderson@uky.edu*
				/ /
9b	(Collaborating and/or Affected Units)			
		College of Design	*3/4/19*	*Mitzi Vernon / 7-7619 / vernon@uky.edu*
				/ /
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		Date Approved	**Contact Person Name**
9c	(Senate Academic Council)		
	Undergraduate Council	*10/1/19*	*Joanie Ett-Mims*
	Health Care Colleges Council (if applicable)		

INFORMATION REQUIRED BY CPE AND SACS	
10. Program Overview – Program Quality and Student Success	
10a	Highlight any distinctive qualities of the proposed program. Are any faculty nationally or internationally recognized for expertise in this field? Does this program build on the expertise of an existing locally, nationally, or internationally recognized program at UK? *(300 word limit)*
	There are three distinctive qualities of the proposed bachelor of science in biomedical engineering program. *This proposed program is unique due to simultaneous educational and experiential emphases on cultivating design-thinking amid a rigorous technical biomedical engineering curriculum. The proposed program will confer graduates with a distinct competitive edge in the employment marketplace.* *Students in the proposed program will benefit from unique learning experiences jointly contributed by internationally recognized faculty from the Colleges of Engineering, Design, Medicine, etc. These faculty will collaborate to provide mutually agreed assignments, joint lectures, design-project mentoring, as well as research-project mentoring. Students will receive from these faculty an extraordinarily rich exposure to a wide variety of classroom lectures, laboratory sessions, studio experiences, and immersion in actual industrial related healthcare challenges.* *Industry represenatives will contribute real-world biomedical product development challenges to senior project design students in this program, and thereby provide access to industrial technologies and learning experiences that rival those of co-ops. Furthermore, this experience will facilitate post-graduate employment of proposed program graduates.*
10b	Clearly state the student admission, retention, and completion standards designed to encourage high quality. *(300 words)*
	See attached Supplement to item 10b.
10c	Describe how the proposed program will articulate with related programs in the state. Include the extent to which student transfer has been explored and coordinated with other institutions. Note: Convert all draft articulation agreements related to this proposed program to PDF and append to the end of this form. *(300 word limit)*
	There is no planned articulation of the proposed BS in Biomedical Engineering with other programs in the state. The proposed program does have considerable articulation with the concurrently proposed Bachelors Degree in Product Design from the UK College of Design.
10d	Identify the applicant pool and how applicants will be reached. *(300 word limit)*
	The applicant pool for the proposed Design Thinking BS in BME degree includes all students seeking a career using technology to improve human healthcare. *Specifically identified potential applicants include:* *1) high school graduates considering careers in medicine, dentistry, or law, and* *2) high-school students contemplating a career in engineering, but who have not yet been exposed to the field of biomedical engineering, and* *3) first year UK College of Engineering students uncommitted to a particular field of engineering.* *Potential applicants will be reached by telephone calls to high school guidance counselors, visits to selected high school programs potentially coupled with exhibits or presentations, program advertisements at e-Day engineering events, presentations to University freshman guidance counselors, and program promotion during engineering orientation week.*
11. Mission: Centrality to the Institution's Mission and Consistency with State's Goals	
11a*	*(related to 2b)* Explain how the program objectives support at least two aspects of UK's institutional mission and academic strategic plan? *(150 word limit)*

	The proposed program supports the mission of the university by educating the next generation of leaders who will use their newly acquired skills to improve human well-being through creative solutions to technical healthcare challenges. *Transformational education is one of the outcomes of the novel curriculum of the proposed program. It offers prospective students a unique opportunity to combine technical and design educational experiences that lead to unique, career-transforming opportunities.* *The proposed program also contributes to regional economic development. Coalescence of UK biomedical engineering and design faculty, together with program graduates and industrial representatives, may provide the basis for new biomedical product-design based organizations in the Lexington area. These design consulting firms may in turn lead to relocation of existing or construction of new product manufacturing firms in the greater Lexington area.*
11b*	*(related to 2b)* How do the program objectives support at least two aspects of the Council on Postsecondary Education's (CPE) Strategic Agenda and the statewide implementation plan? *(300 word limit)*
	The proposed program improves educational opportunities for Kentucky residents. If offers a creative new opportunity for obtaining a higher post-secondary education in a healthcare-related field. This will promote attainment of the goal of 60% of the Kentucky population with a post-secondary degree. *The proposed program offers a unique new opportunity for creating new Kentucky based biomedical product design companies. The ensuring economic benefits from such newly established companies will partially satisfy one of the goals of the CPE Strategic Agenda.*
11c*	If an approval letter from an Education Professional Standards Board (EPSB) is required, check the box below and append a PDF version of the letter to this form. ☐ (E.g. any program leading to teacher, principal, or superintendent certification, rank change, etc.)
12. Resources	
12a*	How will the program support or be supported by other programs within the institution? For example, shared faculty, shared courses, collaborative research, etc. *(300 word limit)*
	The proposed bachelor's program in biomedical engineering (BME) in the College of Engineering (CoE) will have a symbiotic relationship with the concurrently proposed Bachelor's Degree in Product Design from the UK College of Design (CoD). *Specifically, faculty from the CoD will work collaboratively with faculty from BME to teach product design basics and supervise student work in studio based medical product design exercises. Faculty from BME will work collaboratively with faculty from the CoD to teach students regarding the technical constraints implicit in healthcare technology. Faculty from both units will co-mentor students during the proposed senior design projects in BME 420 and BME 421). Classroom, laboratory, studio spaces and equipment will be shared between the CoE and CoD to provide a rich learning environment for students in the proposed BS in BME program as well as students in the proposed BS in Product Design program. Faculty from both colleges will pool their collective industrial relationships to create relevant and impactful senior design projects for program students, as well as to foster robust employment of program graduates.*
12b	What will be the projected "faculty-to-student in major" ratio? *(150 word limit)*
	Given the present effective 5.75 BME faculty members and the planned enrollment of 40 students per year (120 students in BME program specific years 2 to 4) in the proposed BS in BME program, the within major faculty-to-student ratio is expected to be 1:21. Hence, additional full-time faculty with a primary appointment in BME will be acquired beginning in year 3 of the proposed program. These faculty will be added approximately one per year resulting in an improvement in this ratio such that the research excellence and productivities of the faculty will not be adversely affected in the beginning years of the proposed program. Within-major faculty-to-student ratio is expected to be 1:15.5 after year 4 of the proposed program.

12c	Describe the library resources available[18] to support this program. Access to the qualitative and quantitative library resources must be appropriate for the proposed program and should meet recognized standards for study at a particular level or in a particular field where such standards are available. Adequacy of electronic access, library facilities, and human resources to service the proposed program in terms of students and faculty will be considered. *(300 word limit)*
	The University of Kentucky, the flagship public university for the Commonwealth of Kentucky, maintains the premier research library in the state. This library is composed of 11 major facilities: William T. Young Library, Agricultural Information Center, Hunter M. Adams College of Design Library, Education Library, Shaver Engineering Library, John A. Morris Equine Library, Lucille Caudill Little Fine Arts Library, Medical Center Library, Science Library, Special Collections, and the Kentucky Transportation Center Library. *Collections and information resources available from the UK Library website include 4,023,142 volumes, 588,428 electronic books, more than 400 commercial databases, approximately 27,000 linear feet of manuscripts and archives, and a broad collection of computer files, microforms, maps, film/video, audio and graphics. Annual collections expenditures total more than $11.1 million. In FY12, 6.6 million searches were conducted in licensed databases and 2.8 million full-text articles were downloaded.* *UK Libraries collections support teaching, learning, and research in agricultural sciences, life sciences, chemistry, geological sciences, mathematics, physics, humanities, history, social sciences, economics, communications, information studies, business, fine arts, medicine, nursing, dentistry, health sciences, engineering, computer science, and veterinary science.*
12d	Describe the physical facilities and instructional equipment available to support this program. Physical facilities and instructional equipment must be adequate to support a high-quality program. Address the availability of classroom, laboratory, and office space, as well as any equipment needs. *(300 word limit)*
	The department of biomedical engineering, in addition to individual faculty laboratories, offers shared-use and collaborative environmental capabilities including: design and development of smart medical devices, electromechanical testing of biomaterials and structures, microcomputed tomography, diffuse optical spectroscopy and tomography, advanced signal processing of cardiovascular and neural phenomena, computational analysis of musculoskeletal systems and evaluation of cellular and tissue mechanics. This department also has full access to all facilities of the College of Engineering. *The College of Design has three major resources: design studio, fabrication lab, and shop facilities. The design studio is the facility where innovative design solutions to a wide range of spatial challenges become reality. Studio offers hands-on experiences requiring students to become a key component in a culture of critical thinking and creativity that challenges, exercises, and expands preconceptions and encourages formulation of new ideas that stimulate the imagination. Studio is a unique environmental experience that stimulates curiosity and propels students to foster their own vision for the future of biomedical technological environment.* *Studio requires that students "get their hands dirty" testing new intellectual ideas and evaluating creative solutions through drawings, models, scale mockups and digitally fabricated prototypes. This is a group endeavor where learning also occurs by observing faculty and fellow students all working together collaboratively to solve biomedical technological challenges. Learning occurs by project critique, exchange of techniques, and sharing ideas throughout all stages of the design process.* *The Workshop and Digital Fabrication Lab provides a safe, well-maintained environment in which both students and faculty can explore three-dimensional construction in natural (wood, metal, ceramic) and artificial media. Shop facilities provide standard materal shaping tools, e.g. lathe, grinder, milling machine, welding, etc. and hand tools.*

13. Demand and Unnecessary Duplication

[18] Please contact OSPIE (OSPIE@L.uky.edu) for more information.

13a*	Provide justification and evidence to support the need and demand for this proposed program. Include any data on student demand, career opportunities at any level, or any recent trends in the discipline that necessitate a new program. *(300 word limit)* • This evidence is typically in the form of surveys of potential students and enrollments in related programs at the institution. • Anecdotal evidence is insufficient. Demonstrate a systematic collection of data, thorough study of the data, and a reasonably estimated student demand for the program. • Provide evidence of student demand at state and national levels.		
	The United States spent 17.1% of Gross National Product on healthcare in 2014. This percentage is expected to increase to 19.9% by 2025. Advanced healthcare technology, while partially responsible for this escalating cost, is also partially the solution. Development of such technology relies upon human workforce development, and in turn, biomedical engineering educational programs that prepare the next generation of engineers. *This may help explain why biomedical engineering programs enjoy robust enrollments in the top 10 (US News & World Report) engineering schools. Recently published undergraduate enrollments are Georgia Tech (1,300), Hopkins (480), MIT (149), Duke (263), Stanford (graduate only), UC San Diego (~2,500), UC Berkeley (400), Rice University (~200), University Michigan (~200), and University Pennsylvania (~ 300).* *The proposed program is unlike all other existing BME programs due to its curriculum design and intended mission. The integral juxtaposition of engineering and design courses, together with laboratory, studio and industry-immersive experiences, will equally develop both technical engineering and creative design skills in students. The mission of proposed program graduates is to create a new era of biomedical technology that cost effectively advances human healthcare and well being, increases access to healthcare, or provides standard of care equivalent healthcare quality at substantially reduced cost.* *Demand for this program is manifested by student enrollment in our BME minor (currently 30 students), oral expression of student interest, and enrollment data at other institutions.*		
13b	Clearly state the degree completion requirements for the proposed program. *(150 word limit)*		
	Requirements for successful program completion include: completion of University & College requirements regarding writing & UK Core, completion of 128 credit hours, exclusive of those earned in freshman college algebra and freshman college trigonometry, with cumulative standing of at least 2.0 on a 4.0 scale, be admitted to engineering standing in an engineering program for at least the final semester & complete the requirements of that program, complete at least 24 credit hours of departmental courses at or above the 300 level, complete all departmental courses and technical electives with a cumulative standing of at least 2.0 on a 4.0 scale, successful team performance on the senior design project and successful completion of both oral and written defense of this project.		
13c*	Will this program replace or enhance any existing program(s) or tracks (or concentrations or specializations) within an existing program? *(300 word limit)*	Yes ☐	No ☒
	If "Yes," explain:		
13d	Identify the primary feeders for the program. *(150 word limit)*		
	Primary feeders for the proposed program include all students seeking a career in the healthcare technology field. Specific program feeders include, but are not limited to: *1) high school STEM (science, technology, engineering, math) majors considering careers in medicine, dentistry, or law),* *2) high-school students contemplating a career in engineering, but who have not yet been exposed to the field of biomedical engineering,* *3) first year UK College of Engineering students uncommitted to a particular field of engineering.*		
13e	Describe the student recruitment and selection process. *(300 word limit)*		

	Students will be recruited by a variety of means. University of Kentucky representatives will visit area high schools, particularly those with STEM programs, to inform guidance counselors and select student groups regarding the proposed new Bachelor of Science in Biomedical Engineering degree program. Promotional materials will be developed for and distributed to these counselors. Web and social medial advertising will be created to advise prospective high school students of the new program. The new program will also be featured in ongoing University activities, particularly e-Day (engineering) open house events held annually and which attract motivated high school students. *Program promotion will also occur through UK website advertising and news releases. All incoming engineering freshman will, on orientation day, receive an information briefing regarding the proposed new program. In addition, the field of biomedical engineering will be showcased during the required freshman engineering courses EGR 101 (Engineering Exploration) and promoted at the annual meeting of the Biomedical Engineering Society.* *Applicants to the proposed program will be selected based upon high school GPA scores, ACT scores, and demonstrated extracurricular activities (including design experiences). Initial class enrollment is expected to be a maximum of 40 students per class.*
13f*	Specify any distinctive qualities of the proposed program. *(300 word limit)*
	The proposed program is distinctive because of the unique technology and integral design curriculum. Furthermore, execution of this curriculum will be aided by the unique environment at the University of Kentucky, particularly the close academic and geographic relationships between the UK College of Design and College of Engineering and the energetic and visionary leadership provided by the new deans and chairs of the involved units. *All other biomedical engineering programs focus heavily, if not exclusively, on technology based education. The proposed program is distinctive because it provides a strong academic design component integrated with the technology-based biomedical engineering curriculum. The proposed program does not sacrifice science or engineering rigor to achieve this goal. Students completing the program will gain an extraordinarily useful and professionally powerful set of career-sustaining skills enabling them to create innovative new biomedical technologie and thereby address pressing contemporary global healthcare challenges.*
13g	Provide any evidence of a projected net increase in total student enrollments to the campus as a result of the proposed program. *(300 word limit)*
	Healthcare and biotechnology are the gold rush of the 21st Century. Kentucky residents who seek a bachelors degree in biomedical engineering have the University of Louisville as their only current choice for an undergraduate degree in this major. Recent cmmunication with colleagues at the U of L indicates that they reject approximately 50 students per year from their program due to their self-imposed enrollment cap. Activation of the proposed degree program at UK will enable in-state retention of many of these Kentucky residents and draw others to UK who would ordinarily seek education at non-Kentucky institutions.
13h	Use table below to estimate student demand for the first five years following implementation.

	Academic Year	# Degrees Conferred	Majors (headcount) Fall Semester
	20*20* - 20*21*	*0*	*32*
	20*21* - 20*22*	*0*	*70*
	20*22* - 20*23*	*0*	*110*
	20*23* - 20*24*	*28*	*120*
	20*24* - 20*25*	*35*	*120*

13i	Clearly describe all evidence justifying a new program based on changes in the academic discipline or other academic reasons. *(300 word limit)*
	The United States spent 17.1% of Gross National Product on healthcare in 2014. This percentage is expected to increase to 19.9% by 2025. Advanced healthcare technology, while partially responsible for this

	escalating cost, is also partially the solution. Development of such technology relies upon human workforce development, and in turn, biomedical engineering educational programs that prepare the next generation of engineers. *Biomedical engineering programs are the largest departments in the top 10 (US News & World Report) engineering schools. Recently published undergraduate enrollments are Georgia Tech (1,300), Hopkins (480), MIT (149), Duke (263), Stanford (graduate only), UC San Diego (~2,500), UC Berkeley (400), Rice University (~200), University Michigan (~200), and University Pennsylvania (~ 300).* *Many programs offer bachelor's degrees in biomedical engineering, but all focus exclusively on the science, math and technology aspects of this field. Innovation in healthcare technology; however, is not solely determined by technological prowess. Instead, it is punctuated by creative application of these technical skills in a humanistic and economically relevant manner. No program offers a curriculum that simultaneously incorporates technical, creative, and empathetic educational experiences to create a new breed of biomedical engineer. Addressing this pressing societal need is the motivation for the proposed new program.*		
13j	Has the Council on Postsecondary Education identified similar programs?	Yes ☒	No ☐
	(Please contact OSPIE (OSPIE@L.uky.edu) for help with this question.)		
	If "Yes," the following questions (5h1 – 5h5) must be answered.		
(1)	Does the program differ from existing programs in terms of curriculum, focus, objectives, etc.? *(150 word limit)*	Yes ☒	No ☐
	If "Yes," explain: *While using the same CIP code, all other biomedical engineering programs focus heavily, if not exclusively, on science and technical learning. The proposed program is distinguished because in addition to the requisite sciences and engineering coursework, it provides a strong experiential (studios and shop) product design learning component integral to the technical component of the curriculum. These studio and shop experiences will incorporate design, prototyping, computational modeling, and immersive learning in nontraditional settings. These experiences are guided by faculty and fellow student inspired design-based thinking. Students completing the proposed program will gain an extraordinarily useful and professionally powerful set of skills that can be gainfully employed to create innovative new biomedical technologies that expand healthcare services in a cost-effective manner.*		
(2)	Does the proposed program serve a different student population (e.g., students in a different geographic area or nontraditional students) from existing programs? *(150 word limit)*	Yes ☐	No ☒
	If "Yes," explain:		
(3)	Is access to existing programs limited? *(150 word limit)*	Yes ☐	No ☒
	If "Yes," explain:		
(4)	Is there excess demand for existing programs? *(150 word limit)*	Yes ☒	No ☐
	If "Yes," explain: *Recent communication with colleagues at the University of Louisville (the only other institution in Kentucky that offers a Bachelor's Degree in Biomedical Engineering) indicates that they reject approximately 50 students per year from their program due to their self-imposed enrollment cap. Activation of the proposed degree program at UK will enable in-state retention of many of these Kentucky residents and draw others to UK who would ordinarily seek education at non-Kentucky institutions.*		
(5)	Will there be collaboration between the proposed program and existing programs? *(150 word limit)*	Yes ☒	No ☐
	If "yes," explain the collaborative arrangements with existing programs. If "no," explain why there is no collaboration with existing programs.		

	To enhance student learning through collaborative exchanges with the University of Louisville, the UK department of biomedical engineering will collaborate with U of L regarding efforts such as: a) joint seminars featuring invited speakers from industry, b) senior project design competitions judged by students and faculty from the opposite institution, c) KY student chapter of the Biomedical Engineering Society that includes UK and U of L BME students, and d) establishment of a KY Healthcare Challenge Forum that combines the imaginative talents of students and faculty from both institutions to identify cost-effective technological solutions to healthcare challenges unique to Kentuckians.		
13k*	Are there similar programs in other Southern Regional Education Board (SREB) states in the nation?	Yes ☐	No ☒
	If "Yes," please answer the questions below to demonstrate why this proposed program is needed in addition to the one(s) currently in existence.		
13k. i*	Identify similar programs in other SREC states and in the nation.		
13k.ii*	Does the program differ from existing programs in terms of curriculum, focus, objectives, etc.?	Yes ☐	No ☐
	If "Yes," explain. *(300 word limit)*		
13k.iii*	Does the proposed program serve a different student population (e.g., students in a different geographic area and non-traditional students) from existing programs?	Yes ☐	No ☐
	If "Yes," explain. *(300 word limit)*		
13k.iv*	Is access to existing programs limited?	Yes ☐	No ☐
	If "Yes," explain. *(300 word limit)*		
13k.v*	Is there excess demand for existing similar programs?	Yes ☐	No ☐
	If "Yes," explain. *(300 word limit)*		
13k.vi*	Will there be collaboration between the proposed program and existing programs?	Yes ☐	No ☐
	If "No," explain. *(300 word limit)*		
13l	Would your institution like to make this program available through the Academic Common Market[19]?	Yes ☒	No ☐
13m	Clearly describe evidence of employer demand or discipline needs. Such evidence may include employer surveys, current labor market analyses, and future human resources projections. Where appropriate, evidence should demonstrate employers' preferences for graduates of the proposed program over persons having alternative existing credentials and employers' willingness to pay higher salaries to graduates of the proposed program. *(300 word limit)*		
	United States Bureau of Labor Statistics (accessed 30 May 2018, last modified 13 April 2018)) states "employment of biomedical engineers is projected to grow 7 percent from 2016 to 2026, about as fast as the average for all occupations. Increasing numbers of technologies and applications to medical equipment and		

[19] Please contact OSPIE (OSPIE@L.uky.edu) for more information.

	devices, along with the medical needs of a growing aging population, will require the services of biomedical engineers."
13n*	Describe the types of jobs available for graduates, average wages for these jobs, and the number of anticipated openings for each type of jobs at the regional, state, and national levels.
	According to the U.S. Bureau of Labor Statistics, most biomedical engineers work in manufacturing, universities, hospitals, and research facilities of companies and educational and medical institutions. They usually work full time. Median pay (2017) for biomedical engineers (degree level unspecified) was $88,040/year or $42.33/hour. The number of job opportunities for biomedical engineers in 2016, according to this source, was 21,300. No information is available for state or regional job opportunties for biomedical engineers, but it is important to note that the proposed program offers the potential to create a biomedical product design think tank in the Lexington area, and thereby greatly expand the number of biomedical engineering related jobs in this area.
14. Assessment and Oversight	
14a	Describe *program* evaluation procedures for the proposed program. These procedures may include evaluation of courses and faculty by students, administrators, and departmental personnel as appropriate. Program review procedures shall include standards and guidelines for the assessment of student outcomes implied by the program objectives and consistent with the institutional mission. *(300 word limit)*
	The biomedical engineering faculty will annually gauge the success of the degree program by evaluating all student learning outcomes per ABET criteria (Table 1). In addition, the faculty will also assess the following metrics for the proposed program: a) number of applicants, b) applicant rejection rate, c) program-year mean student within-major grade point average, d) 4 and 5-year graduation rate, e) number of job offers per graduate, f) percentage of job offers originating with design sponsors. *Success of the proposed program after the 3rd year of operation will be marked by attainment of ABET accreditation for an initial three year period and a six-year period after the 6th year of proposed program operation. The following benchmarks will be used for self-assessment: a) 40 or more applicants/academic year, b) >25% applicant rejection rate, c) >3.2 mean GPA within major per year, d) 70% or more of students achieving overall score of "good" assessment of student learning outcomes, e) 4-year graduation rate > 75%; 5-year graduation rate > 90%, f) 2 or more job offers per graduate, g) > 50% of job offers from industrial sponsors of senior design projects.* *If the program does not meet these benchmarks, then the BME faculty of record will appoint an ad hoc committee to interview: a) accepted applicants who did not matriculate, b) matriculated students who did not meet the required GPA, c) students who changed majors, d) students who withdrew from the degree program and college, f) students who did not receive more than one job offer. These interviews will be conducted to assess the reasons for these events and establish corrective measures.* *Information regarding individual student progress will be obtained from BME faculty teaching students in the proposed BS in BME program. They will provide student learning outcome (SLO) data based upon exams, homeworks, oral questions posed in class, and course project assignments. This information will be obtained by the instructor of record for each student in each course and reported to the BME faculty.*
14b*	Describe how each program-level student learning outcome will be assessed and how assessment results will be used to improve the program. *(300 word limit)*
	Students who successfully complete the proposed program will be able to apply newly acquired technical engineering and design-centered thinking skills to solve human healthcare problems. They will be able to advance healthcare technology by understanding the design and conduct of experiments as well as the analysis and interpretation of the results. They will gain the ability to design new biomedical technologies within curriculum-taught system (anatomic, physiologic, economic, ethical, manufacturing, regulatory, safety, etc.) constraints. Graduates will be able to apply these new skills to benefit society by providing increased healthcare technology efficacy, greater accessibility, or equivalent efficacy/accessibility at lower cost.

	Learning outcome metrics will assess student abilities per ABET criteria (Table 1). In addition, students in the proposed program will be expected to define healthcare problems in engineering terms, integrate qualitative facts with appropriate quantitative relationships, and formulate specific practical solutions. Student levels of skill acquisition will be assessed by: a) oral and written examinations b) design studio performance, and c) senior design project quality per established metrics (Table 1). Faculty administering these evaluations will require minimum standards of competency that exceed the breadth and depth of standards required of undergraduate engineering students minoring in biomedical engineering, but less than the standards required of graduate students seeking a master's degree. Faculty review of student learning outcome metrics will be performed annually and changes to the curriculum will be implemented for the succeeding acadmic year to remedy any observed deficiencies in these metrics.

15. Cost and Funding of the Proposed Program[20]			
15a	Will this program require additional resources?	Yes ☒	No ☐
	If "Yes," please provide a brief summary of additional resources that will be needed to implement this program over the next five years. *(300 word limit)*		
	Implementation of the proposed program will require additional staff support beginning in year 1 and 4 additional new faculty beginning in year 2. These faculty will be needed to teach the existing and proposed new courses required by the proposed program. Resources for these faculty will be obtained from revenues derived from undergraduate tuition. *The required new faculty will be full-time regular tenure track faculty who will be recruited one per year starting the third year of the program. Implementation of the proposed new program will require modest new classroom, laboratory, and studio space.*		
15b	Will this program impact existing programs and/or organizational units within your institution? *(300 word limit)*	Yes ☒	No ☐
	If "Yes, briefly describe.		
	The proposed bachelor's program in biomedical engineering (BME) in the College of Engineering (CoE) will have a symbiotic relationship with concurrently proposed bachelor of science in product design from the UK College of Design (CoD). *Specifically, faculty from the CoD will work collaboratively with faculty from BME to teach students product design basics and supervise their work in studio exercises. Faculty from BME will work with faculty from the CoD to teach students regarding the technical constraints of engineering which are futher compounded by the unique aspects of human healthcare. Faculty from BME and the CoD will co-mentor students in their senior design projects. Classroom, laboratory, and studio spaces and equipment will be shared between the CoE and CoD to provide students pursuing the proposed BS in BME program a broad educational and experiential learning environment. Faculty from both colleges will pool their collective industrial contacts to create relevant and impactful senior design projects for students.*		
15c	Provide adequate documentation to demonstrate sufficient return on investment to the state to offset new costs and justify approval for the proposed program. Note whether the program is predicted to: increase retention rates; increase revenue; attract a new pool of students; meet employment needs in the state; feed into fields that have been shown to be beneficial to the economic needs of the state, etc. *(300 word limit)*		
	Amounts included under GRAND TOTAL, Total Net Cost are negative cost values for each of the 5 years of the proposed program. This denotes a net surplus of revenues minus expenses for each of these 5 years. Present design of the form will not permit editing of the "cost" designation, thus the "negative" sign prefix for "cost" denotes positive cash flow from the proposed BS in BME program.		

[20] For questions about cost and funding of the program, please contact your department chair, business officer, or associate dean for academic affairs.

16.* Budget Funding Sources, by Year of Program (Please answer in terms of dollar amounts.)					
(Please note – all the fields in number 16 are required for the CPE's pre-proposal form.)					
Total Resources Available from Federal Sources	1st Year	2nd Year	3rd Year	4th Year	5th Year
New					
Existing					
Narrative/Explanation:					
Total Resources Available from Other Non-State Sources:					
	1st Year	2nd Year	3rd Year	4th Year	5th Year
New					
Existing					
Narrative/Explanation:					
`					
State Resources	1st Year	2nd Year	3rd Year	4th Year	5th Year
New					
Existing					
Narrative/Explanation:					
Internal	1st Year	2nd Year	3rd Year	4th Year	5th Year
(New) Allocated Resources					
(Existing) Reallocated Resources					
Narrative/Explanation:					
Student Tuition	1st Year	2nd Year	3rd Year	4th Year	5th Year
New	*397868*	*897467*	*1455518*	*2056203*	*2441800*
Existing					
Narrative/Explanation:	*Tuition calculated for 32, 38, 40, 40 students from years 1 through 4 with 10% increase in out-of-state students annually. Assumes retention rates of 85%, 85%, 90%, and 90% for years 1 through 4, less scholarships awarded to 12% of students. This form will not permit inclusion of proper $ denotations for amounts noted above and below..*				
Total Funding Sources	1st Year	2nd Year	3rd Year	4th Year	5th Year
Total New	*397868*	*897467*	*1455518*	*2056203*	*2441800*
Total Existing					
17. Breakdown of Program Expenses/Requirements[4]					
(Please note – all the fields in number 17 are required for the CPE's pre-proposal form.)					
Staff: Executive, Administrative & Managerial	1st Year	2nd Year	3rd Year	4th Year	5th Year
New	*128000*	*263680*	*331635*	*337629*	*343803*
Existing					

Narrative/Explanation:	*Two administrative staff in year 1 to assist with marketing, operations, and student affairs. Increasing to a total of 4 staff in year 2 and 5 in year 3.*				
Faculty	1st Year	2nd Year	3rd Year	4th Year	5th Year
New		*121600*	*250496*	*387016*	*531503*
Existing	*30,580*	*31,803*	*33,075*	*34,398*	*35,774*
Narrative/Explanation:	*One new additional faculty per year from years 2 to5*				
Student Employees	1st Year	2nd Year	3rd Year	4th Year	5th Year
New		*75000*	*75000*	*100000*	*100000*
Existing					
Narrative Explanation/Justification:	*Two eaching assistants per year ($37,500/TA) starting year 2, increasing to 2.75 years 4 & 5.*				
Equipment and Instructional Materials	1st Year	2nd Year	3rd Year	4th Year	5th Year
New	*50000*	*50000*	*50000*	*50000*	*50000*
Existing					
Narrative Explanation/Justification:	*Program marketing expenses*				
Library	1st Year	2nd Year	3rd Year	4th Year	5th Year
New					
Existing					
Narrative Explanation/Justification:					
Contractual Services	1st Year	2nd Year	3rd Year	4th Year	5th Year
New					
Existing					
Narrative Explanation/Justification:					
Academic and/or Student Services	1st Year	2nd Year	3rd Year	4th Year	5th Year
New					
Existing					
Narrative Explanation/Justification:					
Other Support Services	1st Year	2nd Year	3rd Year	4th Year	5th Year
New					
Existing					
Narrative					

Explanation/Justification:					
Faculty Development	1st Year	2nd Year	3rd Year	4th Year	5th Year
New		*50000*	*50000*	*50000*	*50000*
Existing					
Narrative Explanation/Justification:	*faculty instructional materials attending development of on-line courses and conference attendance for undergraduate engineering education for all faculty*				
Assessment	1st Year	2nd Year	3rd Year	4th Year	5th Year
New	*$50,000*	*50000*	*50000*	*50000*	*50000*
Existing					
Narrative Explanation/Justification:	*Survey (alumni & industrial sponsors) instrument development, beta testing, administration, and analyses to assess programmatic effectiveness.*				
Other	1st Year	2nd Year	3rd Year	4th Year	5th Year
New					
Existing					
Narrative Explanation/Justification:					
Total Program Budgeted Expenses/Requirements	1st Year	2nd Year	3rd Year	4th Year	5th Year
New	*258580*	*642083*	*840206*	*1009043*	*1161080*
Existing					
TOTAL Program Budgeted Expenses/Requirements:	*note negative vales for estimated costs, as shown below, denote cash positive amounts*				
GRAND TOTAL	1st Year	2nd Year	3rd Year	4th Year	5th Year
TOTAL NET COST:	*-139228*	*-255384*	*-615313*	*-1047160*	*-1280721*

18. Course Descriptions

18a	**Program Core Courses (includes pre-major and pre-professional courses)**
Prefix & Number	Course Description (from the Bulletin or the most recent new/change course form)
MA 113	*Calculus I: a course in one-variable calculus, including topics from analytic geometry. Derivatives and integrals of elementary functions (including the trigonometric functions) with applications. Lecture, three hours; recitation, two hours per week. Students may not receive credit for MA 113 and MA 137. Prereq: Math ACT of 27 or above, or Math SAT of 620 or above, or a grade of C or better in MA 109 and in MA 112, or or a grade of C or better in MA 110, or appropriate score on math placement test, or consent of the department. Students who enroll in MA 113 based on their test scores should have completed a year of pre-calculus study in high school that includes the study of the trigonometric function. Note: Math placement test recommended.*
MA 114	*Calculus II: a second course in Calculus. Applications of the integral, techniques of integration, convergence of sequence and series, Taylor series, polar coordinates. Lecture, three hours; recitation, two hours per week. Prereq: A grade of C or better in MA 113, MA 137 or MA 132.*

MA 213	*Calculus III: a course in multi-variable calculus. Topics include vectors and geometry of space, three-dimensional vector calculus, partial derivatives, double and triple integrals, integration on surfaces, Green's theorem. Optional topics include the Stokes theorem and the Gauss divergence theorem. Lecture, three hours; recitation, two hours per week. Prereq: A grade of C or better in MA 114 or in MA 138 or equivalent.*
MA 214	*A course in ordinary differential equations. Emphasis is on first and second order equations and applications. The course includes series solutions of second order equations and Laplace transform methods. Prereq: MA 213 or equivalent.*
PHY 231	*General University Physics: first part of a two-semester survey of classical physics. Consequences of the principles of mechanics are developed conceptually, analytically and quantitatively. Lecture, three hours; recitation, one hour per week. Prereq or concur: MA 113.*
PHY 241	*A laboratory course offering experiments in mechanics and heat, framed in a small group environment that requires coordination and team work in the development of a well-written lab report. Prereq or concur: PHY 231.*
PHY 232	*A general course covering electricity, magnetism, electromagnetic waves and physical optics. Lecture, three hours; recitation, one hour per week. Prereq: PHY 231; concur: MA 213.*
PHY 242	*A laboratory course offering experiments in electricity, magnetism, and light, framed in a small group environment that requires coordination and team work in the development of a well written lab report. Prereq: PHY 241; concur: PHY 232.*
WRD 110	*Composition and Communication I is the introductory course in a two-course sequence designed to engage students in composing and communicating ideas using speech, writing, and visuals. Students will develop interpersonal communication, critical thinking, and information literacy skills by exploring what it means to be engaged, twenty-first century citizens. Students will practice composing, critiquing, and revising ideas based on personal experience, observation, and fieldwork in the community, culminating in several discrete projects using oral, written, and visual modalities.*
WRD 111	*Composition and Communication II is the second of two general education courses focused on integrated oral, written, and visual communication skill development emphasizing critical inquiry and research. In this course, students will explore issues of public concern using rhetorical analysis, engage in deliberation over those issues, and ultimately propose solutions based on well-developed arguments. Students will sharpen their ability to conduct research; compose and communicate in written, oral, and visual modalities; and work effectively in groups (dyads and small groups). A significant component of the class will consist of learning to use visual and digital resources, first to enhance written and oral presentations and later to communicate mass mediated messages to various public audiences. Over the course of the semester, class members can expect to work independently, with a partner, and in a small group (team) to investigate, share findings, and compose and deliver presentations, as well as to practice and evaluate interpersonal and team dynamics in action. Prereq: CIS 110 or WRD 110.*
18b	**Program Guided Electives Courses (for the major)**
Prefix & Number	Course Description (from the Bulletin or the most recent new/change course form)
ME 340	*Modeling of mechanical, thermal, hydraulic and electrical systems, and other phenomena from a systems viewpoint. Analysis of continuous-time models for free and forced response. Laplace transforms and transfer functions. Introduction to numerical simulation. Analysis of higher-order systems. Prereq: MA 214, and engineering standing. Coreq: EM 313.*
EE 211	*Fundamental laws, principles and analysis techniques for DC and AC linear circuits whose elements consist of passive and active components used in modern engineering practice including the determination of steady state and transient responses. In addition to the required text book, additional materials including a portable oscillator & signal generator, a digital multimeter, an electronics-part kit, and a simulation*

	software are required for at-home laboratory assignments. Prereq: MA 114, prereq or concurrent; PHY 232, 242.
EM 221	*Study of forces on bodies at rest. Vector algebra; study of force systems; equivalent force systems; distributed forces; internal forces; principles of equilibrium; application to trusses, frames and beams; friction. Prereq or concur: MA 21. Note: EM 302 is also included in this list, but the form does not allow the space for EM 302 or its description.*
CME 320	*Fundamentals of thermodynamics, review of first law, second and third laws, VL, LL and SL equilibria, homogeneous and heterogeneous chemical reaction equilibria. Prereq: MA 213, PHY 231, and "C" or better in CME 200*
CME 200	*A course in material and energy balances, units, conversions, tie elements, recycle, bypass, equations of state, heat effects, phase transitions, and the first and second laws of thermodynamics applications in separation processes involving equilibrium reactions and energy exchange. Prereq: "C" or better in MA 113; "C" average in CHE 105 and 107; prereq or concur: MA 114, PHY 231.*
EE 305	*A service course covering electrical engineering principles for engineering or science students with majors outside of electrical engineering. Topics include: AC and DC circuits analysis. Prereq: MA 114, PHY 232.*
EM 313	*Study of the motion of bodies. Kinematics: cartesian and polar coordinate systems; normal and tangential components; translating and rotating reference frames. Kinetics of particles and rigid bodies: laws of motion; work and energy; impulse and momentum. Prereq: Registration in College of Engineering, EM 221; prereq or concur: MA 214.*
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18c	**Program Free Electives Courses**
Prefix & Number	Course Description (from the Bulletin or the most recent new/change course form)
BME 405	*Study of continuous and discrete signal concepts, sampling of analog signals, domain transformation (Fourier, LaPlace, Z- Transforms), and introduction to correlation and power spectrum. Characteristics and design of analog and digital filters. Features of biological signals and systems and biomedical applications. Introduction to non-linear systems. Prereq: EE 305 or equivalent and MA 214; or consent of instructor.*
BME 485	*This course is taught concurrently with BME 685 Biofluid Mechanics. This course provides the students with a review of basic fluid mechanics principles and a direct, practical application of these principles to biomedical and clinical problems associated with the human circulatory system. Prereq: Engineering standing or consent of instructor.*
BME 472	*This course presents an engineering-based approach to the quantitative study of the human musculoskeletal system. Principles involving static and dynamic mechanical analyses will be applied to quantify the forces and moments in human posture and movement. Study of the material and biological properties of the musculoskeletal system is included because they are intimately coupled to the formulation and interpretation of problems in static and dynamic biomechanics. Prereq: EM 221, EM 313; or consent of instructor.*
BME 488	*Study of biological and man-made materials that perform, improve, or restore natural functions. Structure and properties of connective tissue and commonly implanted metals, ceramics, and polymers; biocompatibility of materials used in orthopedic, soft tissue, and cardiovascular applications. Prereq: Engineering standing and MSE 201; or consent of instructor.*
BME 515	*This introductory course in mathematical modeling will teach students how to construct simple and elegant models of biological and physiological processes – for instance the absorption and elimination of drugs in the human body or the kinetics of tumour growth in tissue – and to analyze or predict the dynamics of these*

	events by solving the models. Prereq: MA 113, 114, 213, 214, or consent of instructor; familiarity with computer programming.
BME 530	*A comprehensive introduction to major aspects of biomedical instrumentation. Topics include basic concept of medical instrumentation, biopotentials, physiological pressure/flow/respiratory measurement, optical sensing, and clinical applications of all the above. The fundamental mathematics underlying each instrument will be reviewed and an engineering picture of the hardware and software needed to implement each system will be examined. Prereq: Consent of instructor.*
BME 540	*An introduction to mechanical modeling of human motion (lectures) along with application of computational software to model and estimates internal tissues responses to physical demands of several different activities/tasks (lab activities). Prereq: EM 221, EM 313; or consent of instructor.*
BME 579	*A multidisciplinary approach combining engineering principles for systems analysis and control, knowledge of biological control mechanisms, and computational properties of biological neural networks in the development of engineering neural networks for control applications. Topics include: equivalent circuit models for biological neurons and networks, non-linear differential equation representations, biological control strategies for rhythmic movements, design and development of controller for robot function, proposal development and presentation. Prereq: EE 422G and Engineering Standing or consent of instructor. (Same as EE 579.)*
BME 580	*A comprehensive introduction to bio-medical imaging systems used today, including xray imaging and computed tomography (CT), magnetic resonance imaging (MRI), ultrasound imaging (UI), and diffuse optical tomography (DOT). The course will review the fundamental mathematics underlying each imaging modality, the hardware needed to implement each system, and the image reconstruction and analysis. The class may involve homework, projects, and exams. Prereq: EE 305, or consent of instructor.*

18d	**Courses for a Track.** (If multiple tracks are available, click HERE for a template for additional tracks. Append a PDF to the end of this form with each track's courses and descriptions.	
Prefix & Number	Course Type	Course Description (from the Bulletin or the most recent new/change course form)
	☐ Track Core ☐ Track Elective	
	☐ Track Core ☐ Track Elective	
	☐ Track Core ☐ Track Elective	
	☐ Track Core ☐ Track Elective	
	☐ Track Core ☐ Track Elective	
	☐ Track Core ☐ Track Elective	
	☐ Track Core ☐ Track Elective	
	☐ Track Core ☐ Track Elective	
	☐ Track Core ☐ Track Elective	
	☐ Track Core	

	☐ Track Elective	

4.2.2.10.1 Biomedical Engineering

A cumulative UK GPA of at least 2.5 and successful completion of all pre-major courses. Successful completion of the following pre-major courses with at least a 2.5 GPA: BIO 148, BIO 152, BME 201, CHE 105, CHE 107, WRD 110, WRD 111, MA 113, MA 114, MA 213, PHY 231, PHY 241, PHY 232, and PHY 242 and a C or better in each course. If a course is repeated, the best grade will be used for calculation of GPA in the above listed courses.

Proposed BS in BME

128 credits total

2020

Fall		Spring	
Math 113 (Calc I)	(4)	Math 114 (Calc II)	(4)
PHY 231/241	(5)	CHE 105 (Gen Chem)	(4)
CIS/WRD 110	(3)	CIS/WRD 111 Comp & Comm	(3)
EGR 102 (Funds of Eng Comput)	(2)	EGR 103 (Eng Exploration II)	(2)
EGR 101 (Eng Exploration)	(1)	BIO 148	(3)
	15 credits		16 credits

2021

Fall		Spring	
Math 213 (Calc III)	(4)	Math 214 (Diff Eq)	(3)
PHY 232/242	(5)	CHE 107 (Gen Chem II)	(3)
BIO 152	(3)	PRD/BME 170	(3)
BME 201 (Intro to BME)	(3)	PRD 272 (Intro to UX for PD)	(2)
guided engineering elective I	(3)	guided engineering elective II	(3)
		UK Core II (Humanity)	(3)
	18 credits		17 credits

2022

Fall		Spring	
BME 302 (Des Strat in BME)	(3)	STA 381 (Engineering. Statistics)	(3)
guided engineering elective III	(3)	BME 330 (Exptl Methods in BME)	(3)
BME 435 (Comptr Mod Com Sys)	(4)	BME basic elective I*	(3)
PRD/BME 371 (Ergonomics)	(1)	UK Core IV (citizenship)	(3)
PRD/EGR 250 (CAD: Solidworks)	(2)	PRD/BME 350 (matls & processes)	(3)
UK Core III (social sciences)	(3)	PRD 372 (UX & UI for Prod. Des.)	(1)
	16 credits		16 credits

2023

Fall		Spring	
BME 420 (Integ. Senior Pro. Des. I)	(3)	BME 421 (Integ. Senior Pro. Des. II)	(3)
BME basic elective II*	(3)	BME basic elective III*	(3)
BME advanced elective I**	(3)	BME basic elective IV*	(3)
PGY 412g	(4)	BME advanced elective II	(3)
PRD/BME 451 (integ entre ship)	(2)	UK Core V (global dynamics)	(3)
	15 credits		15 credits

* BME course at the 300 or 400-level

** BME course at the 500-level

Response to Form question 5d

TABLE 1

Program Course Map

Proposed Bachelor of Science in Biomedical Engineering

Course	3a	3b	3c	3d	3e	3f	3g	3h	3i	3j	3k
EGR 101, 102, 103	**A**	**E**			**I**	**I**		**I**			
MA 113 - 214	**A**										
PHY 231 - 242	**A**	**I**									
CHE 105, 107	**A**	**I**									
CIS/WRD 110, 111							**A**	**A**	**I**	**A**	
CHE 236	**A**	**R**									
BIO 148 & 152	**A**	**I**									
BME 201	**A**	**I**	**I**		**I**	**I & E**		**E**	**I**	**I**	**I**
Guided engineering electives	**A**	**I**	**I**		**I**						
BME/DES 210			**I & A**								**A**
BME/PRD 250	**A**		**E**								
BME 302	**A**	**I**	**I**			**A**		**A**		**I & E**	
BME 330	**A**	**E**	**I**		**I & A**						
PRD/BME 350	**I & A**							**A**			**A**
DES 272, 371, 372	**A**						**A**				
BME 3xx	**A**	**A**	**E**		**I**			**E**			
STA 381	**A**	**I**									
PGY 412g	**A**	**I**									
BME 420, 421	**A**	**A**	**I & A**	**A**	**A**	**A**	**A**	**A**	**I**	**I & E & A**	**A**
BME 435	**A**				**A**						**E**
BME 4XX	**A**		**I**		**A**						**E**
BME 5XX	**A**		**I**		**A**						**E**

Legend: A = apply, I = introduce, E = explain, R = reinforce,

Response to New Degree Form 5d

The proposed BS in BME program uses the Accreditation Board for Engineering and Technology (ABET) Criterion number 3.X (Table 2) as a set of uniform metrics for measuring student learning outcomes of program educational objectives. These outcomes are refined and listed below as (a) through (k) and are referred to in Table 1 as (3a) through (3k):

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

Curriculum of the biomedical Engineering major introduces and explains, reinforces, and applies the principles enumerated as shown in Table 1 (below).

TABLE 1
Program Course Map
Proposed Bachelor of Science in Biomedical Engineering

Course	3a	3b	3c	3d	3e	3f	3g	3h	3i	3j	3k
EGR 101, 102, 103	**A**	**E**			**I**	**I**		**I**			
MA 113 - 214	**A**										
PHY 231 - 242	**A**	**I**									
CHE 105, 107	**A**	**I**									
CIS/WRD 110, 111							**A**	**A**	**I**	**A**	
CHE 236	**A**	**R**									
BIO 148 & 152	**A**	**I**									
BME 201	**A**	**I**	**I**		**I**	**I & E**		**E**	**I**	**I**	**I**
Guided engineering electives	**A**	**I**	**I**		**I**						
BME/DES 210			**I & A**								**A**
BME/PRD 250	**A**		**E**								
BME 302	**A**	**I**	**I**			**A**		**A**		**I & E**	
BME 330	**A**	**E**	**I**		**I & A**						
PRD/BME 350	**I & A**							**A**			**A**
DES 272, 371, 372	**A**						**A**				
BME 3xx	**A**	**A**	**E**		**I**			**E**			
STA 381	**A**	**I**									
PGY 412g	**A**	**I**									

BME 420, 421	**A**	**A**	**I & A**	**A**	**A**	**A**	**A**	**A**	**I**	**I & E & A**	**A**
BME 435	**A**				**A**						**E**
BME 4XX	**A**		**I**		**A**						**E**
BME 5XX	**A**		**I**		**A**						**E**

Legend: A = apply, I = introduce, E = explain, R = reinforce,

TABLE 2

ABET Student Learning Outcomes

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

Supplement to Item 10b

Proposed New BS in BME Program

Item 10b: clearly state the student admission, retention, and completion standards designed to encourage high quality.

Admissions

The minimum entry requirement for admission into the College of Engineering is an ACT math score of 23 or higher, or the SAT equivalent of 570 or higher. Additionally, students must meet the minimum Kentucky statewide academic readiness requirements for Reading and Writing to be admitted to the College of Engineering:

• Reading: Students must have an ACT Reading subscore of 20 or above (or SAT subscore of 26 or above in Critical Reading);

• English/Writing: Students must have an ACT English subscore of 18 or above (or SAT of 25 or above in Writing).

Alternative admission routes include:

1. 3 or above on the Calculus AB portion of the Advanced Placement Exam.

2. Eligibility to enter MA 110 based on the UK Math Department Placement Exam (61 percent or higher).

3. Completion of or the equivalent of MA 110 with a grade of C or higher.

4. Completion of or the equivalent of MA 109 and MA 112 with a grade of C or higher.

5. Students who do not meet the reading/ writing requirements will be required to take the ACCUPLACER exam and receive a score of 244 or better.

6. Students who do not meet the minimum score on the ACCUPLACER will be required to take APP courses (UK 120 for Reading and UK 130 for Writing) and can be considered for admission to the College of Engineering after successful completion of these courses.

As noted in the UK College of Engineering Bulletin *"all newly admitted students will participate in the First-Year Engineering Program for their first two semesters. During this first year, they will have the opportunity to participate in hands-on engineering activities, explore all the engineering and computer science disciplines and learn about the Engineering Grand Challenges. Based on this experience, students will have the option to change their major or declare their major based on their interests. Upon declaring their major, students will be designated as pre-major until they meet engineering standing requirements. Every student must be admitted to engineering standing in a specific program prior to taking engineering upper level courses that require engineering standing as a prerequisite.*

Admission to engineering standing in a degree program is necessary to continue in upper level courses and to be granted a baccalaureate degree in engineering or computer science. Specific departmental requirements for admission to engineering standing in the department of Biomedical Engineering are as noted below and engineering standing applies to a specific program. Students can request admission to engineering standing in Biomedical engineering after completing the required set of pre-major courses in the first three semesters of the published curriculum in this proposed program."

Students admitted to engineering standing in biomedical engineering must:

a) attain a cumulative UK GPA of at least 2.5

b) successfully complete (grade C or better)* each of the following pre-major courses BIO 148, BIO 152, BME 201, CHE 105, CHE 107, WRD 110, WRD 111, MA 113, MA 114, MA 213, PHY 231 PHY 241, PHY 232, and PHY 242, and
c) earn a grade point average in BIO 148, BIO 152, BME 201, CHE 105, CHE 107, WRD 110, WRD 111, MA 113, MA 114, MA 213, PHY 231 PHY 241, PHY 232, and PHY 242 of at least 2.5.*

* If a course is repeated, then the best grade will be considered for these criteria.

Retention

Student retention begins with individual faculty having an active role in the education of the individual student. All BME faculty will actively engage in teaching, and as needed, research activities with students in the proposed program to maximize retention and graduate rates. An annual (at the conclusion of the spring semester) evaluation of each student's progress will be conducted by the BME faculty, assisted by College of Design (CoD) faculty as appropriate. The faculty will evaluate student progress and if needed, recommend individualized remedial counseling for performance enhancement or maximization. Target retention rates are at least 70% at 4 years and 90% at 6 years from date of freshman enrollment.

Probation

Probation, suspension, and reinstatement follow standard University of Kentucky regulations as stated in Senate Rule 5.3.2.2

Graduation

In addition to the University graduation requirements listed in the Graduation Requirements section of this Bulletin, to be awarded a Bachelor of Science degree in any field of engineering or Computer Science, a student must:

1. *complete the University and College requirements related to writing and the UK Core,*
2. *complete the required number of credit hours (128) exclusive of those earned in freshman college algebra and freshman college trigonometry, with cumulative standing of at least 2.0 on a 4.0 scale,*
3. *be admitted to engineering standing in an engineering program for at least the final semester and complete the requirements of that program,*
4. *complete a minimum of 24 credit hours of* biomedical engineering *departmental courses at or above the 300 level,*
5. *complete all* biomedical engineering *departmental courses and related technical electives with a cumulative standing of* 2.5 out of a possible 4.0 or greater and attain a grade of C or greater in each of these courses,
6. successfully defend an oral presentations of the senior design project to both engineering and clinical audiences.

Italics denote direct quotes from the 2018-2019 UK Bulletin

From: Pearson, RaeAnne
To: Pienkowski, David
Subject: Biomedical Engineering_Substantive Change Form
Date: Wednesday, June 27, 2018 2:17:35 PM
Attachments: image001.png

Dear Dr. Pienokowski ,

Thank you for your email regarding the proposed program, **Biomedical Engineering, BS (14.0501).**

My email will serve 2 purposes: 1.) Next steps for SACSCOC, and 2.) Verification and notification that you have contacted OSPIE—a Senate requirement for proposal approval.

1. **Next steps for SACSCOC:** None required
2. **Verification that OSPIE has reviewed the proposal:** Based on the proposed documentation presented and the Substantive Change Checklist, the proposed program does not constitute a substantive change as defined by the University or SACSCOC, the university's regional accreditor. Therefore, no additional information is required by the Office of Strategic Planning & Institutional Effectiveness at this time. The proposed program may move forward in accordance with college and university-level approval processes.

Should you have questions or concerns about UK's substantive change policy and its procedures, please do not hesitate contacting me.

RaeAnne Pearson, PhD
Office of Strategic Planning & Institutional Effectiveness
University of Kentucky
Phone: 859-218-4009
Fax: 859-323-8688
Visit the Institutional Effectiveness Website: http://www.uky.edu/ie

University of Kentucky
Office of the Provost

105 Main Building
Lexington, KY 40506-0032
P: 859-257-2911
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www.uky.edu

September 19, 2019

Guigen Zhang, Ph.D., Chair, and
David Pienkowski, Ph.D. Coordinator of the Proposed Bachelor of Science in Biomedical Engineering
F. Joseph Halcomb III, M.D. Department of Biomedical Engineering

Dear Drs. Zhang and Pienkowski:

I write this letter offering my support for the proposed Bachelor of Science in Biomedical Engineering (BS in BME) program.

The University is seeking to grow enrollment and is thus encouraging colleges to develop new programs and expand existing programs. This proposal promises to support this university goal of increasing enrollment. BME is a fast-growing program nationwide. This program is expected to attract students from a wide geographical region. Furthermore, at other institutions, the BME student body has women students in the majority, in contrast to many other engineering disciplines, and so this program is expected to increase the gender diversity of the student body in the College of Engineering.

This new BME program at UK will help meet several of the 2019 College of Engineering Strategic goals, including: 1) expanding program offerings to students with a specific target of launching the BME program in 2020; 2) growing the College's undergraduate enrollment to 5,000 students by 2025; and 3) increasing diversity and the number of women engineers. Furthermore, such a program can strengthen linkages between the College of Engineering and health care colleges on campus, as well as strengthen collaboration with the College of Design.

It is expected that this new program will help meet industry's need for creative, talented, technically competent biomedical engineers, and has potential to contribute to the strengthening of engineering industry and in particular the still-small biomedical engineering industry in the Kentucky. The proposed program, developed and taught in close collaboration with the concurrently proposed Product Development program in the College of Design, offers a new opportunity for Kentucky-based commercial development.

It should be noted that my support for this proposal is not a direct commitment of financial resources from my office. However, the University is developing revenue share models. Although the details on the revenue share models are not final yet, the College of Engineering is very familiar with the draft models being discussed and has been working closely with the Office of the Provost in estimating growth and revenue potential for this degree program. The University Senate's review of the curriculum should not be contingent on the financial viability of the program, as it is the responsibility of the College to find and allocate resources to pursue strategic opportunities and priorities.

I believe that this proposed BS in BME program offers multiple benefits to students, the Department, the College of Engineering, the University, the profession of engineering and the state of Kentucky. In short, the Office of the Provost is supportive of this new degree proposal.

Sincerely,

David W. Blackwell
Provost, University of Kentucky

University of Kentucky
College of Engineering
Office of the Dean
353 Ralph G. Anderson Bldg.
Lexington, KY 40506
P: 859-257-1687
F: 859-257-5727 www.uky.edu

September 9, 2019

Guigen Zhang, Ph.D., Chair
David Pienkowski, Ph.D. Coordinator
F. Joseph Halcomb III, M.D. Department of Biomedical Engineering

Dear Drs. Zhang and Pienkowski:

I am excited to write this letter offering my whole-hearted support for your department's proposed Bachelor of Science in Biomedical Engineering program. The college will make available the needed resources including faculty hires to assist the development and offering of this new BS program.

One of our educational goals in the 2019 College of Engineering Strategic Plan is to expand program offerings to students with a specific target of launching the Biomedical Engineering program in 2020. The proposed BS in BME program offers a timely strategic response to the college's growth target of 5000 undergraduate students by 2025.

Based on the data we collected during freemen recruitment, demands by students wanting to pursue a Biomedical Engineering degree at the University of Kentucky have not been met. This new program will help the college meet such demands. Moreover, the attractiveness of this proposed program will bring many out-of-state students to UK.

It is expected that this novel program will meet industry's need for creative, talented, technically competent biomedical engineers to meet rising demands for efficacious and cost-contained solutions to modern healthcare challenges. Graduates from the proposed program will provide returns to the profession, the college, the university, and society. This is precisely what happened approximately 4 years ago when a distinguished graduate of biomedical engineering provided the first endowed department in the history of the University of Kentucky.

Moreover, the State of Kentucky has met with limited success in efforts to attract biomedical manufacturing companies. The proposed program, developed and taught in close collaboration with the concurrently proposed Product Development program in the College of Design, offers a new opportunity for Kentucky-based commercial development. Graduates of the proposed BS in BME program may launch new biomedical product design-based consulting firms in the

Lexington area. In time, the successfulness of such design firms may provide a vehicle for attracting new manufacturing companies to Kentucky.

I am confident that the proposed BS in BME program will be a resounding success. Please advise if I may be able to assist in the development and implementation of this new program. I will be happy to assist as able.

Sincerely,

Rudolph G. Buchheit
Dean, College of Engineering
Professor, Chemical and Materials Engineering

University of Kentucky
College of Engineering
Office of the Dean

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www.engr.uky.edu

February 1, 2019

To Whom It May Concern:

The attached proposal for this new undergraduate degree program was approved by the BME faculty (7 in favor, 0 opposed), by the Engineering Undergraduate Education Team (12 in favor, 1 opposed), and by the College of Engineering faculty (81in favor, 17 opposed).

Sincerely,

Kimberly Anderson, Ph.D.
Associate Dean for Administration and Academic Affairs
College of Engineering

University of Kentucky | College of Design
Dean's Office

4 March 2019

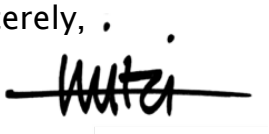
David Pienkowski, Associate Professor
Department of Biomedical Engineering 522
Robotics-Manufacturing Building University of
Kentucky
143 Graham Avenue
Lexington, KY 40506

Dear Professor Pienkowski,

The proposed curriculum for your proposed new Bachelor's degree in Biomedical Engineering requires the following courses in our proposed Bachelor of Science in Product Design (BSPD): PRD/EGR 250, PRD/BME 272, PRD/BME 350, PRD/BME 371, PRD/BME 372, PRD/BME 420, PRD/BME 421, and PRD/BME 451. And we approve of the cross listing of these courses.

This letter serves as a confirmation that we have worked together in developing these two new baccalaureate degrees and understand the necessary and innovative sharing of courses across the curricula. We fully anticipate BSBME students enrolling in the aforementioned product design courses.

Sincerely,



Mitzi R. Vernon, Dean

University of Kentucky
College of Engineering
F. Joseph Halcomb III, M.D.
Department of Biomedical Engineering

DATE: September 12, 2019

TO: Mitzi Vernon, Dean, College of Design

FROM: Guigen Zhang, PhD,
Chair of the F. Joseph Halcomb III, M.D. Department of Biomedical Engineering

RE: Permission to Cross List Courses

The F. Joseph Halcomb III, M.D. Department of Biomedical Engineering hereby extends approval to the College of Design to cross list the following Product Development courses with our department:

PRD/BME 170 ("Human Anatomy for Design")

PRD/EGR 250 ("Computer-Aided Design: Solidworks")

PRD/BME 350 ("Materials and Processes")

PRD/BME 371 ("Ergonomics")

PRD/BME 372 ("UX + UI for Product Design")

PRD/BME 451 ("Integrated Entrepreneurship")

University of Kentucky

Vincent M. Cassone
Professor and Chair
Department of Biology

November 19, 2018

Dr. David Pienkowski
Chair, Department of Biomedical Engineering
University of Kentucky
Lexington, KY 40506

Dear Dr. Pienkowski,

I am happy to approve students majoring in the new B.S. in Biomedical Engineering to take as part of their requirements our introductory biology series, Bio 148, Introductory Biology I, which emphasizes the origin, maintenance, and evolution of biodiversity, and Bio 152, Introductory Biology II, which explores systems level analyses of biological complexity. I don't expect that the small numbers of students you anticipate will negatively impact our program. As a Department, we are also very happy to discuss other ways to increase our educational interactions.

Sincerely Yours,

Vincent M. Cassone, Ph.D.
Professor and Chair
Department of Biology
Director, HHMI STEMCats Program

From: Anderson, Alicia
To: Pienkowski, David
Subject: FW: Proposed BS Program in BME
Date: Tuesday, October 30, 2018 8:47:37 AM

Hi Dr. Pienkowski,

Please see Mark Meier's response below.

Alicia

From: Meier, Mark
Sent: Tuesday, October 30, 2018 8:09 AM
To: Anderson, Alicia <Alicia.Anderson@uky.edu>
Subject: Re: Proposed BS Program in BME

Hi Alicia. Please inform Prof. Pienkowski that the Department of Chemistry approves the use of CHE 105, CHE 107, CHE 111, and CHE 236 in the proposed Biomedical Engineering degree program. I highly recommend that the CHE 109/CHE 110 sequence be added as an alternative to CHE 105. These two courses (combined) are equivalent to CHE 105 and should be listed whenever CHE 105 is mentioned as a requirement.

Best,

Mark Meier
Chair, Department of Chemistry

> On Oct 23, 2018, at 2:31 PM, Anderson, Alicia <Alicia.Anderson@uky.edu> wrote:
>
> Good afternoon, Dr. Mark Meier,
>
> Please see the attached letter from Dr. David Pienkowski.
>
> Thanks,
>
> Alicia Anderson
> F. Joseph Halcomb III M.D., Department of Biomedical Engineering
> 522 Robotics-Manufacturing Building
> University of Kentucky
> 143 Graham Avenue
> Lexington, KY 40506
>
> 859-257-8101

alicia.anderson@uky.edu

<Department Chair Permission Letter to Dr. Mark Meier.pdf>

From: Dziubla, Thomas
To: Pienkowski, David; Zhang, Guigen
Subject: BME classes -CME department approves CME 200 and CME 320 inclusion
Date: Monday, September 16, 2019 8:25:04 PM

Hi David and Guigen,
Sorry for the delay in response.
As we have two separate ABET programs, the faculty must consider the course question separately for each program. The MSE faculty are currently discussing the inclusion and should be presenting a plan soon. (You may already be in touch with them).

In regards to the Chem ENg Program, It is important to note that we currently have an effective student to faculty ratio of 41, and as a result the faculty has expressed some concern over the impact the increase in attendance will have on course delivery.
Yet, the faculty also wish to be supportive of the BME program and believe there are opportunities here to increase the interaction between the department (perhaps through joint hires).
As such, the faculty has voted in favor to permit the inclusion of CME 200 and CME 320 into the BME cirriculum. The exact text of the vote is given below.
Best wishes,
Tom

The Department of Chemical and Materials Engineering tentatively approves the use of CME 200 and CME 320 as part of the curriculum of the
Biomedical Engineering Undergraduate degree assuming there are support mechanisms (to be determined) in place that can mitigate the increased effort required to teach these courses.

Thomas Dziubla
Professor and Chair
Department of Chemical and Materials Engineering
University of Kentucky
177 F Paul Anderson Tower
Lexington, KY 40506-0046
Ph: 859-257-4063
email: Thomas.dziubla@uky.edu
Office: FPAT 177

University of Kentucky
College of Arts and Sciences
Department of Mathematics

25 October 2018

Dr. Pienkowski

Department of Biomedical Engineering

College of Engineering

Dear Dr. Pienkowski:

I am writing to support your proposal for a new Bachelor's degree in Biomedical Engineering. Its students will be permitted to enroll in MA 113, 114, 213, 214.

Sincerely,

Uwe Nagel

Uwe Nagel
Professor and Chair

seeblue.
POT 723 | Lexington, KY 40506 | P: 859-257-3470 | F: 859-257-4078 |www.math.uky.edu | uwe.nagel@uky.edu

University of Kentucky
College of Engineering
Department of Mechanical Engineering

September 9, 2019

Dr. David Pienkowski
Department of Biomedical Engineering
University of Kentucky

Dear Dr. Pienkowski,

The Mechanical Engineering Department is pleased to help support coursework for students that will be pursuing a B.S. degree in Biomedical Engineering (BSBME). The following classes are open to all students in the College of Engineering that meet the course pre-requisites and will be available to students majoring in BSBME.

EM 221 Statics
EM 302 Mechanics of Deformable Bodies
EM 313 Dynamics

In addition, the following course is open to students with Engineering Standing and can also be available for students majoring in BSBME.

ME 340 Introduction to Mechanical Systems

These courses are currently offered every semester, with multiple sections of the EM courses offered both in the Fall and Spring. In addition, we offer each of the EM courses during the summer; thus, there will be numerous options for students to fit these courses into their schedule. We anticipate that the additional students in the courses can be accommodated with our current offerings. The Mechanical Engineering Department supports the use of the courses for BSBME.

Sincerely,

Michael W. Renfro

Michael W. Renfro
Professor and Chair of the Mechanical Engineering Department
University of Kentucky
153 Ralph G. Anderson Building
Lexington, KY 40506

From: Anderson, Alicia
To: Pienkowski, David
Subject: FW: Proposed BS Program in BME
Date: Thursday, October 25, 2018 11:25:11 AM

Dr. Pienkowski,

Please see the email response below from Dr. Alfred Shapere. Let me know if you prefer to have a letter.

Also, I have not heard from Mark Meir.

Thanks,

From: Al Shapere <shapere@g.uky.edu>
Sent: Tuesday, October 23, 2018 3:31 PM
To: Anderson, Alicia <Alicia.Anderson@uky.edu>
Subject: Re: Proposed BS Program in BME

Dear Dr. Pienkowski,

The Department of Physics and Astronomy will allow students in the new BME program to enroll in PHY 231, 232, 241, and 242.
We are pleased that the College of Engineering is creating this program and wish it every success.

Sincerely,

Alfred Shapere
Chair, Dept of Physics and Astronomy

On Tue, Oct 23, 2018 at 2:42 PM Anderson, Alicia <Alicia.Anderson@uky.edu> wrote:

> Good afternoon, Dr. Al Shapere,
>
> Please see the attached letter from Dr. David Pienkowski.
>
> Thanks,
>
> Alicia Anderson
> F. Joseph Halcomb III M.D., Department of Biomedical Engineering
> 522 Robotics-Manufacturing Building
> University of Kentucky
> 143 Graham Avenue
> Lexington, KY 40506
>
> 859-257-8101
> alicia.anderson@uky.edu

From: Graf, Tanya L.
To: Pienkowski, David
Cc: Daugherty, Alan
Subject: RE: Letter of Permission for BME students to take PGY 412g
Date: Monday, October 07, 2019 4:13:15 PM

Dr. Pienkowski,

The Department of Physiology looks forward to supporting the newly proposed Bachelor of Science in Biomedical Engineering by approving the inclusion of PGY412G as a required class for the cirriculum.

We look forward to seeing these students in PGY 412G over the next few years.

Sincerely,

Alan

Alan Daugherty, Ph.D., D.Sc., F.A.H.A
Associate Vice President for Research
Senior Associate Dean for Research, College of Medicine
Chair, Department of Physiology
Director, Saha Cardiovascular Research Center
Gill Foundation Chair of Preventive Cardiology
Professor of Physiology and Medicine
Editor-in-Chief, ATVB

University of Kentucky
BBSRB, Room 243
Lexington KY 40536-0509

P | 859-323-3512 F | 859-257-3235
Skype - alandaugherty
e-mail - alan.daugherty@uky.edu
WEB SITE - http://SahaCVRC.uky.edu

From: Pienkowski, David <pienkow@uky.edu>
Sent: Thursday, October 3, 2019 2:28 PM
To: Graf, Tanya L. <tanya.graf@uky.edu>
Subject: Letter of Permission for BME students to take PGY 412g

Dear Tanya:

Please ask Dr. Daugherty to send me a letter, or write me an email, indicating permission for undergraduate students in the newly proposed Bachelor of Science program in Biomedical Engineering to take PGY 412g as a required course in the fall semester of their senior undergraduate year. I anticipate that approximately 20 students will need to take this course in in fall of 2022. This

number is expected to increase to approximately 40 by fall of 2024. I attach a copy of the proposed curriculum for his review. Please thank him for me for the department's continuing teaching of PGY 412g to our incoming graduate students in biomedical engineering.

Thank you.

David

David Pienkowski, PhD, MBA
University of Kentucky
AB Chandler Medical Center
800 Rose Street, Room MN 564
Lexington, KY 40536-0298

UNIVERSITY OF KENTUCKY

Department of Statistics
311 Multidisciplinary Science Building
725 Rose Street
Lexington, KY 40536-0082

859 257-6115
*fax*859 323-1973

statistics.uky.edu

10/23/18

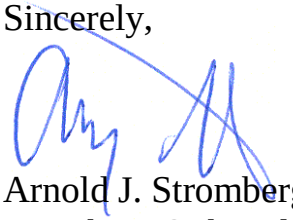
David Pienkowski, Ph.D.
Department of Biomedical Engineering

Dear Professor Pienkowski,

We're pleased to be able to allow students in your proposed undergraduate degree in Biomedical Engineering to enroll in STA 381.

Feel free to contact me if you need additional information.

Sincerely,



Arnold J. Stromberg, Chair
stromberg@uky.edu

University of Kentucky
College of Arts and Sciences
Department of Writing, Rhetoric & Digital Studies

October 24, 2018

Colleagues

I am writing to support Biomedical Engineering's requirement that students in its new degree take WRD 110 and WRD 111 as fulfillment of the UK writing requirement.

We are very happy to have these students enroll in our sections.

Sincerely,

Jeff Rice
Chair, Writing, Rhetoric and Digital Studies
Martha B. Reynolds Professor in Writing, Rhetoric, and Digital Studies
University of Kentucky

University of Kentucky
College of Engineering
Department of Electrical and
Computer Engineering

453 F. Paul Anderson Tower
Lexington, KY 40506
P: 859-257-8042
F: 859-257-3092
www.engr.uky.edu/ece

December 6, 2019

Dr. David Pienkowski
F. Joseph Halcomb III, M.D. Department of Biomedical Engineering
University of Kentucky
Lexington, Kentucky 40506

Dear Dr. Pienkowski,

The Department of Electrical and Computer Engineering approves the request by the F. Joseph Halcomb III, M.D. Department of Biomedical Engineering to enroll students in the EE 211 and EE 305 courses. This approval is in support of their proposed Bachelor of Science in Biomedical Engineering program.

Sincerely,

William T. Smith
Associate Chair
Director of Undergraduate Studies