

SYNOPSIS: UNIVERSITY OF NORTH CAROLINA & NORTH CAROLINA STATE UNIVERSITY REQUEST FOR AUTHORIZATION TO ESTABLISH A NEW JOINT DEGREE PROGRAM

Degree Request: The Joint Department of Biomedical Engineering (spanning the University of North Carolina at Chapel Hill (UNC-CH) and North Carolina State University (NC State)) requests permission to establish a joint B.S. degree program in Biomedical and Health Sciences Engineering. This proposal creates the umbrella degree under which the Joint Department's undergraduate (UG) programs will be housed. This proposed joint degree program is the initial step in the planned merger of the UNC-CH and NC State UG biomedical engineering programs under the auspices of the Joint Department of Biomedical Engineering (referred to hereafter as JBME). The creation of the umbrella program with a different name from NC State ABET accredited BME program is the most straightforward approach to create a joint degree program while protecting the ABET accreditation of the NC State BME program.

Introduction to the Joint Department of Biomedical Engineering: The JBME operates as a single unit spanning two universities and three colleges/schools. Faculty and staff in the department are not distinguished as UNC or NC State faculty but rather as JBME faculty. Faculty and staff have duties spanning both universities and a physical presence at each university. Departmental priorities and initiatives always span and encompass both campuses. Educational and service duties are shared across the universities and all JBME faculty participate in the direction, planning and execution of the UG programs on both campuses. All course work offered in the Department is considered by the JBME as joint NC State-UNC courses and part of a joint education since all curricula, educational objectives, and course content are developed by the JBME faculty. The proposed joint B.S. degree will be seated within this environment.

Major milestones and attributes of the joint B.S. degree program:

1. 2015: Joint B.S. degree is granted.

- All new UG students in JBME in a B.S. degree program without ABET accreditation are required to enter the joint B.S. degree.
 - *Students enrolling through UNC-CH enter the joint B.S. degree program which is seeking ABET accreditation.*
 - *Students enrolling through the NC State B.S. BME do not enter the joint B.S. degree program since the NC State BME degree program is ABET accredited.*
 - *Students in the joint B.S. degree program are enrolled in JBME classes all of which are joint NC State-UNC classes since the courses are taught by JBME faculty and offered by the joint department.*
 - *NC State plays a critical role in preparation for ABET accreditation.*
- NC State and UNC-CH agree that students meet the general education guidelines established at their home institution.
- NC State and UNC-CH agree that admissions, registration, and fees for students entering into the joint B.S. degree program will continue to follow the guidelines at their home institution.
- NC State and UNC-CH agree that all students enrolled in the JBME will receive a joint NC State-UNC-CH diploma at a joint graduation ceremony.
- NC State and UNC-CH agree to initiate plans for joint record keeping and transcript management.
- NC State and UNC-CH agree to work together to solve any unanticipated challenges.

2. 2015-2016: Joint B.S. degree program seeks ABET accreditation

- Planning is initiated for the tracks within the joint B.S. on the two campuses.
- Joint B.S. degree curricula evolves and the first steps toward a full merger with the NC State B.S degree program are initiated. All curricula changes are approved by curriculum committees at both universities.
- NC State and UNC-CH continue working together to meet the challenges of the joint B.S. degree.

3. Joint B.S. degree program is ABET-accredited (earliest possible date is 2017):

- All newly admitted UG students in the JBME must enter the joint ABET-accredited B.S. degree program.
- The joint B.S. degree program offers tracks based at UNC and NC State. All degree requirements can be met without physically traveling between universities.
- JBME UG students have a broad array of options and unprecedented opportunities spanning North Carolina's two flagship universities.
- A name change for the degree program to B.S. in Biomedical Engineering is submitted.

4. Post ABET-accreditation (earliest possible date is 2018):

- The joint program continues to evolve creating a transformative UG educational experience.
- Joint tracks with courses at both universities are added to the existing tracks with approval of both university curriculum committees and offered to interested students.

APPENDIX C

UNIVERSITY OF NORTH CAROLINA & NORTH CAROLINA STATE UNIVERSITY REQUEST FOR AUTHORIZATION TO ESTABLISH A NEW JOINT DEGREE PROGRAM

EXECUTIVE SUMMARY

The Joint Department of Biomedical Engineering (spanning the University of North Carolina at Chapel Hill (UNC-CH) and North Carolina State University (NC State)) requests permission to establish a joint B.S. degree program in Biomedical and Health Sciences Engineering. The proposed joint degree program is part of the initial step in the planned merger of the UNC-CH and NC State undergraduate biomedical engineering programs under the auspices of the Joint Department of Biomedical Engineering (referred to hereafter as JBME).

Forbes Magazine ranked BME as the number one college major in its list of the “Fifteen Most Valuable College Majors” in 2012. Reflecting its importance in meeting today’s needs, *CNN Money* ranked BME the number one best job in America in 2013. In 2010, the U.S. Labor Department accurately predicted the discipline of biomedical engineering would add jobs faster than any other sector of the economy with a growth rate of greater than 60 percent through 2020. The demand for solutions to basic health science and clinical needs is driving this rapid growth, and a steady supply of highly trained life science engineers is critical to meet the demands of our society to develop cutting-edge research and devices. This workforce is well positioned to bring innovative technologies to market and in the process, enhance not only healthcare, but also the international competitiveness of the State of North Carolina. The JBME is at the forefront of meeting these demands and is uniquely positioned to leverage the assets of the state’s two flagship universities to supply the state’s needs for highly trained life science engineers.

The proposed joint B.S. degree program will position the JBME to fully capitalize on the extensive resources of both institutions by initiating a multi-step process leading to the full merger of the two undergraduate degree programs UNC-CH and NC State and to the existence of a single undergraduate degree program in the JBME. In this first step, the undergraduate Applied Sciences degree program (BME minor) in place at UNC-CH in the JBME will be moved into a new joint B.S. degree program in Biomedical and Health Sciences Engineering. This undergraduate program is already leveraging the engineering assets at NC State as well as the engineering expertise of the combined BME faculty by virtue of it being housed within the JBME. Thus, this degree will formalize activities and collaborations already ongoing between the two Universities and is a natural first step in the full merger of the JBME’s undergraduate programs to create a single umbrella B.S. degree in the JBME. The proposed joint degree program will seek to be accredited by ABET (the Accreditation Board for Engineering and Technology) in 2016 or shortly thereafter. An eventual outcome of the granting of this degree will be that

all undergraduate students in the JBME receive an accredited degree. Since the JBME is already operating in a joint and collaborative manner across the two Universities, the proposed change in the degree to a joint B.S. program entails no changes to degree requirements, nor any additional courses, faculty, facilities or resources. The JBME will continue to use the existing infrastructure and facilities at the Universities as well as course work already ongoing at the Universities. The current joint faculty members will serve the joint B.S. degree program so we do not anticipate the need for any additional resources at this time. The new degree will not affect enrollment in other programs at UNC-CH or NC State since both universities already have existing undergraduate programs. Since the NC State BME undergraduate program is already ABET accredited, we do not anticipate NC State students selecting this degree program as their degree of choice until the new joint degree program in Biomedical and Health Sciences Program is ABET-accredited. At this time, newly admitted BME students at NC State will enter the joint degree program with legacy students receiving the option to make the transition if they so desire. As with all degree programs, the joint program is expected to evolve steadily over time as the Universities develop this high-impact, collaborative effort. The JBME has extensively consulted with the administration of both universities to chart a pathway forward with acquisition of the proposed joint degree program identified as the first milestone.

We believe that this is the opportune time to launch this proposed joint degree program request. The Joint B.S. degree program in Biomedical and Health Sciences Engineering will be an integral part of the JBME and as discussed, a core component of the future plans for the undergraduate BME programs at both UNC-CH and NC State. The partnership between the two institutions will not only enrich our students but will also benefit the local and national communities. The synergy between these two great research universities will produce the highest quality biomedical engineers providing foundational education in math, science, engineering, and the humanities. Furthermore, the proposed joint B.S. degree program is a significant step forward in creating a Department of Biomedical Engineering that is a fully joint department at all levels cementing the ties between UNC-CH and NC State. This transformative inter-institutional model will break ground for other collaborative efforts across these two universities as well as with other universities in North Carolina.

APPENDIX C
UNIVERSITY OF NORTH CAROLINA & NORTH CAROLINA STATE UNIVERSITY
REQUEST FOR AUTHORIZATION TO ESTABLISH
A NEW DEGREE PROGRAM

***INSTRUCTIONS:** Each proposal should include a 2-3 page executive summary. The signature of the Chancellor is required. Please submit one hard copy and an electronic copy of the proposal to the Office of the Senior Vice President of Academic Affairs at UNC General Administration.*

Date: August 1, 2014

Constituent Institution: University of North Carolina at Chapel Hill, College of Arts and Sciences & North Carolina State University, College of Engineering

CIP Discipline Specialty Title: Biomedical Engineering

CIP Discipline Specialty Number: 14.0501 Level: B X M _____ Res. Doc. _____ Prof. Doc. _____

Exact Title of the Proposed Degree: Bachelor of Science in Biomedical and Health Sciences Engineering

Exact Degree Abbreviation (e.g., B.S., B.A., M.A., M.S., Ed.D., Ph.D.): B.S.

Does the proposed program constitute a substantive change as defined by SACS? Yes X No _____

The current SACS Substantive Change Policy Statement may be viewed at:
<http://www.sacscoc.org/pdf/081705/Substantive%20Change%20policy.pdf>

If yes, please briefly explain.

The proposed joint-nature of the degree is the only aspect of the proposal that falls under the current SACS Substantive Change Policy.

Proposed date to enroll first students in degree program: Month May Year 2015

Note: At UNC-CH, current students in the “applied sciences: biomedical engineering track” program will be given the option to receive the new degree if the requirements are completed as of May 2015. Incoming first-year students in fall 2015 will be required to receive the new degree. Upon receipt of ABET accreditation for the joint degree program, NC State students will have the option to receive the new degree if they fulfill the requirements in place at that time. After receipt of ABET accreditation, incoming students at NC State will be required to receive the new degree.

Are there plans to offer 50% or more of program credit hours to students off-campus or online? Yes _____ No X

If yes, complete the form to be used to request establishment of a distance education program and submit it along with this request.

Note: If a degree program has not been approved by the Board of Governors, its approval for alternative, online, or distance delivery must wait until BOG program approval is received. (400.1.1[R], page 3)

Provide a summary of the status of this proposal in your campus review processes.

a. List the campus bodies that reviewed and commented on this Appendix C proposal before submission to UNC General Administration. What were there determinations? Include any votes, if applicable.

The Appendix C proposal was reviewed by faculty and full-time professional administrative staff at UNC-CH. This includes 1) the Administrative Boards of the General College and the College of Arts and Sciences, 2) professional administrative staff in the Office for Undergraduate Education, including the Curriculum Director, 3) the dean and senior associate deans for the College of Arts and Sciences, 4) members of the advisory board (or “Administrative Boards”) in the School of Medicine, 5) faculty in the JBME, and 6) UNC-BME undergraduate curriculum committee.

The Appendix C proposal was also reviewed and discussed by faculty and full-time professional administrative staff at North Carolina State University. This includes: 1) the Provost’s Office, 2) the College of Engineering administration (Dean of Engineering as well as the Associate Dean for Academic Affairs), 3) College of Engineering Curriculum Committee, 4) NCState campus-wide curriculum committee, and 6) NCState-BME undergraduate curriculum committee. The Chancellor of NC State has also commented on the proposal.

b. Summarize any issues, concerns or opposition raised throughout the campus process and comment periods. Describe revisions made to address areas of concern.

The following concerns/questions were raised:

1. It would be more logical and straight forward with respect to the Joint Department’s ultimate goals to convert this degree request to a joint B.S. degree originating from both NC State and UNC-CH rather than a standalone UNC-CH degree.

We agree with this suggestion and have therefore converted this application to a joint degree request from UNC-CH and NC State. As background, our original Appendix A proposed a standalone UNC-CH degree program that would exist for a lifetime of 3-5 years. Once ABET accredited, this standalone UNC-CH degree program would have then been merged with the standalone NC State B.S. BME degree program into a single joint degree program (ABET-accredited). It was anticipated that another new degree request would be required for the final merger of the two degree programs. However in response to the feedback above, we have converted the request from a standalone UNC-CH degree into a joint B.S. degree from NC State and UNC-CH. This eliminates the need for a second degree request and ultimately enables the JBME to reach its final goal of a combined undergraduate program and joint degree much sooner. We also believe that this request acknowledges and formalizes events already well underway in the JBME *i.e.* the sharing of faculty and resources across the undergraduate programs at the Universities. As examples, the JBME operates a shared undergraduate summer research program (Lucas Scholars program), currently shares lectures for the undergraduate design courses as well as other undergraduate courses across the two Universities, and operates joint design projects across NC State and UNC-CH. Faculty at one University frequently teach courses at the other University or conduct their course at both the Universities. Course work completed at NC State can substitute for core courses in the UNC-CH degree. Staffing is also now increasingly shared across the Universities. ***Thus key attributes of the undergraduate programs are already joint (Fig.1).*** Granting of the joint degree will further enhance these interactions and greatly facilitate the Department’s ability to leverage the assets of the Universities to ultimately build a transformative undergraduate educational experience.

Examples of Ongoing UNC-NC State BME UG Partnership

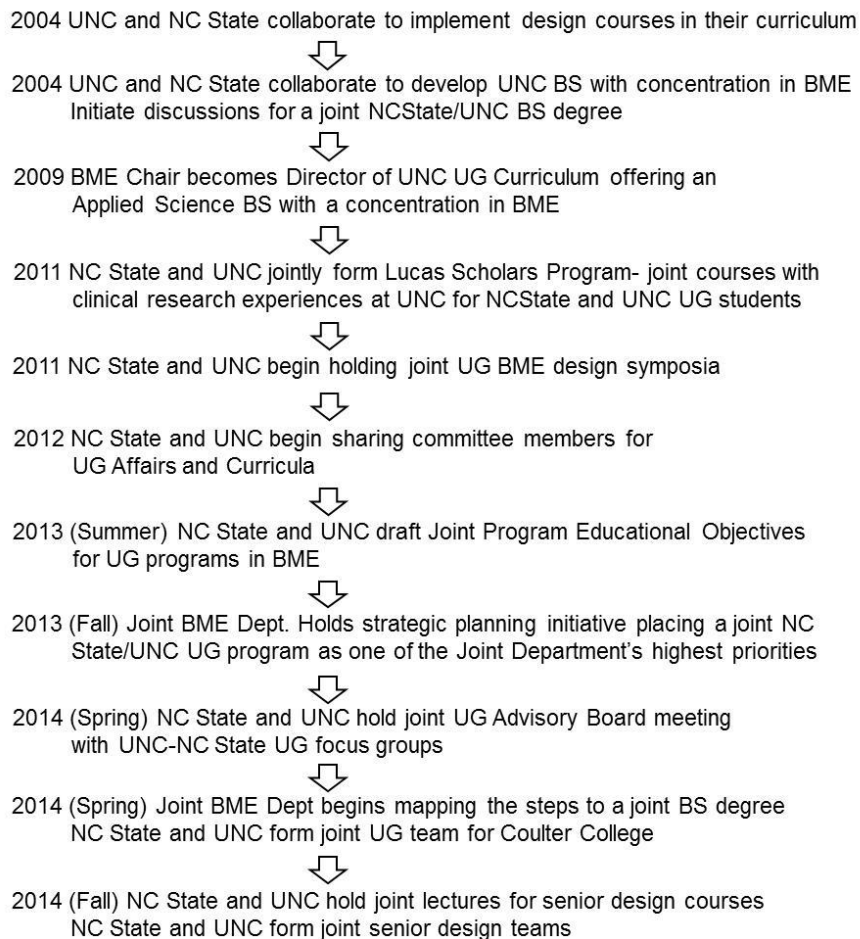


Fig. 1. Examples of the ongoing collaborations between the Universities at the UG level in the JBME

2. How does the degree in question interface with the undergraduate degree in Biomedical Engineering that is housed at NC State in the Joint Department of Biomedical Engineering.

We have modified the document to clearly show that the current application for the joint B.S. in Biomedical and Health Sciences Engineering is the first step in the full merger of the undergraduate biomedical engineering programs at NC State and UNC-CH into an umbrella B.S degree (Fig. 1). Since the new joint degree would not initially be ABET-accredited, the NC State students would be disadvantaged relative to their current ABET-accredited degree if forced to immediately transition to the new joint degree. However, once ABET-accredited, new incoming NC State students will be required to enter the joint degree program. The old standalone NC State degree will be discontinued after all legacy students have completed the old degree or converted to the new degree (if they so desire).

The JBME formed in 2003 has continued to grow and prosper over time as a partnership between NC State and UNC-CH enabling high-impact discoveries and technology development at the interface of engineering and medicine. The ultimate goal for the JBME is to fully combine the two undergraduate programs (NC State and UNC-CH) so that the Department offers a single joint ABET-accredited program. By combining the assets of the state's two flagship Universities, the Joint Department will create an

undergraduate educational experience that fully exploits the state's investments in these institutions to benefit the students at both Universities.

4. Is this degree an endorsement of independent engineering degree programs at UNC-CH or independent human clinical medicine programs at NC State?

As described above, this is a joint degree request that is part of the ongoing biomedical engineering partnership between UNC-CH and NC State and should not be construed as support for any other activities in the area of human clinical medicine at NC State or engineering at UNC-CH.

5. Will the B.S. degree in Applied Sciences with a BME concentration continue to be part of the UNC-CH Academic Inventory?

The B.S. in Applied Sciences with a BME track will be discontinued once the joint degree is granted. The B.S. in Applied Sciences (non-BME track) will remain in the *UNC-CH Academic Inventory* but with no students enrolled for the time being. At some point in the future, the Dept of Applied Physical Sciences at UNC-CH may offer a B.S. in Applied Sciences but there will be no BME track.

6. With respect to the UNC-CH-based students, will changing majors from another science major to BME in years 2 or 3 put the student at an extreme disadvantage with course credit not counting for the new major?

During the first two years, our curriculum has significant overlap with those of other science and math majors. This makes it easier for our students to switch in or out of our major to a science or math major. There are a significant number of students who do this each year. We also believe that the joint degree program will enable students to more easily switch into the BME major since a plethora of engineering electives will be more readily available to meet their degree requirements.

7. With respect to the UNC-CH-based students, is this major/degree possible for a junior transfer student? Or a sophomore transfer student?

We have a few students each year who join the UNC-CH undergraduate program as sophomore or junior transfer students. It is a challenge for those students to complete the current degree program, especially for the junior transfer students. However, these students are particularly motivated and with careful advising and course selections, they have been able to successfully complete the major.

In recent years, we have been able to offer additional sections of some of our required courses so that they are taught in both fall and spring. We also plan to offer two courses in the summer starting in 2015. This will provide our students (both transfer students and others) with additional flexibility in course planning. We also believe that the joint degree will enable students to more easily transfer into the BME major since a plethora of engineering electives will be more readily available to meet their degree requirements. In general, the joint degree would greatly increase flexibility enhancing the student's ability to complete their degrees in a timely fashion.

I. Description of the Program

A. Describe the proposed degree program (i.e., its nature, scope, and intended audience).

As a discipline at the bachelor degree level, biomedical engineering has a strong and growing identity nationwide. There are currently 87 accredited programs around the country, and that number increases each year. In most cases, these B.S. degrees are offered within a standing BME department. The degrees

are variously titled as biomedical engineering, bioengineering, health sciences engineering at different universities among others but all describe essentially the same or similar curricula.

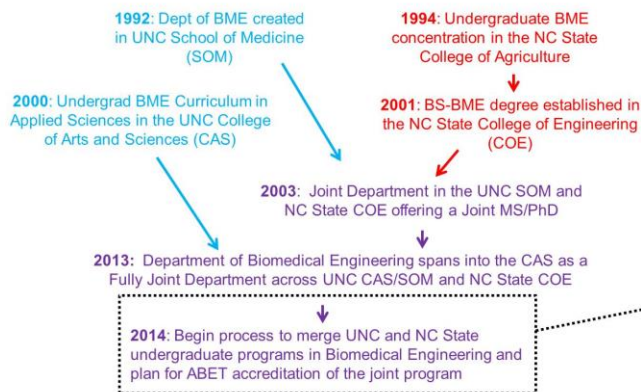
The UNC-CH/NC State Joint Department of Biomedical Engineering, which spans the University of North Carolina at Chapel Hill (UNC-CH) and North Carolina State University (NC State), proposes to create a joint B.S. degree program in Biomedical and Health Sciences Engineering. For simplicity, we refer to this as the joint B.S. in BME for the rest of this document. The JBME was launched in 2003 and was initially housed within the School of Medicine at UNC-CH and the College of Engineering at NC State. Since July 2013, the BME Department has also been housed in a third entity, the College of Arts & Sciences at UNC-CH. Currently, the JBME supports a joint BME graduate degree program (MS and PhD) at UNC-CH and NC State. Graduate students receive a jointly-issued degree, are required to enroll in coursework at both campuses, and spend time during their graduate work on each campus. The JBME offers an ABET-accredited undergraduate program at NC State offering a B.S. degree in BME, and an undergraduate curriculum at UNC-CH offering a B.S. degree in Applied Sciences (BME track). The UNC-CH Applied Sciences BME track has been in place at UNC-CH since 1999, has been under the leadership of the JBME since 2011 and was formally incorporated into the JBME on July 1, 2013. The proposed degree moves the Applied Sciences (BME track) into a jointly offered B.S. degree and is the initial step in the full merger of the UNC-CH and NC State undergraduate programs in the JBME (Fig. 2). Presently, the UNC-CH and NC State programs each leverage resources at the partner institution in a way that makes a merger the natural next step.

The JBME operates as a single unit spanning the two Universities and three Colleges/Schools. The Joint Department does not distinguish faculty as based at UNC or NC State but rather as based in the JBME. Faculty and staff have duties spanning both Universities and a physical presence at each University. The expectations and workloads for faculty are identical across the two Universities. Departmental committees bridge across the two campuses directing departmental activities in a single-minded and cohesive manner. Service duties are shared across the Universities and all JBME faculty participate in the direction, planning and execution of UG programs on both campuses. All course work offered in the Department is considered by the JBME as joint NC State-UNC courses and part of a joint education since all curricula, educational objectives, and course content are developed by the JBME faculty. The proposed joint B.S. degree will be seated within this environment.

As described above, departmental priorities and initiatives always span and encompass both campuses; so much so that increasingly the only distinction attributable to faculty and staff is the institution issuing their pay check. This manner of operation is in great contrast to that of the vast majority of joint BME departments in which one partner dominates in all aspects or in which the partnership is primarily focused on research. The “true jointness” of the UNC/NC State BME Department also drives the definition of “joint” with respect to the undergraduate degree programs. The Department has already begun to leverage its common assets irrespective of the originating University to define and shape the undergraduate programs in BME. Current examples include the sharing of course work, staff, faculty, and facilities (Fig. 1). *Thus the definition of a “joint degree” in the JBME is very different from that of a typical joint degree in which the partners are assigned rigid roles and duties in the shared degree program.*

The eventual full merger of the JBME’s undergraduate programs which will utilize the currently requested joint degree program will permit the JBME to fully capitalize on its repertoire of faculty and staffing expertise as well as its unique infrastructure at the Universities. Currently the JBME accesses many of its unique attributes for the undergraduate programs in an *ad hoc* fashion and in an inefficient manner with respect to time and resources. The merged program with joint degree will enable the JBME to fully leveraging its existing resources providing a higher quality education for the students, eliminating resource duplication, and achieving efficiencies not otherwise possible.

Timeline of UNC-NC State Biomedical Engineering Partnership



Timeline for UNC-NC State BME UG Partnership

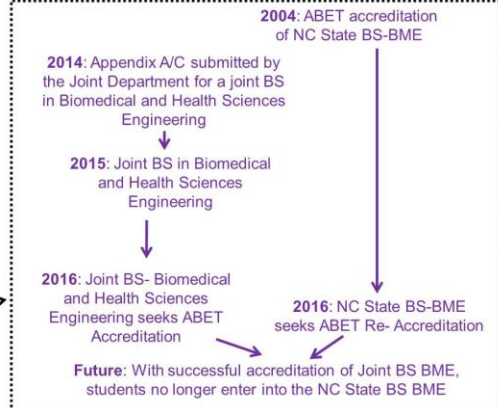


Fig. 2. The UNC-CH/NC State Biomedical Engineering Partnership. Left panel- History of Biomedical Engineering at UNC-CH and NC State. Right panel- Proposed timeline and milestones for the merger of the two B.S. BME degrees at UNC-CH and NC State. NC State and UNC-CH are represented in red and blue respectively with joint efforts marked in purple.

With the JBME spanning into the College of Arts and Sciences at UNC-CH and assuming responsibility for the operation of the Applied Sciences BME track, this is an ideal time to begin planning the future of the Department’s undergraduate programs. A necessary component of these future plans is the transition of the UNC-CH Applied Sciences BME track to a Joint B.S. degree program within the JBME. This new degree program will have a Biomedical Engineering CIP code and will enable us to pursue accreditation by ABET. We plan to pursue accreditation in collaboration with NC State, at the same time that the NC State College of Engineering takes its full roster of programs through re-accreditation. Accreditation by ABET provides “proof that a collegiate program has met certain standards necessary to produce graduates who are ready to enter their professions.”¹ Accreditation will also help to recruit the brightest students to our Joint Department, and help our students to get the best jobs, as graduation from an ABET-accredited program is a prerequisite for employment by a large percentage of companies hiring biomedical engineers. Once the joint B.S. degree program is accredited, the JBME will then phase out the standalone BME degree at NC State so that a single JBME ABET-accredited undergraduate program is present in the Department. A hypothetical timeline for the process shown in Figure 2. Granting of the joint B.S. degree in Biomedical and Health Sciences Engineering is viewed as a necessary first step in this multi-stage process. This joint degree program will initially build off of the UNC-CH Hill curriculum since this program requires a name change and new CIP code in order to seek ABET-accreditation. The JBME in conjunction with the CAS and COE believe that the final undergraduate merger of the two undergraduate programs i.e. full inclusion of the NC State students can only occur after the joint degree program is ABET-accredited. Thus necessary steps in this process are shown in Fig. 2 in the right panel. The UNC-CH degree already utilizes assets at NC State, requires a name change, and is not ABET-accredited currently so this program benefits from all aspects of the multistep process without risk to the students. In contrast, the NC State B.S. in BME is ABET accredited so that it is not desirable for the NC State-based students to move into the joint B.S. degree program until it is accredited. Upon ABET accreditation, the NC State students will achieve significant benefit by moving into the joint degree program. This would be expected to occur in Fall of 2017 so that NC State students would not enter the joint degree until this time. This delay also gives the JBME significant time to plan and implement the logistics of the fully merged undergraduate program. This step-wise process enables the JBME to fully capitalize on the assets of both UNC-CH and NC State to ultimately create a transformative joint undergraduate program across the universities. Further, this strategy permits

¹ ABET - Why Accreditation Matters: <http://www.abet.org/why-accreditation-matters/>

a risk-free approach with respect to students currently enrolled in the ABET-accredited NC State program. This strategy has been formulated in consultation with the COE, CAS, and SOM administrations. The current Appendix C focuses on the immediate near-term plans for the joint B.S. degree rather than projecting out to longer timescales for the fully merged undergraduate program.

It is of note that the current UNC-CH undergraduate program has been and is fully supported by the JBME faculty and staff with a full roster of courses including laboratories (described below). For this reason, the current proposed change in the degree, from a “track” to a Joint B.S. degree program, entails no change in degree requirements, nor any additional courses, faculty, facilities or resources from either University. Instead it formalizes the collaboration already taking place, converts the program to an ABET-accreditable program, and initiates the merger between the UG BME programs at the two Universities.

B. List the educational objectives of the program.

In the biomedical engineering track, students learn to apply engineering principles to solve medical and biological problems. This is a discipline of great breadth that incorporates the fields of medical imaging, informatics, prosthetics, medical devices, tissue engineering and genomics, and applications of signal processing and control. Due to the rapid advances in the fields of medicine and technology, the curriculum in biomedical engineering must necessarily be flexible and responsive to the changing needs of the community.

The curriculum, as for all sciences, is vertically structured, with experience and knowledge from each course serving as a foundation for subsequent courses. The first two years of study have many courses in common with B.S. degree programs in chemistry, physics, computer science, and mathematical sciences. In the last two years, students take advanced engineering courses in a variety of fields and four elective courses in biomedical engineering. A unique aspect of both the UNC-CH and NC State curricula is a design sequence, taken during the last three years. This sequence culminates in a capstone design experience in which the students design and implement medical devices based on their needs assessment research at the local hospitals. The specific requirements are listed below in a year-by-year curriculum plan.

The educational objectives for the Bachelor of Science in Biomedical and Health Sciences Engineering program are:

- Our graduates will be prepared to pursue advanced studies in biomedical engineering or in other disciplines.
- Our graduates will meet or exceed the expectations of their employers in the biomedical engineering workplace or in other professional careers.
- Our graduates will continue to learn and to adapt to evolving technology and changing career opportunities.

It is notable that the undergraduate BME programs at both Universities have identical educational objectives.

C. Describe the relationship of the program to other programs currently offered at the proposing institution, including the common use of:

- 1. Courses**
- 2. Faculty**
- 3. Facilities, and**
- 4. Other resources**

The field of biomedical engineering is concerned with the application of engineering principles to develop technologies and materials that enhance human health and health care. This differentiates BME from other engineering disciplines which do not have such a dominating biology/medical focus. The BME curriculum does have some overlap with curricula in biology, chemistry, physics and mathematics, mostly at the introductory level with classes typically taken by first and second year students. For example, the BME curriculum has students taking core course sequences in biology, chemistry, physics, computer science, and mathematics. A similar scenario exists for BME and the other engineering disciplines i.e. overlap only at lower level introductory courses.

As an engineering discipline, BME is distinct from the natural sciences in its emphasis on design and development of systems that have applications in medicine and biology. This specialization is accomplished partially through a set of four design courses in the curriculum. We also have design projects integrated in other courses throughout the curriculum, all with applications in medicine and biology. The BME degree demands a more rigorous and comprehensive mathematical background than the biological and chemical sciences, and a more extensive biological, medical, electrical circuit and materials background than the physics and mathematical sciences.

The only other engineering degree offered at UNC-CH is in the Department of Environmental Sciences and Engineering. That program is distinct from BME, as there is little overlap between these fields. A multitude of engineering degrees are offered at NC State but again the BME degree is distinct from the other engineering programs with respect to the large numbers of biological and clinical/health-based courses required. All design courses in BME are also focused on identifying problems and developing solutions for clinical medicine and patient care as opposed to the predominance of projects not related to human health found in other engineering disciplines.

Courses:

In the early years of the joint degree program, the courses required for the new degree will be the same as those currently required for the UNC-CH Applied Sciences BME track. A template course outline that allows completion of the degree within four academic years is shown in Section III. D below. Many of these courses including the design courses are jointly conducted at the two Universities.

Faculty:

The Joint B.S. in Biomedical and Health Sciences Engineering will be supported through existing faculty in the JBME. In addition, UNC-CH has already allocated resources for an additional six faculty in the JBME to support the undergraduate programs. Additional faculty are also promised at NC State for the JBME (5 over the next 2 years and additional hires after that time span). The resources are independent of this joint degree program request.

All faculty are expected to be active participants in teaching as well as mentoring, advising, professional activities, and service to the Department, Colleges/Schools, and Universities. Teaching assignments are made by the Department Chair in consultation with the Associate Chairs. Graduate students assist with labs and give supplemental lectures or presentations but only in conjunction with faculty. The faculty teaching load is 2 courses/year (one graduate and one undergraduate). Faculty performance in teaching is assessed by soliciting student feedback on the course as well as by peer review by other faculty. Tenure/tenure-track faculty are expected to support significant research activities funded through extramural sources. This significant base of extramural funding also supports research opportunities for the BME undergraduates.

The JBME faculty are expected to participate in formal academic advising and informal mentoring of undergraduates. Our students are assigned to an advisor in the spring of their sophomore year, but often

students have already been working with a faculty member prior to that point. This is due to the fact that our students begin their pre-requisite courses and courses for their major early in their undergraduate career. Faculty are responsible for assisting students with course planning and offering career advice. Students are responsible for working with their faculty advisors to ensure they are making proper progress and taking the appropriate courses.

Facilities:

At UNC-CH in the College of Arts and Sciences, the JBME currently has one dedicated undergraduate laboratory, our undergraduate design lab, located in Phillips Hall. The space is comprised of two separate lab areas in rooms 114B and 116A Phillips Hall with the former covering 693 square feet and the latter covering 456 square feet. Both rooms are configured in a workstation format with each bench suitable for two students working together at a lab bench. This space is used for many of our required courses particularly the design courses. This space has a variety of equipment and supplies used for engineering design and development, including:

- Electronics equipment (power supplies, function generators, oscilloscopes, microcontroller programming hardware, etc.)
- Rapid prototyping equipment (3-D printers, laser cutter, etc.)
- Mechanical tools (hand saws, drills, etc.)

At UNC-CH, we are in the midst of renovating the undergraduate laboratory space in the basement of Phillips Hall to provide a total of >3,000 square feet. This is due to be completed by spring 2016, and funds have already been allocated by UNC-CH for this project independent of this degree request. This will provide increased space, separated into three different laboratories, plus additional space for storage and group study areas.

At UNC-CH in the School of Medicine, the JBME operates a lab in the new field of Synthetic Biology Engineering which available for use by undergraduate classes. In addition to teaching fundamental research techniques and methodologies, this resource forms the basic support mechanism for an undergraduate iGEM (International Genetically Engineered Machines) team. As an undergraduate-focused competition, iGEM is the premiere undergraduate Synthetic Biology Engineering competition. Student teams are given a kit of biological parts at the beginning of the summer and then, working at their own schools over the summer, they use these parts and new parts of their own design to build biological systems and operate them in living cells. With over 300 sq. ft. of space, this laboratory is fully equipped for studies in this new research field, including a -80°F freezer, nano drop spectrophotometer, gel imager, Evos fluorescent microscope, centrifuges, incubator, heated shaker and all other needed equipment. Finally, design labs (approximately 2,300 square feet) have already been incorporated into the planned renovation of the Mary Ellen Jones Building in the center of the UNC-CH School of Medicine. When completed, these labs will provide additional design space for the undergraduates based at both Universities for their collaborative projects with clinicians in the UNC-CH School of Medicine.

At NC State in the College of Engineering, the JBME has extensive undergraduate teaching space available in Engineering Building 3 (EB3). These facilities include:

EB Room #	Usage	Square Feet
4201A	Cell Culture Lab	236
4201B	Wet Lab	236
4321	Microbiology	217
4321B	Microbiology	230
4321C	Microbiology	285
4413	Equipment/Autoclave	475
4114	Physiology Teaching Lab	782

4118	Bio Instrumentation Teaching Lab	782
4416	Fabrication Lab	684
4201	Senior Design Lab	1882

These labs are extensively equipped including tools such as: Instron Universal Testing Machines with data acquisition computer, Nicolet 660EFT, Vibrational Exciter, Preamplifiers, Electronic Balance and Micrometers, Viscometers, Helium Pycnometer, Thermal Conductivity Probe, and PC-based data acquisition/simulation systems, tools for both metal and wood fabrication, circuit bread-boarding stations, function generators, multimeters, oscilloscopes, biosafety cabinets, CO₂ incubators, chemical fume hoods, centrifuges, inverted microscope with heated stage and camera, microplate reader, real-time thermal cycler, electrophoresis and electroblotting apparatus, centrifuges, and inverted and fluorescent microscopes

Other Resources:

Many of the resources at both UNC-CH and NC State are available to faculty and students and granting of the joint B.S. degree with subsequent merger of the undergraduate programs would greatly facilitate access for the members of the JBME. In the current setting without a joint degree, collaborative software and educational resources are difficult to access for joint ventures at the undergraduate level due to restrictions in secure collaborative tools. Granting of a joint degree would enable greatly facilitated access to collaborative resources that would provide additional enrichment to the undergraduate programs.

II. Justification for the Program – Narrative Statement

A. Describe the proposed program as it relates to:

- 1. Institutional mission**
- 2. Strategic plan**
- 3. Student demand. Provide any update to the documented evidence of student demand presented in Appendix A.**
- 4. Societal demand and employability of graduates. Provide any update to the documented evidence of societal demand and employment opportunities presented in Appendix A.**

Institutional Mission:

Since the JBME spans both the University of North Carolina at Chapel Hill and the North Carolina State University, the Department and its programs abide by the mission statements of both universities.

The UNC-CH **Mission** Statement is as follows (<http://www.unc.edu/ugradbulletin/mission.html>):

The University of North Carolina at Chapel Hill, the nation's first public university, serves North Carolina, the United States, and the world through teaching, research, and public service. We embrace an unwavering commitment to excellence as one of the world's great research universities.

Our mission is to serve as a center for research, scholarship, and creativity and to teach a diverse community of undergraduate, graduate, and professional students to become the next generation of leaders. Through the efforts of our exceptional faculty and staff, and with generous support from North Carolina's citizens, we invest our knowledge and resources to enhance access to learning and to foster the success and prosperity of each rising generation. We also extend

knowledge-based services and other resources of the University to the citizens of North Carolina and their institutions to enhance the quality of life for all people in the State.

The NC State **Mission** Statement is as follows (<http://upa.ncsu.edu/univ/miss>):

As a research-extensive land-grant university, North Carolina State University is dedicated to excellent teaching, the creation and application of knowledge, and engagement with public and private partners. By uniting our strength in science and technology with a commitment to excellence in a comprehensive range of disciplines, NC State promotes an integrated approach to problem solving that transforms lives and provides leadership for social, economic, and technological development across North Carolina and around the world.

The **Mission** of the UNC-CH/NC State Joint Department of Biomedical Engineering is:

Combine engineering and medicine to improve lives.

The new Joint Bachelor of Science in Biomedical and Health Sciences Engineering will fit into the mission of the Department and the universities in that this program will teach a diverse community of undergraduate students to become a next generation of leaders in the advancement of biomedical technologies to save lives in North Carolina, the USA, and throughout the world.

Strategic Plan:

UNC System Strategic Plan:

The new Joint Bachelor of Science in Biomedical and Health Sciences Engineering directly addresses a number of the “Solutions to North Carolina’s Biggest Challenges” as listed in “The Commitment to North Carolina” (p. 11) in *Our Time, Our Future: The UNC Compact with North Carolina* (http://www.northcarolina.edu/sites/default/files/strategic_directions_2013-2018_o.pdf). Discussed below are examples of how the new degree is responsive to the UNC Strategic Directions plan which states that:

- *We will pursue and share knowledge and research that advance the State’s economy and improve the quality of life for all North Carolinians;*
- *We will support and reward faculty who demonstrate an entrepreneurial spirit and seek new frontiers of knowledge, commercialize technology, and create opportunities for students;*
- *We will support faculty and other university researchers in tailoring research and knowledge in ways that advance the state’s economy;*
- *We will nurture and protect the University’s culture of inquiry, innovation, the free exchange of ideas, and commitment to academic freedom;*
- *We will rededicate ourselves to improving the health of all North Carolinians;*
- *We will engage businesses, nonprofits, state agencies, and others in a continuous effort to improve North Carolina’s competitiveness;*
- *We will identify social, scientific, and economic trends that affect the state’s well-being.*

Responsive to the need to advance the State’s economy, BME is a highly entrepreneurial and innovative field. Current BME core faculty have been involved in 22 startup companies and impart this experience to their students. The design series of classes, part of the joint B.S. degree curriculum, are specifically structured around innovation and promotion of entrepreneurship. These classes often lead to invention disclosures, and have led to several startup companies organized by the students themselves.

Responding to the improvement of the health of North Carolina's citizens, biomedical engineers focus on applying engineering principles to medicine with the expressed goal of improving healthcare in North Carolina and preparing a significant portion of its graduates to pursue professional degrees in the health field.

To share knowledge and research, the Biomedical and Health Sciences Engineering will be housed within the JBME and the first step in further joining of the BME Department across the two universities. The JBME and its undergraduate programs represent a unique inter-institutional and interdisciplinary collaboration between UNC-CH and NC State creating opportunities for our students at both universities.

In regards to identifying trends in science and the economy that impact the State, *Our Time, Our Future* (p. 18) points out that biomedical engineering jobs are the one engineering career expected to continue to see substantial growth (NC Biotech Center 2012 Report on STEM Occupations (EMSI) 2001-2011).² This trend imparts a necessity and importance both on a state and national basis to appropriately train our students to meet the growing need for life science engineers for cutting-edge biomedical research and clinical device invention. If the Research Triangle Park is to continue to be an economic engine for the State, we must provide the highly skilled workers to maintain competitiveness at the national and international level.

The **UNC-CH Strategic Plan**² specifically mentions biomedical engineering as a future focus area for investment. The plan specifically emphasizes pharmacoengineering, which is the newest of the five research strengths of the BME Department, and a collaboration with the UNC-CH School of Pharmacy. Specifically, "Targeted investment in pharmacoengineering within the UNC system will build on the success of medicine and life science at UNC-CH and engineering at NC State, and will leverage the success of the existing Joint Department of Biomedical Engineering between those institutions. This investment will be focused on building collaborations among UNC-CH's Schools of Medicine and Pharmacy, its College of Arts and Sciences, and NC State's Colleges of Engineering, Agriculture and Life Sciences, Science, and Veterinary Medicine, as well as with private companies and nonprofits such as the NC Biotechnology Center." The new joint B.S. degree will thus integrate precisely with the UNC-CH Strategic Plan.

The **UNC-CH Strategic Plan** also speaks to maximizing efficiencies and coordination between universities as Goal 4. By incorporating this degree within the UNC-CH/NC State Joint Department of Biomedical Engineering, significant efficiencies are created from the partnership between UNC-CH and NC State. The complete merger of the UNC-CH/NC State BME undergraduate programs further implements the UNC-CH strategic plan leveraging the resources of two great universities to build the BME partnership. The know-how, resources, and facilities within the combined Department are being brought to bear for curricula development as well as research and training experiences for the students without unnecessary duplication between the two universities. The Department is well positioned to develop synergistic experiences and programs for the undergraduates taking advantage of the best opportunities at both UNC-CH and NC State. The JBME is an exemplary collaborative effort between UNC-CH and NC State, and is well positioned to serve as a model for future cooperative efforts between North Carolina's universities.

² UNC Strategic Directions 2013-2018.

https://www.northcarolina.edu/sites/default/files/documents/strategic_directions_2013-2018.pdf

The **North Carolina State University Strategic Plan**³ shares similar goals with the UNC-CH Strategic Plan related to interdisciplinary scholarship. Goal 3 from the NC State plan states the following:

“The history and mission of NC State call for us to address the major challenges that confront the world. Addressing complex problems with many disciplinary aspects requires assembling teams of scholars with varied skills and diverse perspectives. We will maximize the impact of NC State’s research by concentrating our research resources in areas where we have strategic strengths and by creating a culture of collaboration and interdisciplinarity that will enrich not only our research activities, but also our teaching and engagement.”

The JBME creates a unique partnership between UNC-CH and NC State and also spans and connects various disciplines including engineering and medicine. The joint degree and subsequent completed merger between the UNC-CH and NC State UG programs will further contribute to this inter and cross-disciplinary collaboration between the two universities and strengthen the resources available to our students through program, course, and research collaboration among other various forms of interconnectedness between the two universities.

Furthermore, the joint B.S. degree program is also well aligned with Goal 5 from the NC State plan, which focuses on enhancing local and global engagement through focused strategic partnerships. Goal 5 specifically states the following:

“As the world has changed, NC State’s reach has expanded beyond our borders and across the globe, challenging us to be locally responsive to the needs of our community and our state while globally engaging in solving the grand challenges facing our global community.”

One of the strategies provided to achieve Goal 5 relates to the enhancement of active and sustainable partnerships locally, regionally, and globally. As previously mentioned, biomedical engineers work to apply engineering principles to the field of medicine, which contributes to healthcare improvement in the state of North Carolina and beyond. The joint B.S. will also contribute to the overall partnership between UNC-CH and NC State by providing access to the UNC-CH School of Medicine and forging partnerships across disciplines and schools.

The **Joint Department of BME** initiated an extensive strategic planning initiative conducted from August 2013 through January 2014. The BME Strategic Planning Task Force was comprised of BME faculty, students and staff and included a strategic planning consultant from the UNC-CH Kenan-Flagler School of Business. Additionally, a BME Strategic-Planning Advisory Committee met twice during the process to review, critique, and provided feedback as the strategic plan was developed. This Advisory Committee included members of the UNC-CH and NC State Board of Trustees, representatives from the UNC-CH and NC State Chancellor and Provost Offices, the Deans and their associates from the COE, CAS and SOM, industry representatives as well as other stake holders in BME from across the Triangle Region (RTI, NC Biotech).

The BME Strategic Planning Project identified as its Priority 1- **Building an Inter-Institutional Collaboration Model**. A major goal in this priority was the enabling of truly joint departmental

³ North Carolina State Strategic Plan 2011-2020.

<http://info.ncsu.edu/strategic-planning/files/2011/04/nc-state-sp-4-26-11.pdf>

personnel & students at all levels. Priority 2 was **Creation of Global Impact**. A key effort in this component was the education of a high quality workforce by creating a transformative joint undergraduate BME program. We are on a path to accomplish the priorities laid out by the UNC-CH/NC State BME Strategic Planning Effort and this Appendix is one segment of this path.

Student Demand:

Biomedical engineers use engineering expertise to analyze and solve problems in biology and medicine with the goal of providing an overall enhancement in health care. A biomedical engineer often works with other health care professions, such as physicians, nurses, therapists, and technicians to design instruments, devices, and software, to bring together knowledge from many technical sources to develop new procedures or to conduct research needed to solve clinical problems. According to the Biomedical Engineering Society (BMES), many students choose the biomedical engineering field to be of service to people, to partake of the excitement of working with living systems, and to apply advanced technology to the complex problems of medical care.

The United States Department of Labor Occupational Outlook Handbook (2013) reports that the number of **biomedical engineering jobs is rapidly increasing and projected to increase at 62%** from 2010-2020 - substantially faster than all other occupations (projected at 14%).⁴ This rapid rise in biomedical engineering jobs in part due to an aging U.S. population and the increasing demand for improved medical devices and systems.

Specific to North Carolina, between 2002 and 2012, North Carolina gained 21% in population, but only 0.3% in jobs. Furthermore, data indicates that North Carolina suffered an 8.7% job loss for engineers as a whole between 2001 and 2011, with the exception of biomedical engineers. On the contrary, **biomedical engineering jobs increased**.⁵ Thus, there is an immediate need to provide a skilled labor force for this increasing job sector in North Carolina.

Nationally, BME student enrollment from 2000-2012 has grown steadily – with an increase of 9% cumulative annual growth for BME graduate students,⁶ and **12% cumulative annual growth for BME undergraduates**.⁷ These national trends are recapitulated in the JBME with ever increasing numbers of students at both NC State and UNC-CH declaring their major as BME.

Societal Demand and Employability of Graduates:

There has been massive growth of technology in medicine in the past four decades. While initial advances consisted largely of the application of existing technology to medical purposes, more recent medical applications have been a major driving force for the development of new technologies. Medical devices, bionics, signal and image processing, informatics, and telemedicine, as well as biocompatible materials and substrates are just a few of the numerous applications of engineering in medicine which comprise the field

⁴ US Dept. of Labor, Bureau of Labor Statistics, Occupational Outlook Handbook
<http://www.bls.gov/ooh/architecture-and-engineering/biomedical-engineers.htm>

⁵ NC Biotech Center 2012 Report on STEM Occupations (EMSI) 2001-2011.

⁶ National Science Foundation Report on Students in Science and Engineering, Fall 2011
http://www.nsf.gov/statistics/nsf13331/content.cfm?pub_id=4290&id=2

⁷ American Society for Engineering Education, Engineering by the Numbers
<http://www.asee.org/papers-and-publications/publications/college-profiles/2011-profile-engineering-statistics.pdf>

of biomedical engineering. This is a very young field that has experienced unprecedented expansion and has contributed significantly to the ongoing technological revolution in our society. It is reasonable to anticipate that biomedical engineering will be a major driving force in the economic development at the local (RTP), state and, national level for many years to come.

Forbes Magazine ranked BME the number one major in its list of the “Fifteen Most Valuable College Majors” in 2012. Reflecting its importance in meeting today’s needs, CNN Money ranked BME the number one job in America in 2013. The demand for solutions to health science and clinical needs is driving this rapid growth and the Department of Biomedical Engineering at UNC-CH and NC State is at the forefront of meeting these demands. In 2010, the U.S. Labor Department accurately predicted the discipline of biomedical engineering would add jobs faster than any other sector of the economy with a growth rate of greater than 60 percent through 2020. A steady supply of highly trained life science engineers is critical to meet the demands of our society to develop cutting-edge research and devices. This workforce will bring innovative technologies to market and in the process, enhance not only healthcare, but also the international competitiveness of the State of North Carolina and our Nation.

Our undergraduate program in biomedical engineering prepares our students for a position in industry, for graduate studies, and for professional degree programs in the health sciences. In the past 5 years, approximately 40 percent of our graduates have obtained jobs in the biotech, pharmaceutical, and medical instrumentation industries, among others. The companies that employ our graduates include IBM, GlaxoSmithKline, Epic Systems, Stryker, and Teleflex Medical. Another 40 percent of graduates entered graduate school programs in Biomedical Engineering, Engineering Management or other engineering-related programs. Our alumni have studied at many top-ranked graduate programs in Biomedical Engineering, including Duke University, Georgia Tech/Emory, Johns Hopkins, and University of California – San Diego. The remaining 20 percent have matriculated into professional degree programs such as medicine, nursing, and dentistry at schools such as University of North Carolina and Brown University. The opportunities for students in BME remain robust with a diverse and growing array of opportunities post-graduation.

The Joint BME department is committed to educating a new generation of biomedical engineers expressly equipped to meet the complex, yet vital, societal challenges impacting the health of our Nation. To accomplish this, our educational mission is to train students in a translational culture focused on bringing ideas to market. We are leveraging the extensive resources of both UNC-CH and NC State to provide students with a foundational education in math, science, engineering, and the humanities; moreover, they receive training in situations where invention to solve real-world problems both here and abroad is the focus.

B. Provide any update to the discussion of similar degree programs and opportunities for collaboration presented in Appendix A. Discuss here the feasibility of a joint or collaborative degree program with one or more UNC institutions.

The JBME will ultimately combine the two undergraduate programs into a single joint ABET-accredited program in biomedical engineering with a timeline for the proposed merger shown in Figure 1. Granting of the Joint B.S. degree in Biomedical and Health Sciences Engineering is viewed as a necessary first step in this process. The JBME in conjunction with the CAS and COE believe that the merger of the two undergraduate programs is best conducted as a staged process so that both programs are ABET-accredited at the time of the completed merger. Thus, necessary first steps are receipt of the joint B.S. degree followed by the ABET review of the joint B.S. degree program. This step-wise process enables sufficient time for undergraduate program planning across the two universities so that the JBME fully capitalizes on the assets of both UNC-CH and NC State to create a truly transformative merged undergraduate program across the universities. Further, this strategy permits a risk-free approach with respect to the ABET-accreditation of the current NC State program.

UNC-CH and NC State have agreed to work together on the institutional processes described below for the joint degree program as proscribed by UNC-GA (<https://www.northcarolina.edu/apps/policy/index.php?pg=vs&id=s1879>). A number of procedural and practical issues have been anticipated. The proposals listed below will be subject to committee and administration approval at both universities. Unanticipated issues will be worked out by joint faculty committees and upper level administrative supporters of the joint program. As the joint program evolves, issues will be identified and solutions will be discovered and approved. Graduation requirements will satisfy the requirements of the school on the campus at which the student resides. Decisions on any student questions for which a policy statement does not exist will be made by the BME Chair and Directors of Undergraduate Studies on the two campuses with approval through the appropriate administrative review processes at both campuses. Attempts will be made to coordinate the BME departmental and student policies on both campuses with the goal of making them uniform.

1. Admission process- Initially, we anticipate that admissions will occur through each University's current admission process with students entering the College of Arts and Sciences or College of Engineering as they have for the current standalone undergraduate programs. The students would follow the guidelines at their respective University as to when the student declares his or her major as BME. Our vision in the future is to implement a combined admissions process into JBME at the undergraduate level. However admission into JBME would only occur after the students are admitted into NC State or UNC-CH. Admission into JBME would then be considered by a single undergraduate admissions committee formed from the JBME faculty. We will work with the administrations at both Universities to implement a combined admissions strategy in the future that enables a wise use of resources and manpower in the JBME.

2. Registration and enrollment process for students- Initially, students will be based at either UNC-CH or NC State and will register and enroll using the existing processes on the campus in which they are based (their "home" institution). In these early steps in building the joint program, students will continue to have access to courses at the other campus (on which they are not based) through inter-institutional enrollment. In the future, to fully leverage the assets of both Universities, the JBME will work with the registrars and administration at both Universities to implement a joint registration and recording keeping process for the students in the joint program. The faculty of the JBME firmly believe that the undergraduate students must have full access to the resources at both Universities for the joint program to reach its full potential and offer a transformative educational experience. However the JBME faculty understand that implementation of joint registration for the students must be accomplished in a step-wise fashion through a collaborative inter-university process. Upon the granting of this joint degree, both Universities will immediately begin construction of an MOU for the registration and enrollment for JBME students at UNC-CH and NC State.

3. Committee process for graduate students- not applicable

4. Plan for charging and distributing tuition and fees- Students will pay appropriate fees and tuition for the campus on which they are based, as is the case for the existing joint graduate degree program in BME. Funds accruing from fees and tuition collected on a campus will be distributed on that campus as per that campus's funding formulas and guidelines. Each University will be responsible for maintaining their respective facilities and providing infrastructure and staffing support sufficient for the numbers of students based at that campus. Students entering the joint BME program will be granted full access to facilities at both institutions significantly increasing the collaborative abilities of students across institutions and encouraging courses that feature joint group work such as Senior Design." Some efforts or initiatives that are combined between the Universities, for example, the Biomedical Engineering Club, are expected to be supported jointly by the institutions. The expectation is that support will be proportional to the percentage of students based at that University. The BME Chair and Directors of Undergraduate Studies will work with the campuses to acquire support for these types of shared projects.

5. Management of transcripts and permanent records- In the first 2-3 years after the granting of the joint degree, all students in the joint program are expected to be based at UNC-CH so that UNC-CH will have primary responsibility for maintaining transcripts and records during these initial years. However upon the granting of this joint degree, both Universities will immediately begin development of a protocol and construction of an MOU for the sharing of records and transcripts for JBME students between UNC-CH and NC State. This MOU will be in place prior to the accreditation of the joint B. S. degree and entry of NC State students into the joint B.S. degree.

6. Participation in graduation- Currently the JBME holds a single, combined, departmental graduate graduation ceremony on the NC State campus. However, a departmental undergraduate graduation ceremony is held on each campus. For the joint degree, we expect to hold a single ceremony for all JBME graduates at a location midway between UNC and NC State if a sufficiently large facility can be identified. We have found that parents of graduates often wish to tour the campus and facilities as well as to participate in other festivities at the Universities. Thus the joint graduation ceremony may be followed by tours or receptions on each campus for students and parents. Currently JBME faculty and staff participate in the graduation ceremonies held on each campus and we expect that this would continue for the joint graduation ceremonies. Both UNC-CH and NC State hold graduation on the same weekend every year and JBME ceremonies would also be held on that same weekend.

7. Design of diploma- The degree will be awarded with a joint diploma containing seals of both universities as well as appropriate signatures from both institutions. The diploma will be similar to that granted for the joint Ph.D. and M.S. diplomas in BME but with changes appropriate for the this new degree. A mockup of the diploma follows:

**The University of North
Carolina at Chapel Hill**

And

**North Carolina State
University at Raleigh**

By authority of the Board of Governors of the
University of North Carolina, the Faculty and
Trustees have conferred upon



Jonathan Sample Name

the Degree of

Bachelors of Science

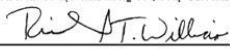
In Biomedical and Health Sciences Engineering

In recognition of the satisfactory fulfillment of the
prescribed requirements for this Degree with all the
rights and privileges pertaining thereto.

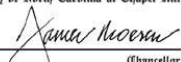
Given in _____, North Carolina, this the _____th day of _____, 200_.



President of the University of North Carolina



Chair of the Board of Trustees
The University of North Carolina at Chapel Hill



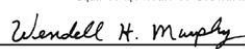
Chancellor
The University of North Carolina at Chapel Hill

Dean of the College of Arts and Sciences
The University of North Carolina at Chapel Hill

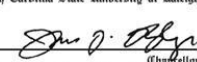




Chair of the Board of Governors



Chair of the Board of Trustees
North Carolina State University at Raleigh



Chancellor
North Carolina State University at Raleigh

Dean of the College of Engineering
North Carolina State University at Raleigh

C. Enrollment (baccalaureate programs should include only upper division majors, that is, juniors and seniors).

Please indicate the anticipated first year and fourth year steady-state enrollment (head count) for the proposed program.

Year 1: Full Time 80 (UNC-CH) Part-time 0 Total 80
This total does not include the students in the NC State BME program (160 students).

Year 4: Full-time 110 (UNC-CH) 160 (NC State) Part-time 0 Total 270

III. Program Requirements and Curriculum

A. Program Planning

1. List the names of institutions with similar offerings regarded as high quality programs by the developers of the proposed program.

At the undergraduate level, the JBME has an ABET-accredited undergraduate BME program based within the College of Engineering at NC State as discussed extensively previously.

Across the state of North Carolina, other universities that offer a B.S. degree in BME are Duke University, the Joint Department at Virginia Tech-Wake Forest University, and the Bioengineering program at NC A&T, which just established its undergraduate BME program this year. East Carolina University offers a B.S. degree in Engineering with a concentration in BME. Given the expansion of the biomedical sciences, their economic importance, and the need for a well-trained work force of North Carolina citizens, it is extremely important that we make every effort to expand the educational opportunities in this engine of economic growth to meet current and future demands.

2. List institutions visited or consulted in developing this proposal. Also discuss or append any consultants' reports or committee findings generated in planning the proposed program.

Please see the prior section on the Strategic Planning Exercise conducted by the JBME.

B. Admission. List the following:

1. Admissions requirements for proposed program (indicate minimum requirements and general requirements).

In these early stages, we do not envision a separate admissions process at UNC-CH. Once NC State students are admitted to the program (~2017), NC State and UNC will work to develop a joint admissions process consistent with both University's process.

2. Documents to be submitted for admission (listing or attach sample).

N/A

C. Degree requirements. List the following:

1. Total hours required. State requirements for Major, Minor, General Education, etc.

For specific course requirements, please see section D below. The total number of hours is 127.

2. Other requirements (e.g. residence, comprehensive exams, thesis, dissertation, clinical or field experience, "second major," etc.).

None

For graduate programs only, please also list the following:

3. Proportion of courses open only to graduate students to be required in program

4. Grades required

5. Amount of transfer credit accepted

6. Language and/or research requirements

7. Any time limits for completion

D. For all programs, list existing courses by title and number and indicate (*) those that are required. Include an explanation of numbering system. List (under a heading marked "new") and describe new courses proposed.

We list the curriculum in several different ways. The majority of our incoming students begin with some college credit through Advanced Placement courses or other means. Therefore, the first schedule shows a possible path for a student who has by-exam (BE) credit for both MATH 231 and CHEM 101/101L. The second schedule shows a possible path for a student who comes to the program with no BE credit. In this case, a student will need to attend at least one summer session to get through all of the requirements. Finally, the last schedule shows what we use for advising our students, which accounts for the variety of incoming credit that the student may have, and makes it clear that students have the option for taking courses in different semesters or in the summer.

This curriculum incorporates several changes that are being submitted for approval. We propose to replace PHYS 351 and 352, Electronics I and II, in our current curriculum with BMME 350, Electronics for BME, and BMME 490, Human Physiology and Biological Measurements. The latter course BMME 490 will have a new course number that we will propose with the formal course submission this fall. These changes are more in line with the existing requirements at NC State. Indeed BMME 351, Human Physiology and Biological Measurements is modeled after the NC State-equivalent course, demonstrating another area of ongoing jointness and collaboration between the UNC and NC State-based undergraduate programs.

Biomedical and Health Sciences Engineering, Sample

Schedule 1

A possible path through the curriculum for a student who has by-exam (BE) credit for both MATH 231 and CHEM 101/101L

First Year			
Fall	Units	Spring	Units
MATH 232	3	MATH 233	3
Chem 102/L	4	COMP 116	3
ENGL 105	3	PHYS 118	4
Foreign language level 2	3	Approaches (PH)	3
Approaches (LA)	3	Foreign language level 3	3
BMME 190 (strongly recommended)	1	LFIT	1
	17		17
Sophomore Year			
Fall	Units	Spring	Units
BMME 160	3	BMME 150	3
MATH 383	3	BIOL 202	4
PHYS 119	4	BMME 210	2
BIOL 101/L	4	Approaches (VP)	3
		Approaches (HS)	3
	14		15
Junior Year			
Fall	Units	Spring	Units
BMME 350 * (PHYS 351)	4	BMME 490* (PHYS 352)	4
BMME 310	2	BMME 465	4
BIOL 252	4	BMME 410	4
MATH 528	3	BME specialty elective 1	3
Approaches (HS/SS)	3		
	16		15
Senior Year			
Fall	Units	Spring	Units
BMME 697	2	BMME 698	4
BMME 341 or 455 or 475	3	BMME specialty elective 3	3

BME specialty elective 2	3	BMME specialty elective 4	3
BIOS 600 or STOR 435 or 455	3	General elective	3
Approaches (HS/SS)	3		
	14		13
		Total Hours	121

*This course was on the new degree proposal, but it's not a current requirement in BME.

BE credit for Chem 101/L,
 Math 231 7
Total w/ BE 128

Biomedical and Health Sciences Engineering, Sample Schedule 2

A possible path through the curriculum for a student who arrives with **no** BE credit

First Year			
Fall	Units	Spring	Units
MATH 231	3	MATH 232	3
Chem 101/L	4	CHEM 102/L	4
ENGL 105	3	PHYS 118	4
Foreign language level 1	3	Approaches (PH)	3
Approaches (LA)	3	Foreign language level 2	3
BMME 190 (strongly recommended)	1	LFIT	1
	17		18
Summer	Units		
MATH 233	3		
Foreign language level 3	3		
	6		
Sophomore Year			
Fall	Units	Spring	Units
BMME 160	3	BMME 150	3
MATH 383	3	BIOL 202	4
PHYS 119	4	BMME 210	2

BIOL 101/L	4	Approaches (VP)	3
		COMP 116	3
	14		15
Junior Year			
Fall	Units	Spring	Units
BMME 350 * (PHYS 351)	4	BMME 490* (PHYS 352)	4
BMME 310	2	BMME 465	4
BIOL 252	4	BMME 410	4
MATH 528	3	BME specialty elective 1	3
Approaches (HS/SS)	3		
	16		15
Senior Year			
Fall	Units	Spring	Units
BMME 697	2	BMME 698	4
BMME 341 or 455 or 475	3	BMME specialty elective 3	3
BME specialty elective 2	3	BMME specialty elective 4	3
BIOS 600 or STOR 435 or 455	3	Approaches (HS)	3
Approaches (HS/SS)	3		
	14		13
		Total Hours	128

*This course was on the new degree proposal, but it's not a current requirement in APPL.

BE credit (none) 0
Total 128

Biomedical and Health Sciences Engineering, Sample Schedule 3

This is the schedule that we use for advising our students, which accounts for the variety of incoming credit that the student may have, and makes it clear that students have the option for taking courses in different semesters or in the summer.

First two years

Fall:

*BMME 160 Statics 3

BMME 190.01 Frontiers of Biomedical Engineering 1

Spring:

*BMME 150 Introduction to Material Sciences 3

Either semester, or in the summer:

*BMME 210 BME Design and Manufacturing I 2
 *BIOL 101, 101L Principles of Biology with Lab 4
 *BIOL 202 Molecular Biology and Genetics 4
 *CHEM 101, 101L General Chemistry I and Lab 4
 *CHEM 102, 102L General Descriptive Chemistry II and Lab 4
 *COMP 116 Introductory Programming 3
 *ENGL 105 / 105I English Composition and Rhetoric 3
 Foreign Language 3 3
 *MATH 231 Calculus of Functions of One Variable 3
 *MATH 232 Calculus of Functions of One Variable II 3
 *MATH 233 Calculus of Functions of Several Variables 3
 *MATH 383 Linear Algebra and Differential Equations (lab section is optional) 3
 *PHYS 116/118 Mechanics 4
 *PHYS 117/119 Electromagnetism and Optics 4
 Approaches class #1 (note 1) 3
 Approaches class #2 (note 1) 3
 Approaches class #3 (note 1) 3
 Lifetime Fitness 1

Junior year

Fall:

*BMME 350 Fundamentals of Biomedical Electronics 4

Spring:

*BMME 490.xxx Human Physiology and Biological Measurements (note 2) 4
 *BMME 465 Biomedical Instrumentation 4
 *BMME 410 Signals and Systems 4

Either semester:

*BMME 310 BME Design and Manufacturing II 2
 *BIOL 252 Fund. Of Hum. Anatomy and Physiol. 4
 *MATH 528 Mathematical Methods 3
 Approaches class #4 (note #1) 3
 BME Specialty Elective 1 3

Senior year

Fall:

*BMME	697	Senior Design Project	2
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Spring:

*BMME	698	Senior Design Project	4
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Courses available either semester:

*Choose one of the following:

BMME 341 Thermodynamics	3
BMME 455 BioFluid Mechanics	3
BMME 475 Transport Processes	3

*You must take each of the following courses:

BME Specialty Elective 2	3
BME Specialty Elective 3	3
BME Specialty Elective 4	3
Statistics Elective (choose from STOR 435, 455 or BIOS 600)	3
*Approaches class #5 (note #1)	3
*Approaches class #6 (note #1)	3

Notes:

1. The 6 Approaches classes must satisfy all UNC General Education requirements in Social and Behavioral Sciences and Humanities/Fine Arts (the Physical and Life Sciences requirements will be satisfied by the other required courses in BME)
2. This is a temporary course number for this new class. It will receive a new course number starting in the 2015/2016 academic year.

Sampling of BME electives:

BMME 485 Biotechnology
 BMME 445 Systems Neuroscience
 BMME 510 Biomaterials
 BMME 550 Medical Imaging
 BMME 580 Microcontroller Applications
 BMME 505 Biomechanics
 BMME 470 Tissue Engineering
 BMME 460 Analytical Microscopy

BMME courses are taught by faculty in the Joint Department of Biomedical Engineering.

IV. Faculty

- A. (For undergraduate and master's programs) List the names, ranks and home department of faculty members who will be directly involved in the proposed program. The official roster forms approved by SACS may be submitted. For master's programs, state or attach the criteria that faculty must meet in order to be eligible to teach graduate level courses at your institution.**

The following faculty will support the Joint B.S. degree and curriculum:

Nancy Allbritton: Professor and Chair; UNC-CH/NC State Joint Dept of Biomedical Engineering

Ted Bateman: Associate Professor; UNC-CH/NC State Joint Dept of Biomedical Engineering

Lianne Cartee: Teaching Associate Professor; Director of Undergraduate Studies at NC State; UNC-CH/NC State Joint Dept of Biomedical Engineering

Ke Chang: Associate Professor; UNC-CH/NC State Joint Dept of Biomedical Engineering

Jacqueline Cole: Assistant Professor; UNC-CH/NC State Joint Dept of Biomedical Engineering

Paul Dayton: Professor and Associate Chair; UNC-CH/NC State Joint Dept of Biomedical Engineering

Robert Dennis: Associate Professor; UNC-CH/NC State Joint Dept of Biomedical Engineering

Andrew DiMeo: Associate Professor of the Practice; UNC-CH/NC State Joint Dept of Biomedical Engineering

Kenneth Donnelly: Lecturer; UNC-CH/NC State Joint Dept of Biomedical Engineering

Matthew Fisher: Assistant Professor; UNC-CH/NC State Joint Dept of Biomedical Engineering

Caterina Gallippi: Associate Professor; UNC-CH/NC State Joint Dept of Biomedical Engineering

Michael Gamcsik: Associate Professor; UNC-CH/NC State Joint Dept of Biomedical Engineering

Shawn Gomez: Associate Professor; UNC-CH/NC State Joint Dept of Biomedical Engineering

Richard Goldberg: Research Associate Professor; Director of Undergraduate Studies at UNC-CH; UNC-CH/NC State Joint Dept of Biomedical Engineering

Edward Grant: Professor; UNC-CH/NC State Joint Dept of Biomedical Engineering

He Huang: Associate Professor; UNC-CH/NC State Joint Dept of Biomedical Engineering

Devin Hubbard: Lecturer; UNC-CH/NC State Joint Dept of Biomedical Engineering

David Lalush: Associate Professor; UNC-CH/NC State Joint Dept of Biomedical Engineering

Frances Ligler: Professor; UNC-CH/NC State Joint Dept of Biomedical Engineering

Elizabeth Loba: Professor and Associate Chair; UNC-CH/NC State Joint Dept of Biomedical Engineering

Jeffrey MacDonald: Associate Professor; UNC-CH/NC State Joint Dept of Biomedical Engineering

Roger Narayan: Professor; UNC-CH/NC State Joint Dept of Biomedical Engineering

Hatice Ozturk: Teaching Associate Professor; UNC-CH/NC State Joint Dept of Biomedical Engineering

Gianmarco Pinton: Assistant Professor; UNC-CH/NC State Joint Dept of Biomedical Engineering

Gregory Sawicki: Assistant Professor; UNC-CH/NC State Joint Dept of Biomedical Engineering

Steve Soper: Professor; UNC-CH/NC State Joint Dept of Biomedical Engineering

Anne Taylor: Assistant Professor; UNC-CH/NC State Joint Dept of Biomedical Engineering

Mark Tommerdahl: Associate Professor; UNC-CH/NC State Joint Dept of Biomedical Engineering

Glenn Walker: Associate Professor; UNC-CH/NC State Joint Dept of Biomedical Engineering

B. (For doctoral programs) List the names, ranks, and home department of each faculty member who will be directly involved in the proposed program. The official roster forms approved by SACS may be submitted. Provide complete information on each faculty member's education, teaching and research experience, research funding, publications, and experience directing student research including the number of theses and dissertations directed.

C. Estimate the need for new faculty for the proposed program over the first four years. If the teaching responsibilities for the proposed program will be absorbed in part or in whole by the present faculty, explain how this will be done without weakening existing programs.

We do not anticipate the need for new faculty members for this new degree. The Department will continue to utilize our current faculty members as well as the additional hires already allotted to the Joint department of BME.

D. Explain how the program will affect faculty activity, including course load, public service activity, and scholarly research.

Our current faculty (and the new hires that will join the Department) will retain their existing course loads, public services activities, and scholarly research. Creation of the joint B.S. does not alter the Department's faculty or staff workloads.

V. Library

A. Provide a statement as to the adequacy of present library holdings for the proposed program to support the instructional and research needs of this program.

Students in the JBME will have access to very robust libraries at UNC-CH and NC State that provide them with the many resources needed to supplement their academic experience. Our students can utilize the BME bus running between NC State Centennial campus and UNC-CH Medical School to travel between the two campuses.

The **UNC-CH Health Sciences Library (HSL)** is the primary library for the UNC-CH Schools of Public Health, Medicine, Dentistry, Nursing, Pharmacy, and UNC Hospitals. It contains 342,748 total volumes and receives 4,354 serial titles. Hundreds of electronic journals and databases such as PubMed, CINAHL, ISI Citation Databases, BIOSIS, PsycINFO, eFacts, Lexi-Comp are available through the Library's website. Faculty, staff, and students can access electronic resources from home. A total renovation of the library building was completed in early 2005. The library is now fully wireless and equipped with 42 public computer workstations, 19 small group study rooms, one Media Studio, two teaching labs with a total of 45 workstations, and a campus equipped computer lab with 28 workstations. Seating capacity of the entire library is now 716 and our students will be able to access this library.

The **James B. Hunt Jr. Library** at NC State is an iconic building that captures the spirit of NC State University's strengths in science, engineering, technology, and textiles. The library has a robot-driven **bookBot** automated book delivery system that holds up to 2 million volumes in 1/9 the space of conventional shelving, enabling the library to provide more space for learning and collaboration. The bookBot is 50 feet wide by 160 feet long by 50 feet tall and is excavated 20 feet below the first floor. The building also includes almost 100 group study rooms and technology-equipped spaces to support learning, research, and collaboration. The Hunt Library is an international destination for those who seek to explore how collaborative spaces and innovative applications of technology can inspire the next generation of engineers, designers, scientists, researchers, and humanists.

B. State how the library will be improved to meet new program requirements for the next four years. The explanation should discuss the need for books, periodicals, reference material, primary source material, etc. What additional library support must be added to areas supporting the proposed program?

No improvements are needed.

C. Discuss the use of other institutional libraries.

Our students also have the option of reserving materials (books, journal articles, videos, etc.) at UNC-CH, NC State, and Duke University libraries through the interlibrary loan program that is in place among the universities. This program allows our students access to even more materials throughout the Triangle that benefit their academic endeavors and further study.

VI. Facilities and Equipment

A. Describe facilities available for the proposed program.

The current laboratory facilities were described above in section I.C.

B. Describe the effect of this new program on existing facilities and indicate whether they will be adequate, both at the commencement of the program and during the next decade.

At UNC-CH, the JBME has already been allocated extensive new space in Phillips Hall and the Mary Ellen Jones Bldg. independent of this degree request. At NC State, the JBME occupies extensive new space on the 4th floor of Engineering Building 3. Currently the JBME is in the enviable position of having unused, open space at both Universities. The JBME expects to completely fill this space over the next 5 years at which time the department expects to have reached steady state with respect to student, faculty, and staff

numbers. Thus the Department projects that our existing space will be adequate in administering the proposed degree program for the foreseeable future.

C. Describe information technology and services available for the proposed program

As part of the College of Arts & Sciences, the Department receives IT services from OASIS and ITS. At NC State, the Department receives IT services from ITECS and OITS. In addition, we have a BME Systems Administrator and IT staff in the Department.

D. Describe the effect of this new program on existing information technology and services and indicate whether they will be adequate, both at the commencement of the program and during the next decade.

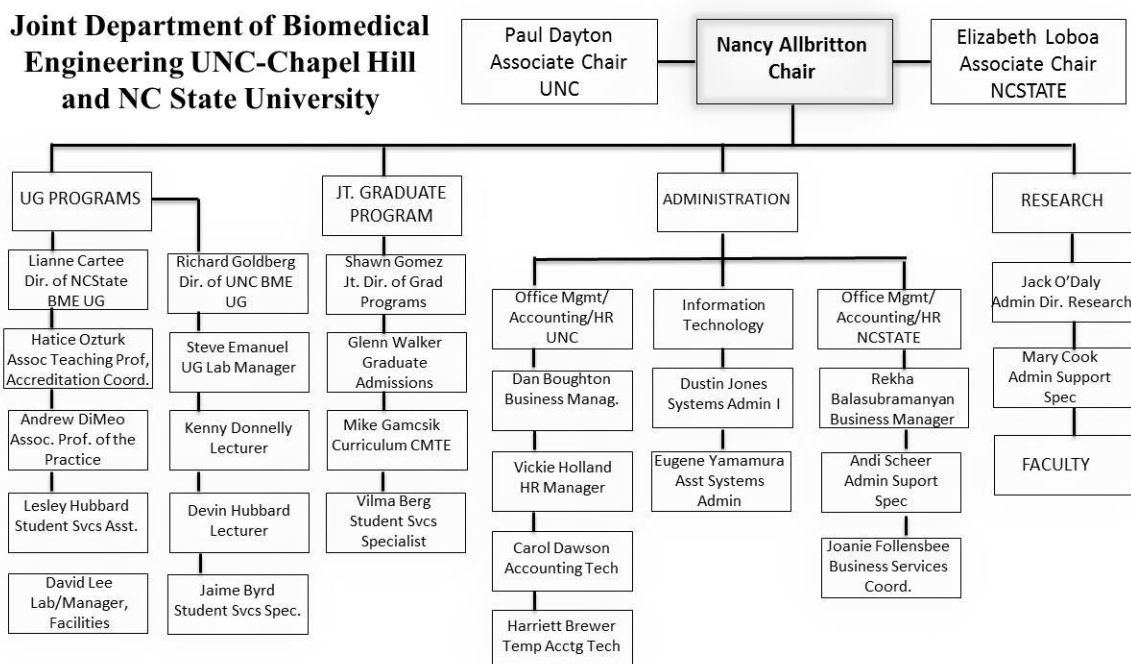
We anticipate that our existing IT services will be adequate during the next decade. As part of the Joint Department of Biomedical Engineering, students have access to both UNC-CH and NC State infrastructure and IT services. This infrastructure includes a high-speed, high-capacity gigabit Ethernet fiber optic data network as well as a technology-rich environment for students that include learning spaces (Learning Commons and Digital Media Lab). Students in the JBME can also access the award-winning Virtual Computing Lab. This service is powered by the Apache Software Foundation and provides students remote access service that allows them to reserve a computer and desired software over the Internet. Applications including Matlab, Maple, SAS, Solidworks, among others are available for student use.

VII. Administration

Describe how the proposed program will be administered, giving the responsibilities of each department, division, school, or college. Explain any inter-departmental or inter-unit administrative plans. Include an organizational chart showing the "location" of the proposed new program.

The proposed program will be administered through the Joint Department of Biomedical Engineering. The undergraduate programs at UNC-CH and NC State as well as the Joint Graduate Program, the administrative offices, and research and faculty at the two universities report to Nancy Allbritton, Chair of the Joint Department of Biomedical Engineering. Dr. Allbritton, reports to the Dean of the College of Engineering at NC State, the Dean in College of Arts and Sciences at UNC-CH and the Dean of the UNC-CH School of Medicine. The three deans oversee all aspects of the Joint Departments operation including the undergraduate programs. ***As a show of the universities support for the BME collaboration, both the NC State and UNC Provosts have agreed to meet with the three Deans and the BME Chair to form a BME Leadership Team.*** The Team will meet twice a year in the Fall and Spring semesters starting with the Fall of 2014. This Leadership Team will be responsible for creating a shared vision to bring the universities together in a seamless partnership that will serve as the prototypical model of inter-institutional cooperation. The team will handle complex topics spanning the two universities such as resource allocation and leverage institutional resources to create a top-tier joint BME department.

The organizational chart for the Joint Department of Biomedical Engineering follows.



VIII. Accreditation and Licensure

A. Where appropriate, describe how all licensure or professional accreditation standards will be met, including required practica, internships, and supervised clinical experiences.

ABET is the organization that accredits undergraduate engineering programs across the country. The joint B.S. degree program curriculum is compatible with the ABET Criterion 5. We have also implemented a system for program outcomes assessment. The last requirement needed to be eligible for ABET accreditation, is the requested joint degree program and the addition of the engineering CIP code. This is a collaborative effort with the College of Engineering at NC State.

B. Indicate the names of all accrediting agencies normally concerned with programs similar to the one proposed. Describe plans to request professional accreditation.

We plan to seek accreditation by ABET, in coordination with the ABET re-accreditation of our Biomedical Engineering program at NC State in 2016 or shortly thereafter.

C. If the new degree program meets the SACS definition for a substantive change, what campus actions need to be completed by what date in order to ensure that the substantive change is reported to SACS on time?

- A joint degree is a substantive change that SACS would need to approve.
- Before submitting to SACS, UNC-GA approval must be received.
- SACS will require a full prospectus to be submitted six months in advance and approval is required before students can enroll in the degree program.

- If the program is being planned to start in fall 2015, the prospectus must be sent to SACS in January, 2015.
- The two institutions (UNC-CH and NC State) are responsible for filing their own requests for approval to SACS separately.

D. If recipients of the proposed degree will require licensure to practice, explain how program curricula and title are aligned with requirements to “sit” for the licensure exam.

Our alumni do not require licensure to hold jobs in biomedical engineering. However, if they do choose to pursue licensure in general engineering, accreditation by ABET will enable them to do so.

IX. Supporting Fields

Discuss the number and quality of lower-level and cognate programs for supporting the proposed degree program. Are other subject-matter fields at the proposing institution necessary or valuable in support of the proposed program? Is there needed improvement or expansion of these fields? To what extent will such improvement or expansion be necessary for the proposed program?

Since this proposed degree is essentially the renaming and conversion of an existing program into a Joint B.S. degree program, the infrastructure and support necessary for implementation and success are already present and in place.

X. Additional Information

Include any additional information deemed pertinent to the review of this new degree program proposal.

None.

XI. Budget

A. Complete and insert the Excel budget template provided showing incremental continuing and one-time costs required each year of the first four years of the program. Supplement the template with a budget narrative for each year.

No additional funds are being requested for this proposed degree.

B. Based on the campus’ estimate of available existing resources or expected non-state financial resources that will support the proposed program (e.g., federal support, private sources, tuition revenue, etc), will the campus:

- 1. Seek enrollment increase funds or other additional state appropriations (both one-time and recurring) to implement and sustain the proposed program? If so, please elaborate.**
- 2. Require differential tuition supplements or program-specific fees? If so, please elaborate.**
 - a. State the amount of tuition differential or program-specific fees that will be requested.**
 - b. Describe specifically how the campus will spend the revenues generated.**

c. Does the campus request the tuition differential or program-specific fees be approved by the Board of Governors prior to the next Tuition and Fee cycle?

No additional funds are being requested for this proposed degree.

C. If enrollment increase funding, differential tuition, or other state appropriations noted in the budget templates are not forthcoming, can the program still be implemented and sustained and, if so, how will that be accomplished? Please elaborate and provide documentation of campus commitments where appropriate.

No additional funds are being requested for this proposed degree.

XII. Evaluations Plans

All new degree program proposals must include an evaluation plan, which includes:

A. Criteria to be used to evaluate the quality and effectiveness of the program, including academic program student learning outcomes.

B. Measures (metrics) to be used to evaluate the program (include enrollments, number of graduates, and student success).

C. The plan and schedule to evaluate the proposed new degree program prior to the completion of its fourth year of operation.

For ABET accreditation, it is necessary that we extensively evaluate our program on an ongoing basis and meet all components of the following ABET criteria:⁸

- Criterion 1. Students
- Criterion 2. Program Educational Objectives
- Criterion 3. Student Outcomes
- Criterion 4. Continuous Improvement
- Criterion 5. Curriculum
- Criterion 6. Faculty
- Criterion 7. Facilities
- Criterion 8. Institutional Support

For Criterion 3, ABET requires all graduates to achieve the following student outcomes:

- (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

⁸ ABET Criteria For Accrediting Engineering Programs

[http://www.abet.org/uploadedFiles/Accreditation/Accreditation_Step_by_Step/Accreditation_Documents/Current/2014_-_2015/E001%2014-15%20EAC%20Criteria%203-13-14\(2\).pdf](http://www.abet.org/uploadedFiles/Accreditation/Accreditation_Step_by_Step/Accreditation_Documents/Current/2014_-_2015/E001%2014-15%20EAC%20Criteria%203-13-14(2).pdf)

- (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.

We have developed a plan to assess the achievement of these student outcomes by our graduates. We have mapped each of these outcomes to at least one required course in the curriculum to assess them directly. We will use student work and relevant rubrics to demonstrate whether the students have successfully achieved these outcomes.

Integral to the ABET process, we must constantly evaluate our program and make improvements as needed. This is accomplished through our reviews of our ongoing course assessment, as well as the feedback from students, faculty, alumni and the external advisory board for the undergraduate program. The BME curriculum committee meets monthly during the academic year, and will use this feedback to make improvements.

XIII. Reporting Requirements

Institutions will be expected to report on new program productivity as a part of the biennial low productivity program review process.

XIV. Attachments

Attach the final approved Appendix A as the first attachment following this document.

This proposal to establish a new degree program has been reviewed and approved by the appropriate campus committees and authorities.

UNC-CH Chancellor: _____ **Date:** _____

NC State Chancellor: _____ **Date:** _____