Biomedical Engineering at USF:
A Joint Program of the College of Engineering
and the Morsani College of Medicine

ROBERT BISHOP, PHD, DEAN
COLLEGE OF ENGINEERING

CHARLES J LOCKWOOD, MD, MHCM, SENIOR VICE
PRESIDENT, USF HEALTH & DEAN
MORSANI COLLEGE OF MEDICINE
# Table of Contents

Executive Summary ........................................................................................................ 3

1. Introduction .................................................................................................................. 6

2. Rationale and benefits of a new joint BME Department ........................................... 6

3. Vision of this Department ............................................................................................ 9

4. Organizational Structure & Consequences of Changes ............................................. 10
   a. Department Administrative Structure and Staffing ............................................... 10
   b. Departmental Resources & Budgetary Implications ................................................ 11
   c. Faculty Appointments and Recruitment ............................................................... 12
   d. Academic Degree Programs .................................................................................... 16
   e. Promotion and Tenure .............................................................................................. 16
   f. Collective Bargaining Considerations ..................................................................... 17
   g. Space and Facilities ................................................................................................ 18
   h. Revenue Sharing and Space Allocation .................................................................. 18
   i. Workload Assignment ............................................................................................ 19
   j. Future Growth, Directions, and Resources Anticipated ....................................... 20
   k. Implementation Timetable ....................................................................................... 22

Appendix A – Biomedical Engineering Initiative Task Force Members .................. 23
Appendix B – Colleges of Engineering with Medicine Collaborations ............... 24

Appendix C – ABET Accredited BME Programs ...................................................... 45

Appendix D – B.S. in Biomedical Engineering Degree Proposal .............................. 49

Appendix E – Policy and Procedures for Proposed Changes in Academic Units of the University of South Florida System (10-055) ........................................ 63

Financial Analysis .......................................................................................................... 66
Executive Summary

Dean Robert Bishop and Dean Charles Lockwood appointed a task force with a charge to undertake the creation of a joint USF Biomedical Engineering Department (joint BME department) bridging the Colleges of Engineering (COE) and Morsani College of Medicine (MCOM) in March 2015 with the vision that this joint effort between COE and MCOM can advance significantly the strategic planning, success, and goals of the University of South Florida. The Biomedical Engineering Task Force included representation from Medicine and Engineering faculty and administration. After a thorough examination of the noteworthy growth possibilities for research and student success embodied in the growing field of biomedical engineering (BME) and all potential factors, the Task Force recommends the creation of a Department of Biomedical Engineering jointly sponsored and governed by the Colleges of Engineering and Medicine.

Rational, background and some specific initiatives for strategically expanding our BME Faculty are presented in this proposal. An expansive vision is presented, as this is an opportune time to make it clear how the Colleges of Medicine and Engineering can partner to advance the strategic planning, success, and goals of the University of South Florida. Basically, taking advantage of the noteworthy growth possibilities for research and student success embodied in the growing field of biomedical engineering (BME), this proposal recommends the creation of a Department of Biomedical Engineering jointly sponsored and governed by the Colleges of Engineering (CCE) and Medicine (MCOM). The new Department will contribute to USF's key mission areas, promoting student success, clinical and basic research, entrepreneurship and economic development in the region, state, and nation, and will provide:

- A new multidisciplinary, state-of-the-art environment for training the next generation of scientists and engineers for employment in new and emerging fields of medicine and engineering
- New targeted interdisciplinary research programs
- Translational research leading to medical innovations and novel therapies
- Increased competitiveness for 'team science' programmatic funding, research center grants, licensing and royalties, and philanthropy
- Enhanced patient care & healthcare delivery: "better care at lower costs"

This proposal suggests the creation of a vibrant intercollegiate department in which, engineers, researchers, and clinicians collectively direct, sponsor, and administer the academic, scientific, and entrepreneurial missions of a world-class BME program. This jointly governed BME department will have an academic mission to produce a skilled labor force that can think critically and creatively, identify and solve problems quantitatively, and communicate effectively. This labor force will serve existing biomedical research laboratories and companies across Florida and the US, and provide engines for health care growth through the formation and relocation of new biomedical industries to the USF, Tampa Bay area.

To fulfill this academic medicine mission, this joint BME department will initially appoint an interim chair and initiate faculty transfers voluntarily from Engineering and Medicine. A national search to identify a permanent chair will be undertaken. Future faculty recruitments will occur through national searches. Early in the creation of the department, approval for a new undergraduate BME degree program will be undertaken and merged with the already successful graduate BME programs (MS and PhD) presently housed in the Department of Chemical & Biomedical Engineering (COE) and moved to the new Department. A tremendous demand is anticipated for a new BME BS degree program that provides the unique type of applied knowledge coming from instruction by engineers, scientists and physicians to reinforce theory. Non-tenured Instructors are to be employed to support the development of new undergraduate curricula, coordination of multi-instructor courses, and rapid growth of this novel academic program.

This jointly governed BME department will have a research mission to form multi-disciplinary research groups that are continuously funded as a result of their advancement of scientific understanding and their development of innovative solutions to health care problems. These research teams will form naturally via shared interests of COE and MCOM faculty in the academic and research missions of the joint department. To fulfill this research mission, all faculty in the joint BME department will be assigned and commit time and resources to the establishment and maintenance of strong graduate and postdoctoral programs through the operation of active vibrant
research laboratories, the pursuit of training grants, and the creation of adequate departmental resources from a successful Legislative Budget Request, and the development of a robust departmental research fund to accomplish this mission. This proposal considers matters of department administrative structure, governance and staffing, faculty appointments, promotion and tenure, space and facilities, departmental funding, revenue sharing and space allocation, research opportunities, education programs, future growth and resources anticipated, and a proposed business plan to fund this jointly sponsored department by the University of South Florida.
1. Introduction and Description of Changes

In March 2015, Dean Robert Bishop and Dean Charles Lockwood appointed a work group to consider the creation of a joint USF Biomedical Engineering Department (joint BME department) bridging the Colleges of Engineering and Medicine. The Biomedical Engineering Task Force included representation from Medicine and Engineering faculty and administration (Appendix A).

The work group recommends the creation of a Department of Biomedical Engineering jointly sponsored and governed by the Colleges of Engineering and Medicine. The new Department will contribute to USF’s key mission areas, namely promoting student success, clinical and basic research, entrepreneurship and economic development in the region, state, and nation, and thereby provide:

- A new multidisciplinary, state-of-the-art environment for training the next generation of scientists and engineers for employment in new and emerging fields of medicine and engineering
- New targeted interdisciplinary research programs
- Translational research leading to medical innovations and novel therapies
- Increased competitiveness for ‘team science’ programmatic funding, research center grants, licensing and royalties, and philanthropy
- Enhanced patient care & healthcare delivery: “better care at lower costs"

The Task Force considered matters of department administrative structure, governance and staffing; faculty appointments, promotion and tenure; space and facilities; departmental funding, revenue sharing and space allocation; research opportunities; education programs; future growth; and resources required.

2. Rationale and benefits of a new joint BME Department

A major benefit of a jointly sponsored BME Department is enhanced research with increased impact on education of the next generation of clinicians, scientists and engineers. The department will help develop new therapies and cures through innovation in health care delivery, personalized medicine and evidence-based medicine. Further, this jointly sponsored department will advance the creation of novel biomedical devices, treatment systems and technologies.
Considerable research collaborations are already in place between faculty in Engineering and Medicine (see Appendix B). A Department of Chemical & Biomedical Engineering already exists in the College of Engineering and has a successful master's program begun in 1998, and more recently a growing PhD program. Faculty from Engineering and Medicine, as well as Public Health, Behavioral & Community Sciences, Nursing, and Physical Therapy are currently engaged in BME research at USF, which will be significantly enhanced by the creation of a joint BME Department.

The proposed program aligns with the University’s mission and goals and the strategic priorities of the USF Board of Trustees, particularly developing nationally distinctive research and graduate programs and that advance collaborative learning, innovation and discovery to improve student success and the health of the community. With its strong science and technology components, the program has the potential also to contribute significantly to the STEM goals of the Board of Governors and USF. Although a growing number of BME accredited programs exist nationally (Appendix C), only a limited number of programs report a jointly sponsored BME department between Engineering and Medicine. When looking closely at these reported programs, most demonstrated collaboration across missions, but it appeared that separate governance structures were maintained under the deans in each of their colleges. The Task Force took inspiration from the program at the University of Alabama-Birmingham, which appeared truly to be a joint venture between the two schools and was in the early stage of implementation. It provided helpful information with the development of this document.

A jointly governed BME department sponsored by both Engineering and Medicine will break new ground at USF, and the Task Force concludes that the two Colleges are ideally suited jointly to administer this program. Cooperation of the two Deans, extensive collaborations among faculty in both Biomedical Engineering and Medicine, and numerous other resources all provide further impetus for this program. The Center for the Advancement of Medical Learning and Simulation (CAMLS), local/regional biotechnology companies, Tampa General Hospital, and other hospitals affiliates such as the Moffitt Cancer Center, the Shriners' Orthopedic Hospital for Children, and the James A. Haley VA Hospital, all located on, adjacent to, or near the USF Tampa
campus offer outstanding collaborative training and research environments for students seeking degrees in BME.

Research and instruction in this new Department will have a positive impact on economic development, especially along the I-4 Corridor area. The Tampa Bay Region has the second-highest concentration of biomedical-related industries in Florida and one of the highest concentrations nationally. As seen in other parts of the country, the presence of training programs in BME encourages the growth of related industries, benefiting not only from direct technology transfer but also the availability of highly trained graduates. The strong collaborations created by the jointly sponsored BME department will bring new opportunities for USF to compete for funding from numerous private foundations and companies supporting advancements in the intersection between medicine and engineering. This partnership will also facilitate USF competing for novel funding opportunities from numerous federal agencies such as DOD, DARPA and DTRA, NIH Center and Training Grants, NIH Biomedical Research Partnership (BRPs), NSF Science and Technology Centers, NSF Integrative Graduate Education and Research Traineeship (IGERTs), Engineering Research Centers and others.

Employment opportunities will also occur because of the creation of this Department. According to U.S. Bureau of Labor Statistics, rapid advances in technology will continue to change what biomedical engineers do and the type of work they create. Thus, the expanding range of activities of biomedical engineers should translate into very favorable job prospects. Employment of biomedical engineers is projected to grow by 27 percent through 2022, much faster than the average for all occupations, and more than other engineering specialties. The aging baby-boomer generation will increase demand for biomedical devices and procedures, such as hip and knee replacements, as this generation seeks to maintain its healthy and active lifestyle. Additionally, as the public becomes aware of medical advances, increasing numbers of people will seek help from their physicians capitalizing on innovations in personalized medicine. Biomedical engineers will likely experience more demand for their services because of the breadth of activities they engage in, made possible by the diverse nature of their training (Bureau of Labor Statistics, U.S. Department of Labor, *Occupational Outlook Handbook, 2014-15 Edition*, Biomedical Engineers, on the Internet at
3. Vision of this Department

The Task Force envisions a vibrant intercollegiate department in which engineers, researchers, and clinicians collectively direct, sponsor, and administer the academic, scientific, and entrepreneurial missions of a world-class BME program. The Task Force sees the joint BME department having an academic mission to produce a skilled labor force that can think critically and creatively, identify and solve problems quantitatively, and communicate effectively. This labor force will serve existing biomedical research laboratories and companies across Florida and provide engines for health care growth through the formation and relocation of new biomedical industries to the USF area.

To fulfill this academic mission, the work group sees the joint BME department developing a new undergraduate BME program and combining it with our successful graduate BME programs (MS and PhD) that are presently housed in the Department of Chemical & Biomedical Engineering. The expectation is that most, if not all, courses will be jointly taught by faculty in the Colleges of Engineering (COE) and Medicine (MCOM). COE faculty will be lead instructors for most core and some elective BME courses, with MCOM faculty giving guest lectures that relate class topics to modern health care applications, challenges, and translational technology transfer opportunities. For example, a junior-level core course in Biomedical Signals and Systems Analysis would have a lecture series on Fourier Transforms given by an engineer followed by a lecture given by a cardiologist illustrating the interpretation of heart rate variability through the use of Fourier analysis of actual ECG data. MCOM faculty will also be lead instructors for some core and elective BME courses, with COE faculty giving guest lectures that show how the biological process under study can be understood mathematically. For example, an upper-level undergraduate/first-year graduate Engineering Physiology course would offer a lecture series on the visual system given by a clinical scientist with a lecture on the design principles of retinal prosthetics and their current limitations given by an engineer. A tremendous demand is anticipated for a new BME Bachelor of Science degree program that provides this unique type of applied knowledge to reinforce theory. The work group proposes that non-tenured Instructors be employed to
support the development of new undergraduate curricula, coordination of multi-
instructor courses, and rapid growth of the academic programs.

The Task Force sees the joint BME department having a research mission to form multi-disciplinary research groups that are continuously funded as a result of their advancement of scientific understanding and their development of innovative solutions to health care problems. The belief is that these research teams will form naturally via shared interests of COE and MCOM faculty in the academic and research missions of the department. For example, interactions between the engineer and cardiologist in the administration of a Biomedical Signals and Systems Analysis course would lead to research discussions from which new collaborative projects would spring. To fulfill this research mission, the Task Force recommends that USF and all faculty in the joint BME department commit time and resources to the establishment and maintenance of strong graduate and postdoctoral programs through the operation of active vibrant research laboratories, the pursuit of training grants, and the creation of adequate departmental resources such as a research fund to accomplish this mission.

4. Organizational Structure & Consequences of Change

   a. Department administrative structure and staffing

   The Deans may appoint an interim Chair until a permanent chair is selected through a national recruitment process. Recruitment and selection of a multidisciplinary chair, with appreciation of the academic, research and clinical missions of the new Department is critical to the future success of this jointly governed BME Department. The Task Force recommends that the Deans of each College appoint individuals to a search committee that will recruit and recommend to the Deans a nationally/internationally recognized individual with a proven and successful track record in biomedical engineering leadership. Each Dean will select an equal number of individuals to the committee (total numbers to be determined by the Deans) with one individual appointed as committee chair. The chair of the committee will be jointly selected by the two deans. The committee will produce advertisements, seek applications, review applicant credentials, conduct interviews, and make recommendations for the selection of the chair to the two deans. Responsibilities of the Department Chair will be outlined by the two deans or their representatives. The Department Chair will have an appointment with tenure in
both Colleges and report to both Deans. Faculty and staff will be hired according to typical rules and regulations of the University. Staff will need to have expertise to help manage a complex department with a mission including student success, research and clinical excellence, and service. The staff should be highly familiar with operations of the university that includes management operations on both sides of campus. They should also have or be able to acquire the skills necessary to create a department clinical practice operation. Operating guidelines and governance principles for the department will be created by faculty once they are appointed.

b. Departmental Resources and Budgetary Implications

The University (Provost, Senior Vice President, USF Health/MCOM Dean, and COE Dean) will seek a Legislative Budget Request (LBR) from the Florida Legislature to provide sufficient resources for this Department to hire faculty and staff, provide instructional resources and fund a robust research environment for faculty to succeed in developing a world-class, jointly governed unit at USF. Until support from a LBR is provided by the Legislature, each College will be expected to contribute equally to a budget that will be sufficient for initial Departmental operations. Allocation of an operating budget should include Education and General funds for faculty salary, tuition revenue generated by the BME program, rebate allocation from research grants and contracts and IP revenue (if any) generated by faculty transferred into the department, clinical revenue from physicians in the department with patient and clinical responsibilities (a clinical operation will need to be created) and an expense budget commensurate for the size of the department.

A research fund to support the department missions is also recommended. This fund will provide a distinctive resource for a joint BME Department at USF. The rational for this fund includes the following.

1) The departmental research fund is vital for uninterrupted support for productive graduate and postdoctoral students in the current funding climate and for getting new research projects off the ground so that they can compete for federal awards with necessary novel pilot data. The research account is also vital for attracting internal and external faculty to join the joint BME department. The Task Force expects USF partially to fund the account through the return of indirect costs on
grants awarded to the department. The Task Force also proposes all COE and MCOM faculty appointed in the department contribute to the account through the buyout of academic year salary on NIH grants (in exchange for reduced teaching load to support research effort) and fixed-percentage return of clinical patient dollars. Contributing faculty will be able to recoup 50% of their buyout dollars to support their graduate students in times of need. The other 50% of their buyout dollars will be provided to the departmental fund. This money, plus the USF indirect cost return and clinical revenue dollars, will be used by the department to fund internal one-year "pilot project" awards which encourage collaborations between research and clinical BME faculty, and to support meritorious incoming graduate students and postdoctoral students for one year. Dispersal of account funds will be overseen by an executive committee composed of the chair, 2 COE faculty, and 2 MCOM faculty appointed in the joint BME department.

2) The Task Force sees the joint BME department having a unique entrepreneurial mission to translate biomedical research into patented therapies for patients in our healthcare system. To fulfill this entrepreneurial mission, the departmental fund will also be used to support internal one-year "startup" awards to develop meritorious technologies to help bridge the funding gap. Budgetary support under this mechanism will require collaboration between a BME department engineer and clinical faculty member (MD, RN, Pharmacy, etc.).

3) The Task Force foresees singular training programs that involve true cross-fertilization between engineering and clinical experiences. For example, further development of a pilot BME Master's program (initiated with MCOM's Vascular Surgery Division) with medical resident training options is recommended.

Ultimately, the budget for this Department will be negotiated by the Provost and Senior Vice President of USF Health and the Deans of each College. A business plan is provided with this report to project the cost of the operation of the BME Department in Appendix E.

c. Faculty Appointments and Recruitment

To initiate this Department, it is recommended that each Dean seek faculty interest within their own units to make application for transfer into this unit. Applications from
both PhD and MD faculty with theoretical or practical expertise in biomedical engineering projects or programs will be considered. A combination of both academic and clinical faculty with primary BME appointments is encouraged and will make this department highly unique. With clinical faculty, a departmental practice plan component is suggested. University physicians generally have primary appointments in the Morsani College of Medicine (MCOM). MCOM physician faculty provide care for patients as part of the USF physicians group (USFPG). Revenue from patient care provided by these physicians' activities come into the USFPG, and become part of the revenue for the clinical department to which that physician belongs. Depending on their assignments, physicians are expected to commit a set number of days to the practice of clinical medicine, with other assigned duties such as administrative, research, and academic responsibilities taking up the remainder of their USF commitment. Physicians in the USFPG receive a salary which may also include stipends and bonuses, and a portion of this comes from the revenue generated from clinical activity. Clinical revenue is applied to cover expenses, department and USFPG overhead, as well as contributions to the MCOM and USF, in addition to covering some or all of the faculty salary. The clinical departments are chaired by physicians who have similar credentials to those of the faculty in the department to which they belong. Matters related to clinical credentialing, peer review, and professional development are managed via the clinical departmental organizational and operating structure.

Currently, physicians in the clinical departments of the MCOM are free to interact and collaborate with faculty in the other colleges at USF, and indeed, some MCOM physicians have done so. Some MCOM physicians have served on Ph.D. dissertation committees for candidates in the College of Engineering and other units of the University. To date, USFPG physicians have not been discouraged from collaborating with faculty in other colleges, provided that such collaboration does not interfere with their clinical, academic, and other assigned responsibilities.

In order for the proposed jointly governed BME department to flourish, a heightened, systematic collaboration between physician and engineering faculty needs to develop. The major way to truly accomplish this ongoing collaboration is for physician and engineering faculty, students, and trainees to be geographically collocated, allowing for
ongoing, daily, or regular, seamless interactions. This requires that physicians be part of the proposed joint BME department. Benefits to physician membership in the joint BME department include:

- providing visibility into the day-to-day problems faced by physicians in the conduct of their clinical activities; many of which may be amenable to technology based solutions: and

- creating sounding boards for the engineering faculty to discuss and refine new and existing inventions and technologies to help improve patient care outcomes and solve clinical problems. Data suggest that such collaborations can yield important intellectual property which can benefit USF intellectually and financially.

Currently, physicians who collaborate with College of Engineering faculty do so because they are passionate about developing the nexus between Engineering and Clinical Practice primarily to help improve the care outcomes for their patients. These are the types of physicians that need to be brought into the proposed joint BME department.

To accomplish this goal, membership in the joint BME department needs to be attractive to physician faculty who are current members of the MCOM departments. However, the joint BME department membership should not pose added financial or other burdens to the physician. Furthermore, because these physicians may be from different specialties, such as cardiology, urology, gynecology, surgery, Maternal-Fetal Medicine, credentialing matters related to each clinical specialty in the joint BME department will need to be addressed. Physician department members should have access to opportunities for promotion through the faculty ranks, up to and including the most senior positions in the department.

Physicians in the joint BME department should have an allotment of clinical activity in their specialty (60-80 % FTE). At least 20% of their effort should be applied to activities related to the joint BME department to include teaching, research, project/idea development, thesis/dissertation supervision, grant applications, and entrepreneurial and IP development activities. Over time, income from entrepreneurial and intellectual property development should be apportioned preferentially to the joint BME department.
and to the involved physician and engineering faculty in order to make joint BME
department membership more attractive than just remaining in the department from
which they came. One way to accomplish this goal is to provide the most attractive
allocation of revenue back to the inventor(s) and the department where the IP was
developed. At the inception of this department, it is recommended all IP revenue be
returned to the department with at least 50% returned to the inventor(s). A portion of
the funds along with overhead from research grants should also be allocated to the
research fund mentioned elsewhere in this document. Early in its development, a joint
BME departmental identity will be critical to create so that the power of “belonging” to
something highly unique and special becomes part of each faculty member’s psyche.
Setting a vision of establishing a world-class department of excellence in teaching,
research, and clinical/professional service will be essential to set the stage for
accomplishing this goal.

The maintenance of secondary appointments in other closely aligned departments of
the University will be encouraged. A selection committee, appointed by the Deans, will
review and make recommendations to the interim or new chair among those applicants
for potential transfer into BME. It is expected the faculty transfers will be small in
number from the two Colleges (or even other units on campus with approval from their
Deans) and will have productive teaching and research programs. It is expected that
these faculty will have research funding or have very high potential for funding. An
interim chair, four engineering faculty and four medicine faculty will comprise the initial
members of this department. To cover teaching needs, two teaching faculty (instructors)
should be recruited. Adjunct faculty may also be necessary. These faculty will provide
the initial nucleus of the BME Department and serve as core faculty. Initially, the core
faculty may have either 9 or 12-month appointments. After an initial three year period,
core faculty members with a 12-month appointment will be expected to raise at least
30% of their salary from research grants or contracts. Nine-month faculty will be
required to bring in their summer salary from grants and contracts. Both categories of
faculty will be eligible for incentive payments based on predetermined performance
metrics. Core faculty will be tenured (or on tenure track status) through the Department
of Biomedical Engineering and will have a primary appointment in one of the Colleges
depending on area of discipline and faculty appointment at time of employment.
Secondary and joint appointments from faculty in other departments/colleges will be
available. At least two Instructors (non-tenure track faculty) will be needed to teach
undergraduate BME core courses and run the new BME undergraduate major, including
seeking and maintaining ABET accreditation. A Laboratory technician to assist with
research operations is also recommended. Support for graduate students will also be
necessary. As resources become available, additional faculty will be recruited based on
BME strategic needs. National searches will be conducted. Over a five year period, at
least seven additional faculty will be needed. It is expected all will be employed on a
12-month contract. These faculty will be employed as out-of-unit faculty for purposes of
the Collective Bargaining Agreement (CBA) to be discussed later. The Department may
also have adjunct, affiliate and volunteer faculty to meet specific needs and will be
approved for membership in the Department by the Chair in consultation with the
Departmental APT committee.

d. Academic Degree Programs

The new Department will take over responsibility and administration of the current
BME Masters and PhD programs, which currently have about 60 students enrolled
(50% increase in enrollment over past 4 years). The current academic programs
include novel joint BME Masters programs with Vascular Surgery and the USF College
of Pharmacy. Tuition revenue from these programs will need to accrue to this new
department. In addition, a full application has been prepared for submission to the FL
BOG for a new undergraduate BME Major to be administered by this new Department
(Appendix D).

BME Department faculty will also participate meaningfully in mentoring medical
students and USF Health residents/fellows in cutting edge research projects, including
generation of new NIH training grants and programs currently being devised to increase
BME activities at the USF Center for Advanced Medical Learning and Simulation
(CAMLS).

e. Promotion and Tenure

Nominations for promotion and/or tenure shall be made by the Chair of the jointly
sponsored Department of Biomedical Engineering in accordance with customary
University policy. A joint Appointment, Promotion and Tenure (APT) Committee (Conjoint Committee) for Biomedical Engineering will be appointed with equal membership from the College of Medicine APT Committee and the College of Engineering Governance Committee during the period of departmental development and achievement of tenure by initial appointees. Two members will be appointed from the respective collegiate APT committees or equivalent upon recommendation by the Chairs of the respective committees. The chair shall be appointed by mutual agreement of the respective Deans each year when convened. The conjoint APT Committee shall make recommendations to the Provost and Senior Vice President for USF Health relative to Promotion and Tenure. Concurrence must be achieved for recommendation to the President for transmission, as appropriate, to the Board of Trustees for action. Tenure and promotion will be conferred to the applicant by each College.

f. Collective Bargaining Considerations

With the exception of the Morsani College of Medicine and the College of Pharmacy, all other Colleges on the USF campus function under a collective bargaining agreement with the United Faculty of Florida and the University. Those Colleges (including Engineering) are considered "in-unit" while the Morsani College of Medicine is considered "out-of-unit." Rules and regulations that dictate the relationship between 'in-unit' employees and University administration (Provost and his Office) differ in some significant ways from "out-of-unit" faculty and their USF Health administration. Guidance was sought from the Provost's office and general counsel on the employment and collective bargaining issues that might be associated with forming a Joint Department of Biomedical Engineering. The proposed department would be equally affiliated with the USF Colleges of Engineering and Medicine, and initially will be composed of faculty from both Colleges. This would be the first department at USF with joint administrative affiliation between two colleges. The issue of how to handle a new entity comprised of in-unit (COE) and out-of-unit (MCOM) faculty was addressed and the recommendation was made by both Provost's Office and General Counsel that a joint department could be started as a "mixed" department (i.e. one with both in- and out-of-unit faculty). The USF negotiated Collective Bargaining Agreement (CBA) would
be observed for all in-unit faculty. Out-of-unit faculty would be treated equitably and according to University administrative rules.

g. Space and Facilities

Space is currently assigned to faculty both in the College of Engineering BME program and the Morsani College of Medicine. It is recommended that space will continue to be provided until new or alternative facilities are made available by USF. Also, research and instructional space may be found at adjacent on- or off-campus locations such as the top floor of the Interdisciplinary Sciences Building (ISA), Business Park Building (BPB, former Draper Lab Space) or Genzyme laboratory facilities to co-locate all faculty under one structure. Eventually, space and facilities will become available either through vacating of space by faculty in current medical school facilities upon construction and opening of the USF Health Heart Institute or by moving BME researchers with cardiovascular research to the Heart Institute. Recently, Draper Labs, a non-profit research institute collaborating with USF and located in the USF Research Park, vacated approximately 23,000 sq ft of administrative offices and research laboratory space. This space could easily house the new BME department with sufficient space remaining for future growth. CAMLS, located in downtown Tampa near the new Morsani College of Medicine and Heart Institute Tower, also has the potential to locate some of the BME research faculty who are involved in medical device development. The CAMLS Innovation Center’s 4,200 square-foot, state-of-the-art facility provides the ideal environment for research teams to work on complex medical innovations. From on-site engineering and 3D modeling services to rigorous clinical testing and investigations, the Innovation Center offers the perfect environment and infrastructure to tackle the most challenging and complex stages of device development, simulation testing, and deployment. Potentially other space on campus may eventually also house part of a growing BME Department either through new construction or build-out of space as current facilities are repurposed.

h. Revenue Sharing and Space Allocation

As Resource Centered Management (RCM) is implemented at USF, it will be important that the new BME department have revenues that it generates returned to the department for base support, funds for special initiatives, and revenue for continued
growth of strategic departmental initiatives. All student FTE (and any corresponding distribution of tuition revenue) generated by Departmental faculty through teaching activity will be credited and allocated to the jointly sponsored Department of Biomedical Engineering. Overhead revenue from grants and contracts will be distributed based on the recommendations of the University Research Advisory Committee and approved by USF Leadership (see recommendations under department resources above). Full overhead return on all grants and contracts is recommended to be returned for the first five years to support departmental start-up. After this initial period, the two Deans jointly will determine return of overheads to the BME Department according to University and RCM guidelines. The task force recommends that the BME Department be held harmless for a period of five years before any assessments directed by the RCM model are made for University services.

Space allocation will be considered based on current space allocation models in both Engineering and Medicine. A BME faculty space committee, which will consider research funding, will recommend the appropriate space allocation model to the Chair of the Department with concurrence of the Deans.

1. Workload Assignment

Significant differences currently exist in faculty appointments and responsibilities of the Colleges of Engineering and Medicine. Engineering faculty have nine-month academic year contracts with the possibility of three summer months supported by research or other activities approved by the Department Chair. The standard workload provided by the Provost’s Office is four courses per year. The Engineering workload model allows faculty to reduce teaching in exchange for research activities, academic year salary offset from research grants and contracts, mentoring students, and significant service in consultation with the Chair. In Medicine, faculty are appointed on a 12-month basis, but clinician scientists and basic scientists are expected to support at least 30% of their annual salary from extramural grants and contracts or from significant teaching responsibilities. Medicine faculty typically may serve as course directors, teach courses, provide course lectures, and serve as facilitators for group learning activities where education value units (EVU) are provided based on amount of class time exposure and teaching responsibilities. Clinical faculty also have patient care
responsibilities which support variable but significant portions of their salary. Workload assignments for Medicine faculty, although arranged somewhat differently, are consistent with workloads of faculty in Engineering. The Task Force recommends that all new faculty be appointed to 12-month contracts and that a standard workload model consistent with College of Engineering and Morsani College of Medicine policies and practices be implemented in the joint BME department. The workload model should include credit for research, scholarship and entrepreneurship; teaching and teaching innovation; student training and mentorship (students, post-docs, fellows, etc.); patient care and education; service to USF and the community; and professional service and outreach. Criteria for workload as well as expectations should be developed by a BME faculty workload committee and recommended to the BME Chair with approval by the Deans in Engineering and Medicine.

J. Future Growth, Directions, and Resources Anticipated

The Department of Biomedical Engineering is to be an intercollege, interdisciplinary department jointly administered by the Deans of the College of Engineering and the Morsani College of Medicine. The Department will need to be supported by current and new funding proposed in a jointly supported University Legislative Budget Request for 2016/17. With the addition of clinical faculty appointed to the department, practice plan revenue will be available which makes this department highly unique among other BME programs around the country that purport to be jointly governed. The BME Chair will be responsible to both College Deans who will meet not less than quarterly to review progress with the Department Chair and to consider funding allocations and supplementation of resources. Growth areas that should be considered for resource support come from the asset map included with this proposal. The following areas were identified as current and potential areas of research and instructional strength of this joint BME department. They include:

- Nanomedicine and Drug Delivery
- BioMEMs and Biosensing
- Biomedical Devices
- Prosthetics and Robotics
- Computer science and engineering
Ultimately, the Department will be accountable through its Deans to both the Provost/Senior Executive Vice President for Academic Affairs and the Senior Vice President, USF Health. With guidance from the BME strategic plan (to be developed by the Department), growth of student enrollment and increases in external funding, additional resources may be allocated internally from tuition and grant overhead revenue and reallocation of University Education and General Budget. Special requests for additional state allocations through future Legislative Budget Requests may also be made.

By formally bridging the Colleges of Engineering and Medicine in novel ways, a joint Biomedical Engineering Department will enhance student success in engineering and medicine, research collaborations among faculty in the two schools, lead to new innovative research initiatives and enhanced translational research with direct impact on patient care. New comprehensive training and degree programs, such as a new undergraduate BME major that is critically needed in Florida, will prepare highly skilled trainees to succeed in graduate school, medical and other professional schools or industry. BME graduates will be leaders and innovators in the rapidly changing healthcare marketplace. Similarly, clinical trainees will acquire a more informed perspective on the potential innovations in biomedical engineering and their applications to clinical practice. Realizing these goals, the USF joint BME department will evolve into a world-class research and instructional unit and be recognized as a leader and innovator among BME Departments in the State of Florida and the nation. (In part, inspired by: Alexander, JI and Vickers, SM. Implementation of a Joint Biomedical Engineering Department in the School of Engineering and the School of Medicine at the University of Alabama at Birmingham, November 14, 2013).
DRAFT: May be modified based on scheduling of some of the following:

Timetable 2016 (for discussion, see Appendix E)

January 31 -- List BS BME degree program on new program pre-proposal work plans
August 30 -- Secure college (both MCOM & COE) approvals for new department
October 1 -- Secure Faculty Senate approval
October 15 -- Secure approvals from Senior Leadership with financial commitments
October 30 -- Initiate departmental structure
November 1 -- Conduct internal search for Interim Chair
November 1 – December 30 -- Seek faculty transfers from each college and reassign

Timeline 2017

January 9 – May 12 -- Appoint interim chair, transfer faculty, set up degree programs, provide faculty assignments, plan teaching schedules, assign department space and address other administrative responsibilities.

June 1 -- Approval of the BS degree in Biomedical Engineering
July 1 -- Accounts Open and Operational
August 1 -- Functional department is up and running!
October 1 -- Begin search for permanent Chair

Timeline 2018-19

January 8 – BME Department is operational: Department consists of a chair, 8 faculty and two instructors; 25,000 sq. ft. of space is assigned for instructional and research missions.
Appendix A

Biomedical Engineering Initiative Task Force Members

College of Engineering

José Zayas-Castro, PhD, Co-Chair
Professor and Associate Dean for Research
Department of Industrial & Management Systems Engineering
josezaya@usf.edu
813-874-5589

Robert Frisina, PhD
Professor, Department of Chemical and Biomedical Engineering
rfrisina@usf.edu
813-974-4394

Nathan Gallant, PhD
Interdisciplinary Professor, Department of Chemical and Biomedical Engineering
ngallant@usf.edu
813-974-5840

Christopher Passaglia, PhD
Associate Professor, Department of Chemical and Biomedical Engineering
passaglia@usf.edu
813-974-7140

Morsani College of Medicine

Phil Marty, PhD, Co-Chair
Associate Vice President, USF Health Office of Research
Professor, Public Health and Medicine
pmarty@health.usf.edu
813-974-5200

Lennox Hoyte, MD, MS
Professor, Department of Obstetrics & Gynecology
lhoyte@health.usf.edu
813-259-8671

Bruce Lindsey, PhD
Distinguished USF Health Professor, Department of Pharmacology and Physiology
blindsey@health.usf.edu
813-974-2590

Shyam Mohapatra, PhD, MBA
Distinguished USF Health Professor, Department of Internal Medicine
Associate Dean for Graduate Programs, College of Pharmacy
smohapat@health.usf.edu
813-974-856
Appendix B

Examples of COE/USF Health Collaborations involved in BME

I. Redwan Alqasemi, PhD, Department of Mechanical Engineering

First Study
- What is a Brief title/description of the collaboration?
  MRI: Acquisition of a CAREN Virtual Reality System for Collaborative Research in Assistive and Rehabilitation Technologies
- Which USF Health Faculty/Group are you collaborating with?
  Sandy Quillen, School of Physical Therapy
- Are there any publications from the collaborations?
  No
- Are you Funded or not?
  National Science Foundation, $450,000
  Applied for - 09/01/2012 - 08/31/2015
- Do you have any special equipment or other resources used in this collaborative study?
  Computer Assisted Rehabilitation Environment (CAREN) system

Second Study
- What is a Brief title/description of the collaboration?
  Development of Simulation Tool for Upper Extremity Prostheses
- Which USF Health Faculty/Group are you collaborating with?
  Sandy Quillen, School of Physical Therapy
- Are there any publications from the collaborations?
  No
- Are you funded or have you applied?
  Department of Defense, TATRC, $700,000,
  Applied for - 09/30/2014
- Do you have any special equipment or other resources used in this collaborative study?
  Vicon Motion Analysis System

Third Study
- What is a Brief title/description of the collaboration?
  Drug Delivery to Cancer patients Using Robotics Technologies
- Which USF Health faculty/Group are you collaborating with?
  Shyam Mohapatra, USF Health
- Are there any publications from the collaborations?
  No
- Are you funded or have you applied?
  No, but applied for
- Do you have any special equipment or other resources used in this collaborative study?
  Customized robotic system

Fourth Study
• What is a Brief title/description of the collaboration?
  International Collaboration in Rehabilitation Robotics at King Abdulaziz University
• Which USF Health Faculty/Group are you collaborating with?
  Sandy Quillen and Jason Highsmith, School of Physical Therapy

Are there any publications from the collaborations?
No

• Are you Funded?
  King Abdulaziz University, $315,454, 01/01/2009 06/30/2011
• Do you have any special equipment or other resources used in this collaborative study?
  None

II. Stephanie Carey, PhD, Asst. Professor of Mechanical Engineering

First Study
• What is a Brief title/description of the collaboration?
  MRI: Acquisition of a CAREN Virtual Reality System for Collaborative Research in Assistive and Rehabilitation Technologies
• Which USF Health Faculty/Group are you collaborating with?
  Sandy Quillen, School of Physical Therapy
• Are there any publications from the collaborations?
  Sarah Tudor, Mechanical Engineering Master's Thesis; IMECE, BMES conference papers
• Are you Funded?
  National Science Foundation, $450,000, 09/01/2012 – 08/31/2015
• Do you have any special equipment or other resources used in this collaborative study?
  Computer Assisted Rehabilitation Environment (CAREN) system

Second Study
• What is a Brief title/description of the collaboration?
  Movement Science III class project – DPT students come to Engineering motion analysis lab collect data, Engineering students analyze data
• Which USF Health Faculty/Group are you collaborating with?
  Sandy Quillen, Jason Highsmith, School of Physical Therapy
• Are there any publications from the collaborations?
  No
• Are you Funded?
  No
• Do you have any special equipment or other resources used in this collaborative study?
  Vicon Motion Analysis system

Second Study
• What is a Brief title/description of the collaboration?
  Multi-modal Assessment Tool for Lower Limb Prostheses Users
• Which USF Health Faculty/Group are you collaborating with?
  **Sandy Quillen, Jason Highsmith, School of Physical Therapy**
• Are there any publications from the collaborations?
  No
• Are you Funded?
  Applied for funding, under review: Department of Defense, Clinical and Rehabilitative Medicine Research Program, Orthotics and Prosthetics Outcomes Research Program, W81XWH-14-OPORP-OPORA, $725,000
  Department of Defense, Congressionally Directed Medical Research Programs, Peer Reviewed Orthopaedic Outcomes Research Award, W81XWH-14-PRORP-ORA, $2,181,497
• Do you have any special equipment or other resources used in this collaborative study?
  Computer Assisted Rehabilitation Environment (CAREN) system

Third Study
• What is a Brief title/description of the collaboration?
  Development of Simulation Tool for Upper Extremity Prostheses
• Which USF Health Faculty/Group are you collaborating with?
  **Sandy Quillen, School of Physical Therapy**
• Are there any publications from the collaborations?
  Several publications
• Are you Funded?
  Department of Defense, TATRC, $700,000, 09/30/2014
• Do you have any special equipment or other resources used in this collaborative study?
  Vicon Motion Analysis System
• Which USF Health Faculty/Group are you collaborating with?
  **Sandy Quillen, Jason Highsmith, School of Physical Therapy**
• What is a Brief title/description of the collaboration?
  Myoelectric versus Body-Powered Upper Limb Prostheses Evidence Report
• Are there any publications from the collaborations?
• Are you Funded?
  Academy of Orthotists and Prosthetists, $9500, 05/01/2013-05/01/2014
• Do you have any special equipment or other resources used in this collaborative study?
  USF Online Library

Fourth Study
• What is a Brief title/description of the collaboration?
  USF-PAMA Caring for Artists and Arts that Heal Conference Grant
• Which USF Health Faculty/Group are you collaborating with?
  Heather Hartsell, Matthew Lazinski, School of Physical Therapy

• Are there any publications from the collaborations?
  Fit to Play: Mind-Body Integration Program for Collegiate Musicians

• Are you Funded?
  USF Conference Support Grant, $4,200, 02/27/15

• Which USF Health Faculty/Group are you collaborating with?
  Heather Hartsell, Matthew Lazinski, School of Physical Therapy

• Do you have any special equipment or other resources used in this collaborative study?
  Vicon Motion Analysis System

III. Robert Frisina, PhD, Professor of Chemical & Biomedical Engineering; Director of Biomedical Engineering; Director – Global Center for Hearing & Speech Research

First Study
• What is a Brief title/description of the collaboration?
  Investigation of molecular mechanisms for drug treatments of age-related hearing loss in the cochlea of the inner ear.

• Which USF Health Faculty/Group are you collaborating with?
  Bernd Sokolowski, Dept. of Otolaryngology

• Are there any publications from the collaborations?

• Are you Funded?
  Granting Agency: NIH-National Institute on Aging (NIA); Project Title: "Aging Auditory System: Presbycusis & its Neural Bases" Priority Score=22, Percentile=9%; Grant #: P01 AG009524-20 Includes two NIH Diversity Supplements, BME PhD Students P.I. and Core Director (C.D.): Robert Frisina, Ph.D. Total USF Costs for Years 16-20: $4,300,000. Start Date: 9-15-10; Duration: 5 years.

• Do you have any special equipment or other resources used in this collaborative study?
  Vivarium

Second Study
• What is a Brief title/description of the collaboration?
  First FDA Clinical Trial for a New Drug to Treat Age-Related Hearing Loss

• Which USF Faculty/Group are you collaborating with?
  Paul Boyev, Dept. of Otolaryngology

• Are there any publications from the collaborations?
  Not Yet
• Are you Funded?
  Autoifony Therapeutics
  Project Title: "A Balanced, Randomized, Placebo-Controlled, Double-Blind Study of the Efficacy and Safety of AUT00063 Versus Placebo in Age-Related Hearing Loss [CLARITY-1 Study]" PI: Robert Frisina, Ph.D., Co-Investigator, Paul Boyev, M.D. USF Total Costs: $400,000. Start Date: December 2014; Duration: 1 year.

• Do you have any special equipment or other resources used in this collaborative study?
  USF Office of Clinical Research's Clinical Services

Third Study
• What is a Brief title/description of the collaboration?
  New BME Masters option with Vascular Surgery, where engineers spend 2 months at Tampa General, including OR time. In 4 semesters, requirements are to complete a BME Master's Thesis, and submit a patent and publication on a new vascular surgery device.

• Which USF Health Faculty/Group are you collaborating with?
  Karl Illig, Div. of Vascular Surgery

• Are there any publications from the collaborations?
  1st student just finished, working on her publication

• Are you Funded?
  No external funding

• Do you have any special equipment or other resources used in this collaborative study?
  Tampa General. Potential for CAMLS to become involved.

Fourth Study
• Which USF Health Faculty/Group are you collaborating with?
  Gary Martinez, Moffitt Cancer Center

• What is a Brief title/description of the collaboration?
  One of 2 teams in the world developing micropumps for inner ear drug delivery biotherapeutics (auditory & vestibular applications)

• Are there any publications from the collaborations?
  6 Peer-reviewed articles and a number of abstracts published to date. None yet with our new Moffitt imaging collaboration.

• Are you Funded?
  NIH-Nat. Inst. on Deafness & Communication Disorders (NIDCD)Project Title: "Enabling Microsystem Technologies for Advanced Drug Delivery" Priority Score=14, Percentile=1%; Grant #: R01 DC014566-01 MPI: Robert Frisina, Ph.D. MPI: David Borkholder, Ph.D. Total Costs: $3,100,000. Start and End Dates: 4/01/15 – 3/31/20

• Do you have any special equipment or other resources used in this collaborative study?
  Moffitt Animal Imaging Ctr. (rodent CT and MRI scanners)

• Do you have any special equipment or other resources used in this collaborative study?
IV. Richard D. Gitlin, PhD, Professor of Electrical Engineering--Two major collaborations: MARVEL and Vectorcardiogram [see below]:

First Study
- What is a Brief title/description of the collaboration?
  MARVEL is an in vivo Camera Module (CM) that is anchored to the abdominal wall and actuated by tiny motors, giving surgeons a full hemisphere range of view with wireless communications and control.
- Which USF Health Faculty/Group are you collaborating with?
  Dr's. Alex Rosemurgy and Sharona Ross [no longer at USF-COM].
- Are there any publications from the collaborations?
  Publications from the collaborations [papers below, 4 patents filed]:
- Are you Funded?
  Yes - NSF: Improving the Communications Performance and Reliability of In Vivo Wireless Medical Devices [Richard Gitlin].
  NSF: Virtually Transparent Epidermal Imagery [Yu Sun, Adam Anderson, Richard Gitlin]
- Do you have any special equipment or other resources used in this collaborative study?
  Vivarium experiments.

Second Study
- What is a Brief title/description of the collaboration?
  Integrated Vectorcardiogram [IVCG] is a compact "band aid" size device with wireless and machine learning features that will enable 24x7 diagnostic-quality long term cardiac rhythm data collection ["BIG
DATA"] to be continuously wirelessly received and processed. This capability has never been available before.

- Which USF Health Faculty/Group are you collaborating with?
  Dr. Peter Fabri [recently retired USF]

- Are there any publications from the collaborations?

- Are there any publications from the collaborations?
  No publications

- Are you Funded?
  No, start-up

- Do you have any special equipment or other resources used in this collaborative study?
  No

V. Larry Hall, PhD, Chair & Professor of Computer Science & Engineering
- What is a Brief title/description of the collaboration?
  Text mining issues for looking at all studies on a subject (meta study).
  No pubs, no funding, just starting.

- Which USF Health Faculty/Group are you collaborating with?
  Sudeep Sarkar COE and Ben Djuibegovic COM

- Are you Funded?
  No, Yes

- Do you have any special equipment or other resources used in this collaborative study?

VI. Christopher Passaglia, PhD, Assoc. Professor of Chemical & Biomedical Engineering
- What is a Brief title/description of the collaboration?
  Project 1: Richards, Maddow, and I are working on an image processing algorithm for quantifying the blurriness of ocular fundus images for diagnostic purposes
  Project 2: Tzekov and I are studying electroretinogram responses in rats, humans, and other animals

- Which USF Health Faculty/Group are you collaborating with?
David Richards, Brian Maddow, and Radouil Tzekov

- Are there any publications from the collaborations?
  Project 1: one patent pending and one manuscript being prepared for submission
  Project 2: two manuscripts being prepared for submission

- Are you Funded?
  Project 1: not funded, no applications; Project 2: two grant proposals submitted and not funded, one grant proposal pending

- Do you have any special equipment or other resources used in this collaborative study?
  Project 1: none; Project 2: OCT imaging system, confocal microscope

VII. Anna Pyayt, PhD, Asst. Professor of Chemical & Biomedical Engineering

- What is a Brief title/description of the collaboration?
  Development of new technologies for early detection of pregnancy complications

- Which USF Health Faculty/Group are you collaborating with?
  Valerie Whiteman and Lennox Hoyte

- Are there any publications from the collaborations?
  Publications are in process

- Are you funded?
  The project was in the final of the Nokia Sensing Challenge. One NIH R21 is submitted, Bill & Melinda Gates- “Saving lives at birth” will be submitted by 3/27/15

- Do you have any special equipment or other resources used in this collaborative study?
  We have a new IRB under review. It will allow evaluating the technology on 100 of blood samples of pregnant women.

VIII. Kyle Reed, PhD, Department of Mechanical Engineering

First Study

- What is a Brief title/description of the collaboration?
  "Gait adaptation in transfemoral amputees using split-belt treadmill training", PI: Dr. Kim

- Which USF Health Faculty/Group are you collaborating with?
  Seok_Hun Kim in Physical Therapy and Rehabilitation Sciences

- Are there any publications from the collaborations?
  To date, none are published.

- Are you Funded?
  Yes, $24,895; 6/1/2014-5/31/2015

- Do you have any special equipment or other resources used in this collaborative study?
  No

- Which USF Health Faculty/Group are you collaborating with?
  Seok_Hun Kim in Physical Therapy and Rehabilitation Sciences
• What is a Brief title/description of the collaboration?
  "Robot-assisted balance training"
• Are there any publications from the collaborations?
  Yes, one conference published and one journal about to be submitted:
  S. H. Kim and K. B. Reed, "Robot-Assisted Balance Training for Gait
  Modification," Proc. of the 13th Intl. Conf. on Rehabilitation Robotics
  (ICORR), Seattle, USA, June, 2013.
• Are you Funded?
  Not funded, but have applied for funding to NIH
• Do you have any special equipment or other resources used in this
  collaborative study?
  No

Second Study
• What is a Brief title/description of the collaboration?
  "Walking Crutch/Cane for Enhanced Assistance, Balance, and
  Control of Walking Dynamics"
• Which USF Health Faculty/Group are you collaborating with?
  Seok Hun Kim in Physical Therapy and Rehabilitation Sciences
• Are there any publications from the collaborations?
  Yes, one conference submitted to the Intl. Conf. on Rehabilitation
  Robotics (ICORR)
• Are you Funded?
  NSF I-Corp award and have also applied to NIH
• Do you have any special equipment or other resources used in this
  collaborative study?
  No

Third Study
• What is a Brief title/description of the collaboration?
  Gait Enhanced Mobile Shoe for Stroke Rehabilitation
• Which USF Health Faculty/Group are you collaborating with?
  David Z. Rose, Neurology Deptartment
• Are there any publications from the collaborations?
  No
• Are you Funded?
  Motorum, LLC: "Gait Enhancing Mobile Shoe for Stroke
  Rehabilitation", $134,606 ($60,313 from Moterum; $74,293 from the
  Florida High Tech Corridor); 6/15/2014 – 6/14/2015.
• Do you have any special equipment or other resources used in this
  collaborative study?
  GEMS Device

IX. Steve Saddow, PhD, Sylvia Thomas, PhD, Dept. of Electrical Engineering
• Which USF Health Faculty/Group are you collaborating with?
  Gabriel de Erausquin, Psychiatry & Behavioral Neurosciences
• What is a Brief title/description of the collaboration?
  "Harnessing 3C-SiC for Next Generation MRI-compatible
Microelectrode Arrays
• Are there any publications from the collaborations? No
• Are you Funded? NIH grant pending
• Do you have any special equipment or other resources used in this collaborative study? No

X. Ravi Sankar, PhD, Professor of Electrical Engineering

First Study
• What is a Brief title/description of the collaboration? Wireless Sensors System for Monitoring and Management of Parkinson's Disease
• Are there any publications from the collaborations? No
• Which USF Health Faculty/Group are you collaborating with? S. -H. Kim, USF Physical Therapy and Rehabilitation Sciences International Collaborators: S. Cho, Kangnam University, South Korea, R. Altafim, Univ of Sao Paulo, Brazil
• Are you Funded? No
• Do you have any special equipment or other resources used in this collaborative study? No

Second Study
• What is a Brief title/description of the collaboration? AFib Source Location Identification through Signal Analysis
• Which USF Health Faculty/Group are you collaborating with? J. Sanchez-Ramos and T. Zesiewicz, Dept. of Neurology and VA Hospital
• Are there any publications from the collaborations? No
• Are you Funded? No
• Do you have any special equipment or other resources used in this collaborative study? No

Third Study
• What is a Brief title/description of the collaboration? AFib Source Location Identification through Signal Analysis
• Are there any publications from the collaborations? No
• Are you Funded? No
• What is a Brief title/description of the collaboration?
  Other Projects include: Signal Processing for P300-based BCI
  ROI based Compression and Watermarking for Medical Imaging
  Robust Speech and Speaker Recognition
  Age and Gender Recognition
  Accent and Stress Speech
  Biometric Applications
• Which USF Health Faculty/Group are you collaborating with?
  Stuart Hart, CAMLS and Others
• Are there any publications from the collaborations?
  No

• Are you Funded?
  No
• Do you have any special equipment or other resources used in this collaborative study?
  No

Fourth Study
• What is a Brief title/description of the collaboration?
  Image analysis of cells and on fostering of biomedical innovation and translation of research.
• Which USF Health Faculty/Group are you collaborating with?
  Sudeep Sarkar, COE, & Shyam Mohapatra, MCOM
• Are there any publications from the collaborations?
  No
• Are you Funded?
  NIH Proposal has been prepared
• Do you have any special equipment or other resources used in this collaborative study?
  No

XI. Yu Sun, Asst. Professor of Computer Science and Engineering

First Study
• What is a Brief title/description of the collaboration?
  We are developing an augmented reality system for minimally invasive surgery.
• Which USF Health Faculty/Group are you collaborating with?
  Jaime Sanchez (General Surgery); Terri Ashmeade (Medicine Pediatrics); Thomas McCaffrey (Medicine Otolaryngology); Dr. Kevin Sneed (College of Pharmacy)
• Are there any publications from the collaborations?
Second Study

- What is the Brief title/description of the collaboration?
  We are developing an approach to measure pain of infants in NICU.
- Which USF Health Faculty/Group are you collaborating with?
  Dr. Terri Ashmeade
- Are there any publications from the collaborations?
- Are you Funded?
  No. We have applied NIH grant once
- Do you have any special equipment or other resources used in this collaborative study?
  No
- Which USF Health Faculty/Group are you collaborating with?
  Tom McCaffrey
- What is a Brief title/description of the collaboration?
  We have developed a telemedicine robotic system.
- Are there any publications from the collaborations?
- Are you Funded?
  No. We have applied NIH grant once
- Do you have any special equipment or other resources used in this collaborative study?
  No

Third Study

- What is a Brief title/description of the collaboration?
  We are developing a holographic greeter for the new USF pharmacy research.
- Which USF Health Faculty/Group are you collaborating with?
  Dr. Kevin Sneed
- Are there any publications from the collaborations?
- Are you Funded?
  NIH Proposal has been prepared
- Do you have any special equipment or other resources used in this collaborative study?
  No

XII. Yicheng Tu, PhD, Assoc. Professor of Computer Science and Engineering

- What is a Brief title/description of the collaboration?
  A data streaming platform for health informatics
• Which USF Health Faculty/Group are you collaborating with?
  Dr. Ming Ji, School of Nursing
• Are there any publications from the collaborations?
  Not so far
• Are you Funded?
  We are in the processing of developing an R15 to NIH
• Do you have any special equipment or other resources used in this collaborative study?
  Accelerometer, cell phones

XIII. Hui Yang, PhD, Dept. Asst. Professor, Industrial & Management Systems Engineering

First Study
• What is a Brief title/description of the collaboration?
  NSF CMMI-1266331, Collaborative Research
• Which USF Health Faculty/Group are you collaborating with?
  Eric S. Bennett & Daniel Yip, Molecular Pharmacology and Physiology, Fabio Leonelli, Cardiology
• Are there any publications from the collaborations?
  D. Du†, H. Yang*, S. Norrting, and E. Bennett, "In-silico modeling of glycosylation modulation dynamics in hERG channels and cardiac electrical signaling," IEEE Journal of Biomedical and Health Informatics (Feature Article highlighted in the homepage of IEEE journal website), Vol. 18, No. 1, p205-214, 2013, DOI: 10.1109/JBHI.2013.2260864
D. Duť, H. Yang, A. Ednie, and E. Bennett, "Computer modeling and optimization of cardiac models," placed first in the CIEADH Doctoral Colloquium poster competition, ISERC 2014, Montreal, Quebec, Canada, May 31-June 3, 2014

- Are you Funded?
  Yes

- Do you have any special equipment or other resources used in this collaborative study?
  Patch clamping, Wireless ECG sensors, Optical mapping

**Second Study**

- What is a Brief title/description of the collaboration?
  **MRI: Acquisition of a CAREN Virtual Reality System for Collaborative Research in Assistive and Rehabilitation Technologies**
  The CAREN system involves many collaborators listed below. We are in the process of setting up an Educational Business Account (EBA) in order to charge for use of the system so that the equipment, supplies and lab can be maintained.

- **Collaborators**
  
  **USF:**
  Rajiv Dubey, Ph.D., Mechanical Engineering  
  David Diamond, Ph.D., Psychology and Pharmacology  
  Sandy Quillen, Ph.D., School of Physical Therapy & Rehabilitation Sciences  
  Kyle Reed, Ph.D., Mechanical Engineering  
  Sudeep Sarkar, Ph.D., Computer Science & Engineering  
  Redwan Alqasemi, Ph.D., Mechanical Engineering  
  Karen Berkman, Ph.D., USF Center for Autism and Related Disabilities  
  Lawrence Braue, Ph.D., USF Veterans Services  
  Stephanie Carey, Ph.D., Mechanical Engineering  
  M. Jason Highsmith, Ph.D., School of Physical Therapy & Rehabilitation Sciences  
  William Kearns, Ph.D., Aging and Mental Health Disparities  
  Seok Hun Kim, Ph.D., School of Physical Therapy & Rehabilitation Sciences  
  Kevin Kip, Ph.D., College of Nursing  
  Merry Lynn Morris, M.F.A, College of the Arts  
  Yu Sun, Ph.D., Computer Science & Engineering  
  Tom Weller, Electrical Engineering

**Tampa VA:**  
Steve Scott, DO, Physical Medicine and Rehabilitation  
Sam Phillips, PhD, CP, Prosthetist, Biomedical Engineering  
Gail Laitlef, DO, Physiatrist, Regional Amputee Clinic
Gail Powell-Cope, PhD, Nursing
Jan Jasiewicz, PhD, Motor Control
Matthew Peterson, PhD, Biomedical Engineering
Manutchanok (MJ) Jongprasithporn, PhD, Industrial Engineering,
Human Factors
Jeff Craighead, PhD, Computer Science
Marissa McCarthy, MD, Physical Medicine and Rehabilitation, TBI

Draper:
Kevin Hufford, Mechanical Engineering

XIV. Other collaborations and success stories involving USF Faculty:

A. USF Faculty at a Former University

USF BME Task Force Member (RF) was one of the Founding Faculty of
the BME Department at the University of Rochester (NY). Initially, graduate
and undergraduate degree programs were established. After initial success
with these programs, a new BME Department was formed and announced to
be a joint department between the College of Engineering, which is part of
the River/Main campus at Rochester and the University of Rochester Medical
School. Grants from the Whitaker Foundation (totaling about 10 million
dollars) and NY State funding facilitated a successful launch of this new BME
Department including the construction of a new 3-story building located at the
juncture between the River and Medical School campuses. This new BME
building houses BME Department offices, new classrooms, auditorium
lecture hall, and both research and instructional laboratories, as well as
gathering places and café. The Rochester BME Department has evolved
where its faculty and activities tend to gravitate towards the College of
Engineering, vs. the Medical School. However, there are still faculty in the
Department who have primary or secondary appointments in the Medical
School and the current and founding chair originally came out of the Medical
School. This Department is now ranked in the top 50 BME departments in
the country by US News & World Report, and 4th in NY State, behind
Columbia, Cornell and Rensselaer Polytechnic Institute (RPI).

B. The CAMLS Example

The following description is taken from a BME document, entitled
"Roadmap for USF/CAMLS Device Design Program" that Robert Frisina,
PhD (Engineering), Karl Illig, MD (Medicine) and others have worked on, and
can be adapted for the proposed new joint BME Department.

The USF/CAMLS Device Design Program (USF/CAMLS-DDP) is
everned to be a major strategic component of the proposed joint
eering-medicine Department of Biomedical Engineering. Such a
department would include undergraduate and graduate degree programs,
basic research, attractive mechanisms for physician R&D involvement, and
other scholarship. The objective of the USF/CAMLS-DDP is to formalize
collaboration of engineers and physicians in a real-world environment, with a
goal to generate intellectual property, scholarship, corporate support, and federal grant funding opportunities, through the cross-education of those from each school in the knowledge base of the other...this initiative is envisioned to be a core component of the proposed BME Department.

In any academic environment, it is easy (and too often is the "default" setting) to provide education in a sterile, classroom setting, with educational materials supplied as lectures, text, and other static formats. Most existing device design programs follow this pattern. USF, through the Center for Advanced Medical Simulation and Learning (CAMLs), has made a commitment to environmentally-based learning. In addition, several other institutions throughout the world have established, with varying degrees of immersion, interactive relationships between engineers and physicians, and our early efforts have emphasized clinical exposure for engineering students. We propose to expand our early efforts and create a durable multidisciplinary educational program that emphasizes practical training, taking advantage of our unusual assets (CAMLs, the proposed Department of Biomedical Engineering, high clinical volume, and interested and experienced personnel).

Our underlying goals are to provide an environment where practical needs are identified and subsequent invention and translation to market is facilitated, while providing the highest level of education for all involved. We feel that academic-industry partnership, scholarship, and federal and other funding will be vastly facilitated and subsequently follow. As outlined in the Executive Summary at the beginning of this document, all USF/CAMLs-DDP programs and outcomes are envisioned to derive from and should address the following five goals.

**Graduate Education**

1. Robust, world-class graduate training programs for two groups of learners.
   a. Biomedical engineers who are intimately tied into the real-world clinical environment of medicine, who thus understand the issues that physicians face based on direct experience (clinic, ward, and operating room). A major part of their training will be based on immersion in clinical medicine, both simulated (CAMLs) and actual (TGH). This aspect of the program is arguably absolutely unique to our program and will be a strong recruiting tool.
   b. Physicians who are strongly interested in device design, innovation, and engineering in general. Formal training will be performed during truly protected time (one to two years’ training during or after their medical school training), and again these students will have substantial exposure to the engineering world (both didactic and practical).

2. We envision expansion of this program as it develops, perhaps to include business students, law students, administrative personnel, and so on, although specifics will need to be better elucidated once the program is active.

3. Graduates of this program will be expected to be highly competitive for complex medical device company jobs or prepared to go on for doctoral work in
engineering, medical school, or medical or business leadership roles; medical graduates are envisioned to be prepared for careers in biomedical innovation, medical leadership, and so on.

**Interdisciplinary Collaboration**
1. Creation of a group of physicians who understand engineering principles, including what can and cannot be done, based on direct experience, and creation of a group of engineers who understand surgical and other clinical issues, needs, and current resources.

2. Improve the ability of engineers and physicians to communicate with each other in general.

3. We envision benefit in this area to the involved faculty as well as to the individual students. Improved faculty collaboration may provide a more durable benefit, in fact, than that provided to each individual graduate.

4. Collaboration leading to further interaction between major USF schools, providing global benefit to the University as a whole.

**Device Development**
1. A steady stream of ideas, ideally leading to inventions, created with the help of the resources CAMLS can bring to bear.

2. Potential corporate start-up spin-offs that will benefit the USF schools of medicine, engineering and others, CAMLS, the Tampa Bay Community, patients, and the population in general.

3. Creation of IP that will benefit all inventors and "investors."

4. Focus on practical inventions, derived from the inventors' immersion in the world of medicine as well as engineering.

**Industry Relationships**
1. Better relationships with existing device corporations, who value both the ideas generated from this program and the personnel we train.

2. Encourage/recruit companies to "invest" in this program, either on a global basis or based on a particular year, person, project, program, or idea.

3. Robust interaction with business (entrepreneurship, marketing, company creation) and perhaps law students during the development and commercialization process of bringing device ideas to practicality to provide them with real-world training.

**Competitive Advantages**
   We believe we have multiple advantages over existing programs, that, when taken together, allows us the possibility to become the leading device design program in the world.

**Clinical Exposure**
1. To our knowledge, only a few programs (Rochester, Johns Hopkins) provide significant clinical exposure to the engineering students. Our program is significantly driven by clinicians (philosophically, a 50-50 partnership) and as such both our early efforts and our future plans emphasize this facet of training.
Many programs supply engineering and device development exposure to non-engineering students, but we strongly believe that we can provide the most practical educational experience to non-clinicians by immersion in the clinical world.

2. We also have the unique resources offered by CAMLS in this regard. While we can provide observational experience as above, such students cannot legally participate in direct patient care. The simulation facilities at CAMLS (both individual and group/situational) are uniquely designed to provide high-fidelity hands on experience.

**Location**

USF-CAMLS-DDP would have the distinction of being the only such program in the southeast US. The Stanford and Hopkins programs seem most similar in scope to what we are trying to do. Rochester is entirely focused on vascular surgery.

**Proposed Specific Structures**

The USF/CAMLS-DDP program will consist of multiple closely related intersecting components, organized according to the five overarching vision goals presented in the Executive Summary.

- **Graduate Education**
  - Initially, we plan on training two general levels of students
    - Masters level BME students, culminating in Master’s Degree

- **Conventional biomedical engineering curriculum (USF main campus, CAMLS)**
  - 5 required courses: BME I and II, Biostatistics, Anatomy, Physiology
  - Additional courses related to medical training
    - Medical and research ethics
    - A business school course or two? Identify
    - A reverse engineering course, ala Cincinnati?
  - Pick a field of medicine, we ensure mentoring (TGH, CAMLS)
  - Likely heavily device-dependent fields, but can be anything including drug development, software.
  - Initially vascular surgery, but plan to expand opportunities
  - Early immersion/practicum to select – rotational or pre-selected?
  - Attend weekly conferences, required reading
  - Two four week clinical rotations, including call
  - CAMLS curriculum – simulation, team training
  - Attend a regional or national meeting, “homework”
  - Significant, personal mentoring on a weekly basis

- **Develop an idea (with a clinical partner – resident, student, faculty, nurse?) (CAMLSS)**
  - Develop at CAMLS – brainstorming, prototyping
  - “Shark tank” – Defend in front of engineers and medical personnel
  - Bring to the point of patentability, development
  - Work with other fields as we mature
    - Legal
• Business school students – entrepreneur program

• Write a manuscript for publication (with clinical partner)

• Physicians during (or after) training
  o Two options:
    ❖ For residents with an engineering degree: BME Master's Degree
    ❖ One versus two years? Bob and I need to chat. If we have funding, we can offer up to two years, depending on the wishes and training of the resident.
    o Altered course load – will not need anatomy and physiology, but will need further BME work, likely statistics, and so on.
    o For residents without an engineering degree: Certification TBD (Masters in medical science; Entrepreneurship). Sense is that they will value more something beyond a "certificate."
      ❖ One to two year program, full-time
      ❖ Again, will need to nail down courses. Heavier on engineering courses.
    o Trainees in both tracks will need practical engineering experience.
    o They will be assigned an engineer mentor to come up with a practical idea for a device/system/drug as above, although focus will be adding medical knowledge to the engineering environment.

• As above, both a patentable idea and scholarly output will be required for graduation in either track.

• Eventually we plan on opening this up to other interested trainees (legal, business, management, and so on) but this will need to be further explored once we have some practical experience overall.

• As above, CAMLS-based training will be critical at all phases of this process:
  o BME student didactic education
    ❖ Anatomy
    ❖ Clinical simulations – first and third floor
  o Practical exercises based on selected field – designed to introduce student to techniques, in turn to gain a direct sense of what works and what is needed
  o "Home base" for design development (TBRIC)
    ❖ Ideas, conceptualization
    ❖ Prototype development and testing
    ❖ Group interaction (business, legal, medical)
    ❖ Corporate relations: Identification of possible corporate partners to sponsor further device development and/or licensing of intellectual property.

• Interdisciplinary Collaboration
  o This is envisioned to derive naturally from the training programs described above, at both a faculty and trainee level.
• We envision collaboration in, but not limited to:
   Development of IP
   Scholarly output
   Grant funding
   Joint attendance at meetings, perhaps participation in each other’s meetings

• Device Development
   A very obvious and fundamental goal of this program is generation of ideas for devices to improve our ability to provide medical care.
     This will improve our reputation for clinical progress and outcomes
     This will also obviously generate IP for USF
   Most trainee projects should lead to patents
   USF has strong logistical support for this, and is a world leader in terms of # of patents generated annually
   Several options exist for managing IP
     Purchase outright by a company
     Licensing (with varying degrees of developmental help) by a company, or
     Creating our own/spin off company

• Industry Relationships
   This will be a critical component of the program from the outset. We aim to cultivate specific relationships with specific people within each relevant company, organized around this program.
   Specific goals will include:
     Industry participation in ideas, ideally “purchasing” an MD/BME team to work on a specific idea, with right of first refusal for ownership and/or development.
     Engineering internships for both groups of trainees, but especially physicians pursuing BME training.
     Acting as a source of ideas in general.
     Acting as a goal for employment of graduates of this program.
   Other ideas
     Provision of training/shadowing opportunities for their engineers

• Marketability, Recruitment, and Funding Opportunities
   We aim to publicize this program robustly. It is likely that our program will be the program that offers engineering trainees the most clinical exposure of any such program, and we will be the ONLY program to involve specific and situational simulation. This will:
     Attract students from outside USF, and
     Attract corporate partners.
   We anticipate (and will require) significant academic output to derive from this. This will:
     Enhance the reputations of all involved, and
     Provide significant education to students in this regard.
Finally, a very critical goal in this regard is to increase our competitiveness for funding. This would be envisioned to be at any/all levels, including federal, foundation, corporate/industry, society, and others. Needs include:
- Endowments (faculty support)
- Tuition and supplies
- Specific research projects
  - Specific device development ("sponsored" by a company)
  - Other issues yet to be identified

Summary

We propose creation of a Device Design Program, initially run by Biomedical Engineering and Vascular Surgery and eventually being part of the interdisciplinary Biomedical Engineering Department, which has as its goal interdisciplinary training of engineering students and medical residents in the process of device invention and development. As well as ensuring engineering exposure to medical trainees, it will be absolutely unique in two areas: Very strong reliance on clinical exposure for engineering students, and in the use of CAMLS for training. We anticipate that this program will generate devices that will improve patient care and generate IP for the University and inventors, foster improved interdisciplinary interaction between the colleges of Medicine and Engineering, create unique and lasting industry relationships, and foster scholarly output. We also believe that this program has the potential to generate significant funding opportunities and will act as a major marketing and recruiting pull for the University.
## Appendix C

Accredited BS Programs (90) (P also have PhD program, J have joint program with a Medical School)

<table>
<thead>
<tr>
<th>Arizona State University (P)</th>
<th>Union College</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boston University (P)</td>
<td>University of Alabama at Birmingham (P,J)</td>
</tr>
<tr>
<td>Brown University</td>
<td>University of Buffalo (P)</td>
</tr>
<tr>
<td>Bucknell University</td>
<td>University of California, Davis (P)</td>
</tr>
<tr>
<td>Case Western Reserve University (P)</td>
<td>University of California, Irvine (P)</td>
</tr>
<tr>
<td>City University of New York, City College (P)</td>
<td>University of California, Los Angeles (P)</td>
</tr>
<tr>
<td>Clemson University (P,J)</td>
<td>University of California, Riverside (P)</td>
</tr>
<tr>
<td>Columbia University (P)</td>
<td>University of California, San Diego (P)</td>
</tr>
<tr>
<td>Drexel University (P)</td>
<td>University of Central Oklahoma</td>
</tr>
<tr>
<td>Duke University (P)</td>
<td>University of Cincinnati (P)</td>
</tr>
<tr>
<td>Florida Gulf Coast University</td>
<td>University of Connecticut (P)</td>
</tr>
<tr>
<td>Florida International University (P)</td>
<td>University of Hartford</td>
</tr>
<tr>
<td>George Mason University (P)</td>
<td>University of Illinois at Chicago (P,J)</td>
</tr>
<tr>
<td>Georgia Institute of Technology (P,J)</td>
<td>University of Illinois at Urbana – Champaign (P)</td>
</tr>
<tr>
<td>Illinois Institute of Technology (P)</td>
<td>University of Iowa (P)</td>
</tr>
<tr>
<td>Indiana Institute of Technology</td>
<td>University of Louisville</td>
</tr>
<tr>
<td>Indiana University - Purdue University</td>
<td>University of Maine (P,J)</td>
</tr>
<tr>
<td>Indianapolis (P)</td>
<td>University of Maryland College Park (P)</td>
</tr>
<tr>
<td>Lawrence Technological University</td>
<td>University of Miami (P)</td>
</tr>
<tr>
<td>Lehigh University (P)</td>
<td>University of Michigan (P,J)</td>
</tr>
<tr>
<td>Louisiana Tech University (P)</td>
<td>University of Minnesota - Twin Cities (P)</td>
</tr>
<tr>
<td>Marquette University (P)</td>
<td>University of Pennsylvania (P)</td>
</tr>
<tr>
<td>Miami University</td>
<td>University of Pittsburgh (P)</td>
</tr>
<tr>
<td>Michigan Technological University (P)</td>
<td>University of Rhode Island</td>
</tr>
<tr>
<td>Milwaukee School of Engineering</td>
<td>University of Rochester (P)</td>
</tr>
<tr>
<td>New Jersey Institute of Technology (P)</td>
<td>University of South Carolina (P)</td>
</tr>
<tr>
<td>North Carolina State University, Raleigh (P,J)</td>
<td>University of Southern California (P)</td>
</tr>
<tr>
<td>Northwestern University (P)</td>
<td>University of Tennessee at Knoxville (P)</td>
</tr>
<tr>
<td>Oregon State University</td>
<td>University of Texas at Austin (P,J)</td>
</tr>
<tr>
<td>Pennsylvania State University (P)</td>
<td>University of the Pacific</td>
</tr>
<tr>
<td>Purdue University at West Lafayette (P)</td>
<td>University of Utah (P)</td>
</tr>
<tr>
<td>Rensselaer Polytechnic Institute (P)</td>
<td>University of Virginia (P,J)</td>
</tr>
<tr>
<td>Rice University (P)</td>
<td>University of Washington (P,J)</td>
</tr>
<tr>
<td>Rose-Hulman Institute of Technology</td>
<td>University of Wisconsin – Madison (P)</td>
</tr>
<tr>
<td>Rutgers, The State University of New Jersey (P)</td>
<td>Vanderbilt University (P)</td>
</tr>
<tr>
<td>Saint Louis University (P)</td>
<td>Virginia Commonwealth University (P)</td>
</tr>
<tr>
<td>State University of New York at Binghampton (P)</td>
<td>Virginia Tech University (P,J)</td>
</tr>
<tr>
<td>Stevens Institute of Technology (P)</td>
<td>Washington State University</td>
</tr>
<tr>
<td>Stony Brook University (P)</td>
<td>Washington University (P)</td>
</tr>
<tr>
<td>Syracuse University (P)</td>
<td>Western New England University</td>
</tr>
<tr>
<td>Texas A&amp;M University (P)</td>
<td>Wichita State University</td>
</tr>
<tr>
<td>The Catholic University of America (P)</td>
<td>Worcester Polytechnic Institute (P)</td>
</tr>
<tr>
<td>The College of New Jersey</td>
<td>Wright State University</td>
</tr>
<tr>
<td>The George Washington University (P)</td>
<td>University of Florida (pending)</td>
</tr>
</tbody>
</table>
Joint BME-MED Programs/Departments

Clemson-MUSC: a graduate research and training program established in the Fall of 2003 based on a formal agreement between the two institutions. Since its inception, the program has grown to comprise of 5 primary faculty from Clemson University, who are permanently located and conduct their research full-time on the MUSC campus in Charleston, SC, and 26 basic science and clinical faculty from MUSC, who hold program faculty appointments in the program. Program students and cross-over interdisciplinary MUSC students can complete required and elective bioengineering courses, taught locally by primary and program faculty and through videoconferencing from participating faculty in the parent bioengineering department at Clemson. In addition, the students can enroll in basic science and clinical MUSC electives for full transfer credit.

Georgia Tech-Emory: a unique partnership and a BOLD experiment, the biomedical engineering PhD program is offered through the Wallace H. Coulter Department of Biomedical Engineering, a unique public and private partnership conferred jointly by both Georgia Tech's College of Engineering and Emory University’s School of Medicine.

NC State-UNC: In 2003, the University of North Carolina at Chapel Hill and North Carolina State University formally brought their exceptional strengths and national reputations via their College of Arts & Sciences, School of Medicine, and College of Engineering to establish our department. The undergraduate program at NC State is an ABET accredited program that offers a bachelor’s degree in Biomedical Engineering. At UNC-Chapel Hill, the joint department offers undergraduate education under the auspices of the College of Arts & Sciences.

Memphis-UTenn: By our state-certified program of graduate education beginning in 1996, each individual is placed at one site, either UM or UT for registration each term. Generally, this site is where the student's major advisor is employed and the source of stipend and tuition funding is located. This site also provides indirect services, e.g., health insurance and clinical services. Classes are held on both campuses; laboratories in BME are available for research on both campuses. Transfer of sites is possible. Registration processes are treated in other questions. The joint program is largely constructed about a reciprocal agreement that exists between the UM and UTHSC. This agreement offers a means to extend the offerings of each by use of the available services of the other. It does not expect the other to provide funding to extend the offerings of the other campus.

Toledo: The Doctor of Philosophy in Biomedical Engineering at the University of Toledo is a joint program between The College of Engineering (COE) and The College of Medicine (COM). The curriculum also provides a PhD program for MD students from undergraduate engineering backgrounds that are interested in pursuing a dual degree and careers as physician scientists. For students directly admitted into the Ph.D. program with a B.S. degree, the minimum coursework requirements specified below must be satisfied.

- Register and mandatory attendance at a weekly seminar series in the COE or COM every semester.
- Complete 13 hours of core coursework (3 or more hours in COM)
- Complete 12 hours of engineering/life sciences elective coursework.
- Complete 3-6 hours of entrepreneurship elective coursework.
- Complete 15 hours of other engineering/science elective coursework.
- Complete at least 45 semester hours of dissertation research.

**UAB:** Since 1979, the Department of Biomedical Engineering has resided wholly within the School of Engineering. In 2014 the department was recreated as a joint department between the School of Engineering and the UAB School of Medicine. By integrating the department into the School of Medicine, administrators say they hope to capitalize on existing and emerging strengths in research, education and patient care at UAB. Historically, biomedical engineers at UAB have collaborated with clinicians and medical researchers on a limited basis through various centers or individual research projects. By integrating the department into the medical school, SOM Dean says he expects to see an increase of interdisciplinary research, as well as new interdisciplinary programs that will facilitate transition from the laboratory to the clinic. ([http://www.uab.edu/engineering/home/bmenews/13-departments-research/dept-biomedical-eng/945-uab-schools-of-engineering-and-medicine-create-joint-department-of-biomedical-engineering](http://www.uab.edu/engineering/home/bmenews/13-departments-research/dept-biomedical-eng/945-uab-schools-of-engineering-and-medicine-create-joint-department-of-biomedical-engineering)).

Organizational structure is roughly as follows:

- joint department with joint hires and joint operational leadership overseen by Deans of COE and COM
- split indirect costs, split hiring/startup costs, and split salary costs (true joint appointments)
- faculty primary appointment and tenure through department with higher percentage
- "memorandum of understanding" to address problems that might arise with departments, chairs, deans

  **example 1:** COM hired BME faculty member with 12 month appointment at 75% COM-25% COE, meaning that COE covered 25% of startup and basically pays summer salary in exchange for their teaching a course (or two) and 25% of their grant indirect costs. Tenure through COM.

  **example 2:** COM hired BME faculty member with 12 month appointment at 75% COE-25% COM, meaning that COM covered 25% of startup and pays summer salary in exchange for 25% of grant indirect costs (maybe COM course too?). Tenure through COE.

  **example 3:** COE hires BME faculty member with 9 month appointment at 51%COE-49%COM, meaning that startup and grant indirect costs are split 50-50 and COE pays academic-year salary. Tenure through COE.

**UIC:** Beginning in Fall of 2011, the Department of Bioengineering is now in both the College of Engineering (COE) and the College of Medicine (COM) at UIC, home of the largest medical school in the country. This is a new arrangement that is in line with trends in best practices at other top programs around the country.

**UMaine:** The Graduate School of Biomedical Science and Engineering (GSBSE) is a unique graduate program that includes the University of Maine as the degree granting institution and five additional cooperating academic and research institutions within Maine (Jackson Labs, Univ. Southern Maine, Univ. New England, Mt Desert Island Biology Labs, Maine Medical Center Research Institute).

**UMichigan:** The department is currently housed in engineering, though its researchers regularly collaborate with medical doctors and a number of Medical School faculty hold joint appointments there. In 2012, the academic structure was changed to bring biomedical engineering researchers closer to the patients their technologies aim to benefit. As part of this plan, BME will expand over the next five years from approximately 20 primary faculty members to 35. Most of the new joint hires will be Medical School appointments. The department will retain its space on North Campus in engineering and in the North Campus Research Complex. It will also open a space at the Medical School in the future. The BME Chair interacts regularly with Medical School Department Chairs at Research Advisory Board meetings.
Virginia: The Department of Biomedical Engineering at the University of Virginia was established in 1967 as a joint program of U.Va.’s School of Medicine and School of Engineering and Applied Science. There are 21 core BME faculty and more than 20 joint faculty across multiple schools and departments.

UWashington: Joint department in nationally recognized School of Medicine and College of Engineering, with 46 active core teaching and research faculty and 9 joint faculty.

VTU-WFU: A joint degree partnership between Virginia Tech and Wake Forest University that is called the School for Biomedical Engineering and Sciences. Currently the program has 76 tenure track faculty (25 primary and 51 joint) as well as an additional 68 affiliate faculty appointments. One campus is chosen as “home base” but students have the opportunity to experience both environments and the faculty of each through courses taught by video broadcast, and by inter-campus visits. Financial support is available for students on both campuses. Traditionally first-year students are offered either a full fellowship or a Graduate Teaching Assistantship which provides a competitive stipend and pays full tuition. Students are also hired by faculty to be graduate research assistants, and often summer internships in select programs become available.

UT-San Antonio/UT-Health Science Center-San Antonio: Purely a joint graduate program. The Dean of the College of Engineering at UTSA and The Dean of the Graduate School of Biomedical Sciences at UTHSCSA have overall responsibility for the Joint Graduate Program in Biomedical Engineering. The graduate faculty of the Biomedical Engineering program, along with the Program Director and Associate Director, are responsible for curriculum development and ongoing review. The Program Director and Associate Director advise all graduate students, maintain records, and represent the program. The day-to-day administrative operation of the BME Program is the responsibility of the Program Director and Associate Director. The Chair of the Admissions Committee, the Chair of the Committee on Graduate Studies (COGS)/Graduate Studies Committee (GSC), and the Chair of the Curriculum Committee report, advise, and make recommendations to the Program Director and Associate Director. The Program is supervised by a COGS/GSC composed of all BME Program faculty (both Core and Associated) who are also on the Graduate Faculty at either UTSA or UTHSCSA or both. From this group, subcommittee Chairs are elected to perform various activities for which the COGS/GSC is responsible such as recommending admission of applicants to the program, overseeing academic curricula, monitoring the academic progress of students in didactic and research activities, attesting eligibility for admission to candidacy for a degree, and verifying to the Graduate Faculty Council (GFC) [=Graduate Council at UTSA] that students have fulfilled all requirements for the awarding of the degree. Recommendations are made by this committee to the Program Director and Associate Director for implementation and, if warranted, forwarded to the Graduate Deans for approval. The initial Program Director was appointed from the Core faculty by the two Graduate Deans, with the assistance of a committee composed of equal numbers of faculty from the two institutions. The term of the first Program Director was three years. Since the expiration of his term, the Biomedical Engineering Program faculty elect a new Program Director and Associate Director every three years. After each election, the credentials of both newly elected Directors are forwarded to the Deans for final approval.
Appendix D

USF SYSTEM
New Academic Degree Program Authorization
Pre-Proposal Form

New Academic Program Pre-Proposal Process
New academic program pre-proposals are initiated and developed by the faculty. Approval of the pre-proposal must be obtained from department chairs and college deans or equivalent administrators before submission for USF System level review and consideration for inclusion in the USF Annual Work Plan. Details of the pre-proposal process and a timeline can be found on the Office of Institutional Effectiveness, Academic Program Planning and Review website.

Original copies of completed pre-proposals (including required signatures) must be submitted by October 1st to Kelly Bergquist, BEH 339. (For questions: kbergqui@usf.edu 4-2490)

Pre-proposal Application Form

<table>
<thead>
<tr>
<th>PROGRAM PROPOSAL INFORMATION</th>
<th>TYPE(PRINT CLEARLY)</th>
</tr>
</thead>
<tbody>
<tr>
<td>USF Institution</td>
<td>College of Engineering, Tampa Campus</td>
</tr>
<tr>
<td>Degree Program Title (e.g. M.A. in Biology)</td>
<td>B.S. in Biomedical Engineering</td>
</tr>
<tr>
<td>CIP Code</td>
<td>14.0501</td>
</tr>
<tr>
<td>Proposed Mode of Delivery (% online if applicable)</td>
<td>100% offline initially.</td>
</tr>
<tr>
<td>Enrollment Projections (FTE) : Year 1 and Year 5</td>
<td>Year 1: 35 Year 5: 70</td>
</tr>
<tr>
<td>Proposed Implementation Date (e.g. Fall 2012)</td>
<td>Fall 2015</td>
</tr>
</tbody>
</table>

Please provide a succinct, thorough response to each of the following:

Program Summary: (Briefly describe the proposed program)

1. Briefly summarize the overall rationale for the new academic program. Include a consideration of any ways in which the proposed program is distinct from others already offered in the SUS (use the 4-digit CIP as a guide). Discuss how this program supports specific university and SUS missions. Consider collaborative opportunities with other SUS institutions as appropriate. (maximum length 250 words)
The proposal to offer a new degree program in Biomedical Engineering is aligned with the strategic goals and plans of the SUS Board of Governors and USF, namely to increase degree productivity and program efficiency while increasing student access and success in degree programs in the STEM fields. Biomedical Engineering is one of the fastest-growing degree programs in the country, with a strong projected labor market growth. So far there is only one accredited BS-BME program in the SUS at FIU. University of Florida recognized the need and demand and has started offering this option (with limited access) to their engineering students starting in 2012 and they are expected to have an accredited program in 4-5 years. FGCU has a degree program in a closely related field (Bioengineering).

As a result, Florida residents, especially those who are in the greater Tampa region does not have the option for this fast-growing and important new field of engineering despite having a very strong programs in other health-related fields such as medicine, nursing, pharmacy and related subjects. USF is located in a large metropolitan area which draws the majority of its students from the region and having the BS-BME option at USF will not only present opportunity for USF students to enter into this fast-growing profession but also to continue to graduate degrees in many health-related areas that involve research in biomedical fields. They will also meet the growing demand in the large industrial base do biomedical-related companies located in Florida, especially around the Florida High-Tech Corridor. A BS in BME will provide them with unique skills that are at the intersection of engineering and medicine, to meet many current and future demands related to decreasing the high costs of health care, while at the same time, maintaining and improving quality of care delivered.

It is proposed that the Department of Chemical and Biomedical Engineering at USF develop and offer a new BS degree program in Biomedical Engineering in addition to the existing BS ChE program in order to meet the growing demand for this newly emerged, but rapidly growing field at the intersection of engineering and bio-medicine.

Student Demand: (Describe the demand in the SUS for the proposed program)

2. Briefly describe the demand for the proposed program and consider the following in your narrative:
   - Recognizing that programs at different levels may require different degrees of justification (e.g., greater duplication may be warranted at undergraduate and master’s levels), indicate why duplicative programs should be warranted.
   - Consider the numbers of graduates and students enrolled at similar programs currently offered online or face-to-face.
Appendix D

- Consider as applicable: place-bound learners, underserved populations in the field/profession, and professional credentials requirements. (maximum length 250 words)

According to the American Society for Engineering Education, of the 83,000 engineering degrees granted in 2012, nearly 4000 were biomedical engineering, becoming the 6th most popular major in a short time period, just behind mechanical, civil, electrical and chemical engineering which are most traditional engineering disciplines.

Interestingly 39% of the degrees went to women, one of the largest in engineering (only environmental had more percentage of women).

Georgia Tech had the largest enrollment (granting over 157 degrees in 2011),

The most telling story is the trend over 2002-2011, during which the number of biomedical engineering graduates increased from 1,315 to 4066, a growth of over 200% whereas the total number of engineering graduates grew only 24%.

University of Florida recognized this demand and has started offering a BS in BME program in 2012. However this is a limited access program and only the second in the SUS. Therefore it is not expected to meet the growing demand for this program regionally and state-wide.

<table>
<thead>
<tr>
<th>Bachelor's Degrees</th>
<th>2002</th>
<th>2003</th>
<th>2004</th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
<th>2011</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aerospace</td>
<td>1,711</td>
<td>2,011</td>
<td>2,322</td>
<td>2,571</td>
<td>2,722</td>
<td>2,788</td>
<td>2,650</td>
<td>3,067</td>
<td>3,219</td>
<td>3,469</td>
</tr>
<tr>
<td>Architectural</td>
<td>613</td>
<td>633</td>
<td>680</td>
<td>722</td>
<td>801</td>
<td>886</td>
<td>723</td>
<td>753</td>
<td>743</td>
<td></td>
</tr>
<tr>
<td>Biological/Agricultural</td>
<td>668</td>
<td>803</td>
<td>801</td>
<td>835</td>
<td>648</td>
<td>650</td>
<td>623</td>
<td>631</td>
<td>719</td>
<td>796</td>
</tr>
<tr>
<td>Biomedical</td>
<td>1,316</td>
<td>1,628</td>
<td>2,619</td>
<td>3,410</td>
<td>2,917</td>
<td>2,869</td>
<td>3,237</td>
<td>3,644</td>
<td>3,670</td>
<td>4,088</td>
</tr>
<tr>
<td>Chemical</td>
<td>8,099</td>
<td>8,235</td>
<td>4,801</td>
<td>4,511</td>
<td>4,492</td>
<td>4,551</td>
<td>4,650</td>
<td>5,185</td>
<td>5,649</td>
<td>6,407</td>
</tr>
<tr>
<td>Civil</td>
<td>8,066</td>
<td>8,162</td>
<td>8,142</td>
<td>8,247</td>
<td>8,635</td>
<td>9,402</td>
<td>10,132</td>
<td>10,508</td>
<td>11,027</td>
<td>12,154</td>
</tr>
<tr>
<td>Civil/Environmental</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Computer</td>
<td>4,720</td>
<td>5,746</td>
<td>5,638</td>
<td>5,458</td>
<td>4,901</td>
<td>4,048</td>
<td>3,608</td>
<td>3,394</td>
<td>3,340</td>
<td>3,381</td>
</tr>
<tr>
<td>Computer Science</td>
<td>6,842</td>
<td>6,649</td>
<td>6,156</td>
<td>6,419</td>
<td>7,330</td>
<td>6,446</td>
<td>5,664</td>
<td>5,652</td>
<td>6,046</td>
<td>6,708</td>
</tr>
<tr>
<td>Electrical</td>
<td>11,402</td>
<td>13,804</td>
<td>12,500</td>
<td>12,458</td>
<td>11,915</td>
<td>11,497</td>
<td>10,760</td>
<td>10,509</td>
<td>9,659</td>
<td>9,942</td>
</tr>
<tr>
<td>Electrical/Computer</td>
<td>2,567</td>
<td>2,762</td>
<td>2,198</td>
<td>2,065</td>
<td>2,269</td>
<td>2,428</td>
<td>2,216</td>
<td>2,164</td>
<td>2,175</td>
<td>2,165</td>
</tr>
<tr>
<td>Engineering General</td>
<td>1,069</td>
<td>1,105</td>
<td>1,138</td>
<td>1,179</td>
<td>1,176</td>
<td>1,246</td>
<td>1,160</td>
<td>1,246</td>
<td>1,335</td>
<td>1,465</td>
</tr>
<tr>
<td>Engineering management</td>
<td>237</td>
<td>288</td>
<td>328</td>
<td>359</td>
<td>359</td>
<td>366</td>
<td>357</td>
<td>359</td>
<td>356</td>
<td>355</td>
</tr>
<tr>
<td>Environmental</td>
<td>485</td>
<td>516</td>
<td>576</td>
<td>522</td>
<td>437</td>
<td>454</td>
<td>486</td>
<td>503</td>
<td>587</td>
<td>608</td>
</tr>
<tr>
<td>Mechanical</td>
<td>15,247</td>
<td>13,601</td>
<td>14,182</td>
<td>14,847</td>
<td>16,083</td>
<td>16,701</td>
<td>17,324</td>
<td>17,375</td>
<td>19,391</td>
<td>19,241</td>
</tr>
<tr>
<td>Mining</td>
<td>112</td>
<td>86</td>
<td>92</td>
<td>120</td>
<td>119</td>
<td>153</td>
<td>190</td>
<td>191</td>
<td>213</td>
<td></td>
</tr>
<tr>
<td>Nuclear</td>
<td>145</td>
<td>135</td>
<td>202</td>
<td>275</td>
<td>342</td>
<td>402</td>
<td>415</td>
<td>376</td>
<td>414</td>
<td>469</td>
</tr>
<tr>
<td>Other</td>
<td>3,106</td>
<td>2,492</td>
<td>2,488</td>
<td>2,724</td>
<td>2,602</td>
<td>2,842</td>
<td>3,511</td>
<td>3,361</td>
<td>3,784</td>
<td>3,730</td>
</tr>
<tr>
<td>Petroleum</td>
<td>207</td>
<td>269</td>
<td>293</td>
<td>315</td>
<td>339</td>
<td>426</td>
<td>492</td>
<td>653</td>
<td>753</td>
<td>865</td>
</tr>
<tr>
<td>Total</td>
<td>65,701</td>
<td>71,168</td>
<td>72,493</td>
<td>72,602</td>
<td>74,186</td>
<td>73,316</td>
<td>74,170</td>
<td>74,397</td>
<td>76,347</td>
<td>83,001</td>
</tr>
</tbody>
</table>

51
Appendix D

Workforce and Economic Development Needs: (Describe how the proposed program meets workforce and economic development needs)

3. Briefly describe how the proposed program meets workforce and economic development needs and consider the following in your narrative:
   - impact of this program (local, state, national, international)
   - impact of research funding
   - Changing professional credential requirements (maximum length 250 words)
Appendix D

According to the Bureau of Labor Statistics (BLS), "Employment of biomedical engineers is projected to grow by 62% from 2010 to 2020, much faster than the average for all occupations". For comparison, the demand for all engineers is projected to grow by 11%, whereas the demand for all occupations is expected to grow by 14% during the same decade time period.

Again according to BLS "The aging baby boom generation is expected to increase demand for biomedical devices, medications, drugs and procedures, such as hip and knee replacements...Biomedical engineers will likely experience more demand for their services because of the breadth of activities the engage in, made possible by the diverse nature of their training".

Quoted from: http://www.bls.gov/ooh/architecture-and-engineering/biomedical-engineers.htm

According to the 2010-2015 Strategic Plan of Workforce Florida (http://www.workforceflorida.com/News/Media/1121/WF1StrategicPlan2010_2015_Web.pdf)
"Technology, Engineering and Math (STEM) are a foundation for business competitiveness, talent readiness and career advancement...Industries identified as targets for the STEM Council include life sciences, aerospace, energy, manufacturing, information technology and homeland security and defense, as well as others."

According to Enterprise Florida, Florida is home to 200 biotech companies specializing in therapeutics, diagnostics, industrial biotechnology and related fields. Florida has one of largest medical device manufacturing industries. Florida ranks 2nd in the U.S. for the number of FDA-registered medical device establishments. Nearly 19,000 Floridians work in this industry. Major companies include: Medtronic, Boston Scientific, Beckman Coulter, Osmo and Baxter International. In addition Florida has over 150 pharmaceutical and medicine manufacturing companies that employ nearly 5200 Floridians.

Florida has nearly a million workers in the healthcare sector, delivering one of the most sophisticated health care in the world.

---

Institution Approval

☐ USF assumes responsibility for funding this program if approved.

<table>
<thead>
<tr>
<th>Provost</th>
<th>Signature</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dr. Ralph Wilcox</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Appendix D

USF Pre-proposal Supplemental Application Form (for internal USF use only)

<table>
<thead>
<tr>
<th>PROGRAM PROPOSAL INFORMATION</th>
<th>TYPE/PRINT CLEARLY</th>
</tr>
</thead>
<tbody>
<tr>
<td>College/ Division</td>
<td>College of Engineering</td>
</tr>
</tbody>
</table>

According to the 2012-2025 Strategic Plan of the SUS Board of Governors:

(http://www.fiboa.edu/pressroom/strategicplan.php) Strategic Priorities for a Knowledge Economy includes: Increase student access and success in degree programs in the STEM fields and other areas of strategic emphasis that respond to existing, evolving, and emerging critical needs and opportunities.

According to the 2013-2018 Strategic Plan for USF: Goal 1 includes: Enhance opportunities for all students by providing transformative learning—including an increased commitment to science, technology, engineering and mathematics and health fields—that is intellectually, scientifically and technologically sound and produces relevant applied skills and engaged outcomes.

The proposed degree program is strongly aligned with these goals and priorities.

1. It will increase access to STEM degrees as it opens up new avenues; biomedical engineering encompasses all four STEM disciplines
2. It will increase production of USF graduates in STEM areas
3. It will meet the goals of creating a workforce trained to meet the challenges of the 21st century, especially those dealing with an aging population and American Health Care Crisis
4. It will lead to increased retention of our brightest and best students who often have to go out of state in order to satisfy their desire to be part of this important field.

4. How does this program support the institutional, USF System, and SUS Strategic Plans?

5. Does this program offer collaborative and/or interdisciplinary opportunities at other institutions in the USF and SUS systems? If so, what efforts have been made to initiate collaboration?
Appendix D

By its nature, Biomedical Engineering is an interdisciplinary subject and involves many branches of science, mathematics/statistics and engineering.

We have initiated discussions with other departments within and outside the College of Engineering regarding cooperation and collaboration in not only course offerings but also in technology transfer and research. Many of the faculty in CHBME are already involved in research and course collaborations with Moffitt Cancer Center, College of Medicine, Johnnie Byrd Alzheimer’s Research Center, College of Public Health, College of Behavioral & Community Sciences, and College of Pharmacy.

The first two years of this program is primarily focused on science and mathematics courses. We will draw from courses currently offered by departments of Biology, Chemistry, Physics and Mathematics to fulfill these requirements. Community college transfer students can fulfill these requirements before they transfer to USF. Due to the large enrollments in these courses at USF, the addition of BS BME will have only a minimal impact on the system.

A key feature will be to integrate all aspects of the American Medical Assoc. requirements for admission to US Medical Schools into our undergraduate BME curriculum, to ensure that the process is seamless for those USF students wishing to attend medical school.

6. Provide information on the available resources and capacity for your program. In your response, include faculty availability and student support resources including the library. How will department/college resources be shifted to support the program?

The Department of Chemical and Biomedical Engineering has added a number of full-time faculty (8 in total) over the last few years, nearly doubling the faculty size over the last 10 years, while we were building up the graduate research and educational programs in Biomedical Engineering (MS, PhD).

Simultaneously, many of the other departments in the college have added new faculty in this fast growing area of research and development, thus allowing the College to expand its portfolio of courses in Biomedical Engineering.

This growth, combined with the fact that the undergraduate BME program has overlap with the traditional chemical engineering courses taught by our faculty, allows us to take advantage of the existing faculty resources to fulfill many of the course needs.

As shown in the attached course requirements for the BS-BME program, we have identified that the program will require only 8 new courses to be added. Some of these courses can be taught by existing faculty. We estimate that with the addition of two instructors we can meet the additional teaching load.

The library resources required for the program is already in place, since we have developed a strong graduate research and teaching program in biomedical engineering over the last 15 years.

We anticipate that we will need to add one full time staff member to assist with student advising, registration and other curricular and ABET accreditation needs.
Appendix D

7. Please list the Student Learning Outcomes for the program (undergraduate programs must comply with BOG Regulation 8.016 “Academic Learning Compacts”).

See attached.
Appendix: Academic Learning Compact

Bachelor of Science Degree in Biomedical Engineering

Program Mission Statement

The mission of the College of Engineering at the University of South Florida is to improve the quality of life in our community by:

- Providing a high quality education for our students and practicing professionals
- Creating new knowledge and solving real world problems via innovative research and technology transfer development
- Engaging in effective community service and outreach.

Expanding on this, the mission of the BS in Biomedical Engineering Program includes:

- Provide a broad education that encompasses engineering, mathematics and basic sciences targeted at advanced health care and biotechnology;

Program Educational Objectives

1. Produce graduates who will be able demonstrate their professional engineering competence in their chosen career by holding positions of increasing responsibility in industry, government, educational institutions or private practice
2. Produce graduates who will be able to use their broad educational background to foster communications across professional and disciplinary boundaries.
3. Produce graduates who continue to improve their professional skills, knowledge and understanding through continuing their education, pursuit of advanced degrees and/or pursuit of professional licenses in their chosen profession.

Expected Student Outcomes: Graduate of the Program must demonstrate the following:

A. Discipline Specific Knowledge and Skills

Outcome 1: Prior to graduation, the student in this program must demonstrate an ability to design a system, component, product or process related to the biomedical applications
Outcome 2: Prior to graduation the student must demonstrate ability to apply knowledge of science, mathematics and engineering
Outcome 3: Prior to graduation, the student must demonstrate an ability to design and conduct experiments as well as analyze data

B. Critical Thinking Skills
Appendix D

Outcome 1: Prior to graduation the student will demonstrate an ability to design a system, component, product or process to related to medical applications, while taking into account economic, environmental, social, political, ethical, safety, manufacturability and sustainability constraints.

C. Communication Skills

Outcome 1: Prior to graduation, the student must demonstrate an ability to communicate effectively.
Appendix D

Proposed USF Biomedical Engineering (BME), BSBME, 127 hours

The schedule that follows indicates the required courses for this degree program and the recommended sequence of registration for full-time engineering students. Students who adhere to the recommended sequence of courses, and complete each course with the required grade, will be fully prepared for each subsequent semester. Registration assistance will be provided by academic advisors in the College of Engineering.

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fall Semester - Year 1</td>
<td></td>
</tr>
<tr>
<td>CHM 2045 General Chemistry I</td>
<td>3</td>
</tr>
<tr>
<td>CHM 2045L General Chemistry I Laboratory</td>
<td>1</td>
</tr>
<tr>
<td>EGN 3020 Foundations of Engineering</td>
<td>1</td>
</tr>
<tr>
<td>ENC 1101 Composition I</td>
<td>3</td>
</tr>
<tr>
<td>MAC 2281 Engineering Calculus I</td>
<td>4</td>
</tr>
<tr>
<td>XXX XXXX Fine Arts Elective</td>
<td>3</td>
</tr>
<tr>
<td><strong>Total 15</strong></td>
<td></td>
</tr>
<tr>
<td>Spring Semester - Year 1</td>
<td></td>
</tr>
<tr>
<td>CHM 2046 General Chemistry II</td>
<td>3</td>
</tr>
<tr>
<td>CHM 2046L General Chemistry II Laboratory</td>
<td>1</td>
</tr>
<tr>
<td>ENC 1102 Composition II</td>
<td>3</td>
</tr>
<tr>
<td>MAC 2282 Engineering Calculus II</td>
<td>4</td>
</tr>
<tr>
<td>PHY 2048 General Physics I</td>
<td>3</td>
</tr>
<tr>
<td>PHY 2048L General Physics I Laboratory</td>
<td>1</td>
</tr>
<tr>
<td><strong>Total 15</strong></td>
<td></td>
</tr>
<tr>
<td>Fall Semester - Year 2</td>
<td></td>
</tr>
<tr>
<td>EGN 3443 Engineering Statistics I</td>
<td>3</td>
</tr>
<tr>
<td>MAC 2283 Engineering Calculus III</td>
<td>4</td>
</tr>
<tr>
<td>PHY 2049 General Physics II</td>
<td>3</td>
</tr>
<tr>
<td>PHY 2049L General Physics II Laboratory</td>
<td>1</td>
</tr>
<tr>
<td>XXX XXXX Social and Behavioral Sciences Elective</td>
<td>3</td>
</tr>
<tr>
<td>XXX XXXX Humanities Elective</td>
<td>3</td>
</tr>
<tr>
<td><strong>Total 17</strong></td>
<td></td>
</tr>
<tr>
<td>Spring Semester - Year 2</td>
<td></td>
</tr>
<tr>
<td>BME 4100 Introduction to Biomedical Engineering</td>
<td>3</td>
</tr>
<tr>
<td>EGN 3343 Thermodynamics I</td>
<td>3</td>
</tr>
<tr>
<td>EGN 3433 Modeling and Analysis of Engineering Systems (or MAP 2302 Differential Equations)</td>
<td>3</td>
</tr>
<tr>
<td>XXX XXXX Social and Behavioral Sciences Elective</td>
<td>3</td>
</tr>
<tr>
<td>BSC 2010 Biology I</td>
<td>3</td>
</tr>
<tr>
<td>BSC 2010L Biology Lab I</td>
<td>1</td>
</tr>
<tr>
<td><strong>Total 16</strong></td>
<td></td>
</tr>
<tr>
<td>Summer Term - Year 2</td>
<td></td>
</tr>
<tr>
<td>CHM 2210 Organic Chemistry I</td>
<td>3</td>
</tr>
<tr>
<td>CHM 2210L Organic Chemistry Laboratory I</td>
<td>2</td>
</tr>
<tr>
<td>FNC 3245 Communications for Engineers</td>
<td>3</td>
</tr>
<tr>
<td><strong>Total 8</strong></td>
<td></td>
</tr>
<tr>
<td>Fall Semester - Year 3</td>
<td></td>
</tr>
<tr>
<td>BME XXXX Biomechanics</td>
<td>3</td>
</tr>
<tr>
<td>BMEXXXX Fluid flow, Heat and Mass Transfer for BME</td>
<td>4</td>
</tr>
</tbody>
</table>
### Appendix D

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Name</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>ECH 4845</td>
<td>Num. Meth. in Chemical &amp; Biomedical Engineering</td>
<td>4</td>
</tr>
<tr>
<td>BSC 2011</td>
<td>Biology II</td>
<td>3</td>
</tr>
<tr>
<td>BSC 2011L</td>
<td>Biology II Lab</td>
<td>1</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>15</td>
</tr>
</tbody>
</table>

**Spring Semester - Year 3**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Name</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHM 2211</td>
<td>Organic Chemistry II</td>
<td>3</td>
</tr>
<tr>
<td>CHM 2211L</td>
<td>Organic Chemistry II Laboratory</td>
<td>2</td>
</tr>
<tr>
<td>BME 4503</td>
<td>Biomedical Instrumentation</td>
<td>3</td>
</tr>
<tr>
<td>BME xxxx</td>
<td>Physiology for Engineers I</td>
<td>3</td>
</tr>
<tr>
<td>XXX XXXX</td>
<td>Humanities Elective</td>
<td>3</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>14</td>
</tr>
</tbody>
</table>

**Fall Semester - Year 4**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Name</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>BME xxxx</td>
<td>BME Lab</td>
<td>3</td>
</tr>
<tr>
<td>BME xxxx</td>
<td>Physiology for Engineers II</td>
<td>3</td>
</tr>
<tr>
<td>BME xxxx</td>
<td>BME Design I</td>
<td>3</td>
</tr>
<tr>
<td>EMA 4003</td>
<td>Introduction to Materials Science</td>
<td>3</td>
</tr>
<tr>
<td>XXX XXXX</td>
<td>Science or Engg Upper-Level Elective</td>
<td>3</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>15</td>
</tr>
</tbody>
</table>

**Spring Semester - Year 4**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Name</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>BME xxxx</td>
<td>BME Design II</td>
<td>3</td>
</tr>
<tr>
<td>BME Upper level Electives</td>
<td></td>
<td>6</td>
</tr>
<tr>
<td>XXX XXXX</td>
<td>Human Cultural Diversity /Global Context Elective</td>
<td>3</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>12</td>
</tr>
</tbody>
</table>

Total 127 hours

**Bold** indicates new courses to be developed and added

**Italics** indicates courses to be redesigned
### Appendix D

Existing faculty with Biomedical Engineering Research and Education Interests

<table>
<thead>
<tr>
<th>Name</th>
<th>Rank</th>
<th>Research Interests</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dr. Norma Alcantar</td>
<td>Associate</td>
<td>Micellar Surfactants, Nanoparticles, Organic/Inorganic Thin Films, Drug Delivery, Pathology of Alzheimer's Disease</td>
</tr>
<tr>
<td>Dr. Venkat Bhethanabota</td>
<td>Chair, Professor</td>
<td>Chemical and Biological Sensors, Plasmonics, Computational Catalysis</td>
</tr>
<tr>
<td>Dr. Scott W. Campbell</td>
<td>Professor</td>
<td>Phase Equilibria, Environmental Modeling</td>
</tr>
<tr>
<td>Dr. Robert Frisina, Jr.</td>
<td>Professor</td>
<td>Neuroengineering: Sensory Systems; Drug Delivery</td>
</tr>
<tr>
<td>Dr. Richard Gilbert</td>
<td>Professor</td>
<td>Florida Technical Education Curriculum Reform; Instrumentation and Controls; Cancer Treatment</td>
</tr>
<tr>
<td>Dr. Yogil Goswami</td>
<td>Professor</td>
<td>Energy Conversion, Solar Energy, Hydrogen Energy and Fuel Cells, Thermodynamics and Heat Transfer, HVAC</td>
</tr>
<tr>
<td>Dr. Vinay K. Gupta</td>
<td>Professor</td>
<td>Self-Assembly Materials, Surface and Interfacial Science</td>
</tr>
<tr>
<td>Dr. Mark Jaroszestki</td>
<td>Associate</td>
<td>Gene and Drug Delivery by Electroporation, Corona Charge, and Plasmas</td>
</tr>
<tr>
<td>Dr. Babu Joseph</td>
<td>Professor</td>
<td>Modeling, Simulation, Biomass Conversion, Photocatalysis, Biofluidics</td>
</tr>
<tr>
<td>Dr. Piyush Koria</td>
<td>Assistant</td>
<td>Tissue Engineering &amp; Regenerative Medicine, Nanomedicine, Biomaterials, Wound Healing</td>
</tr>
<tr>
<td>Dr. John Kuhn</td>
<td>Professor</td>
<td>Heterogeneous Catalysis, Materials Chemistry, Chemical Separations</td>
</tr>
<tr>
<td>Dr. William Lee</td>
<td>Professor</td>
<td>Basic, applied and forensic biomechanics; psychology of medical procedures, engineering education</td>
</tr>
<tr>
<td>Dr. George Philippidis</td>
<td>Associate</td>
<td>Biomass and Biofuel Engineering</td>
</tr>
<tr>
<td>Dr. Christopher Passaglia</td>
<td>Associate</td>
<td>Neuroengineering, Visual and Computational Neuroscience, Glaucoma</td>
</tr>
<tr>
<td>Dr. Anna Pyat</td>
<td>Professor</td>
<td>Bio-photonics, Advanced Material and Devices, Nanotechnology, New Biomedical Instruments, Sensors</td>
</tr>
<tr>
<td>Dr. Aydin K. Sunol, PE</td>
<td>Professor</td>
<td>Process and Product Systems engineering, Green Chemistry and Engineering, Supercritical fluids</td>
</tr>
<tr>
<td>Dr. Rong Tong (starts Fall '13)</td>
<td>Assistant</td>
<td>Biomaterials, Drug Delivery</td>
</tr>
<tr>
<td>Dr. Ryan Toomey</td>
<td>Associate</td>
<td>Biomacromolecule and Polymer Science, Tissue Engineering Scaffolds</td>
</tr>
</tbody>
</table>

**Adjunct Faculty**

<table>
<thead>
<tr>
<th>Name</th>
<th>Rank</th>
<th>Research Interests</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dr. David Eddins</td>
<td>Associate Professor</td>
<td>Auditory Perception and Hearing Enhancement Technology &amp; Signal Processing</td>
</tr>
<tr>
<td>Dr. Alberto Sagues</td>
<td>Professor</td>
<td>Corrosion of Engineering Materials</td>
</tr>
<tr>
<td>Dr. Joseph Walton</td>
<td>Professor</td>
<td>Neural Substates of Auditory Processing using Multi-electrode Arrays in Normal and Disease States</td>
</tr>
<tr>
<td>Dr. Robert Frisina, Sr.</td>
<td>Research Professor</td>
<td>Neuroengineering: Sensory Systems</td>
</tr>
<tr>
<td>Dr. Richard Connolly</td>
<td>Research Professor</td>
<td>Gene and Drug Delivery by Electroporation, Corona Charge,</td>
</tr>
</tbody>
</table>

*Commentary (red):* Is he still at USF?  

Other COE faculty with Biomedical Research Interests
### Appendix D

List of courses currently offered in Biomedical Engineering (Spring 2013)

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Section</th>
<th>Type</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>BME 4100</td>
<td>001</td>
<td>Class Lecture</td>
<td>Intro Biomedical Engineering*</td>
</tr>
<tr>
<td>BME 6931</td>
<td>797</td>
<td>Class Lecture</td>
<td>System on a Chip</td>
</tr>
<tr>
<td>BME 6931</td>
<td>798</td>
<td>Class Lecture</td>
<td>Biomedical Image</td>
</tr>
<tr>
<td>BME 4406</td>
<td>001</td>
<td>Class Lecture</td>
<td>Engineer of Biological</td>
</tr>
<tr>
<td>BME 6000</td>
<td>901</td>
<td>Class Lecture</td>
<td>Biomedical Eng 3</td>
</tr>
<tr>
<td>BME 6107</td>
<td>001</td>
<td>Class Lecture</td>
<td>Biomaterials &amp; Material</td>
</tr>
<tr>
<td>BME 6420</td>
<td>001</td>
<td>Class Lecture</td>
<td>Human Sensory Processes</td>
</tr>
<tr>
<td>BME 6931</td>
<td>001</td>
<td>Class Lecture</td>
<td>Biomedical Image</td>
</tr>
<tr>
<td>BME 6931</td>
<td>002</td>
<td>Class Lecture</td>
<td>System on a Chip</td>
</tr>
<tr>
<td>BME 6931</td>
<td>003</td>
<td>Class Lecture</td>
<td>Biomedical Engineering II</td>
</tr>
<tr>
<td>BME 6931</td>
<td>004</td>
<td>Class Lecture</td>
<td>Modern Biomed Technologies</td>
</tr>
<tr>
<td>BME 6931</td>
<td>006</td>
<td>Class Lecture</td>
<td>Bioelectronics</td>
</tr>
<tr>
<td>BME 4440</td>
<td>001</td>
<td>Class Lecture</td>
<td>Intro to Bioastronautics</td>
</tr>
</tbody>
</table>

### Fall 2012

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Section</th>
<th>Type</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>BME 4100</td>
<td>001</td>
<td>Class Lecture</td>
<td>Intro Biomedical Engineering*</td>
</tr>
<tr>
<td>BME 6931</td>
<td>799</td>
<td>Class Lecture</td>
<td>Biomedical Sys. &amp; Pat.</td>
</tr>
<tr>
<td>BME 5320</td>
<td>001</td>
<td>Class Lecture</td>
<td>Theory &amp; Design of Bioprocess</td>
</tr>
<tr>
<td>BME 6000</td>
<td>001</td>
<td>Class Lecture</td>
<td>Biomedical Engineering</td>
</tr>
<tr>
<td>BME 6634</td>
<td>001</td>
<td>Class Lecture</td>
<td>Biotransport Phenomena</td>
</tr>
<tr>
<td>BME 6931</td>
<td>002</td>
<td>Class Lecture</td>
<td>Bioelectricity</td>
</tr>
<tr>
<td>BME 6931</td>
<td>001</td>
<td>Class Lecture</td>
<td>Cell and Tissue Engineering</td>
</tr>
</tbody>
</table>

*Former Course #: ECH 4931*
I. PURPOSE & INTENT

According to the University of South Florida System's (USF System) established Principles of Shared Governance, organizational restructuring of academic units within member institutions of the USF System shall be implemented only after open dialogue and review among faculty and administration.

II. STATEMENT OF POLICY

In particular, any policy and procedure shall ensure that the academic unit(s) most affected by a proposed major restructuring shall be afforded the first opportunity to review and report their recommendations. Those recommendations shall then be reported to and reviewed by the Faculty Senate or equivalent representative body of that member institution, which will assess the effectiveness of the procedures followed, review the implications for the entire institution, and make a recommendation to the institution’s administration.

Simultaneously, the USF System Faculty Council (SFC) will review the implications for the entire System, and make a recommendation to the Provost and Executive Vice President of the University of South Florida System. All stages of the review process shall be completed expeditiously, within ninety (90) days of the initial proposal.

III. DEFINITIONS OF TERMS

Major organizational restructuring is defined as any creation, dissolution, merger, or separation of academic departments, schools, or colleges. Proposals for such restructuring must include a written proposal submitted through the dean's office to the Provost and Executive Vice President of the University of South Florida System and/or the chief
academic officer (regional vice chancellor for academic affairs) of a member institution and/or the Senior Vice President for USF Health (if the proposal is in USF Health), and will include at a minimum:

A. A description of the proposed changes.
B. A rationale for the changes.
C. A reasonable statement of the financial and budgetary implications of the changes.
D. An examination of the likely consequences of the changes at the college/school, institution, and USF System levels, as well as any regional or societal implications.
E. A clear and specific timeline for the implementation of the changes.
F. A brief description of the nature of preliminary consultations with the academic entities affected by the changes, including a summary of the responses. This will normally report on discussion at the level of the college and/or department/school, depending on the entity most affected.

IV. PROCESS STEPS

- Each member institution of the USF System will adopt the following procedures: The Faculty Council (or equivalent) of the most affected college(s) or school(s) will receive the proposal from the initiating dean. In institutions without a representative body at that level, the Faculty Senate will receive the proposal.

- The proposal will be discussed at the next meeting of the receiving body. Members of affected academic entities will be invited in advance to comment in writing. The body may vote to recommend the proposal or to request further information and continue discussion at a second meeting.

- If necessary, and in case of emergency action, the president of any affected faculty governance body and/or the Provost and Executive Vice President of the University of South Florida System and/or the chief academic officer of a member institution (regional vice chancellor for academic affairs) and/or the Senior Vice President for USF Health (if the proposal is in USF Health) may call special meetings to expedite the process, including during summer months.

- The restructuring proposal, together with any commentary or recommendation from the Faculty Council (or equivalent), will be forwarded at the same time to the Faculty Senate of the affected member institution (unless the Senate was the initial receiving body) and to the SFC, with a copy to the initiating dean. These two bodies will report to the institution's administration and/or the Senior Vice President for USF Health (if the proposal is in USF Health), with a copy to the Provost and Executive Vice President of the University of South Florida System.
and the initiating dean on: a) the sufficiency of consultation, and b) the implications of the proposed changes at the institution and system levels.

- The entire process, from receipt of the proposal by the Faculty Council (or equivalent), and ending with submission of the final report to the institution’s administration, shall take no more than ninety (90) days.

It is mutually recognized that the administration holds ultimate authority and responsibility for determining the most appropriate academic structure and organization within the University, including Sec. 447.209, Florida Statutes, while the Faculty Councils, Faculty Senates, and the SFC are bound to fulfill their responsibility as advisors on academic affairs to the USF System’s and the institution’s administrations.

Authorized and signed by:

Ralph Wilcox, Provost and Executive Vice President
Judy Genshaft, President
## Biomedical Engineering Financial Proposal

**College of Engineering & Morsani College of Medicine**

**Statement of Cash Flows (Estimates)**

<table>
<thead>
<tr>
<th>Year</th>
<th>Cash Flows from Operating Activities</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Student Tuition and Fees</td>
<td>$ -</td>
<td>$ 1,138,494</td>
</tr>
<tr>
<td>Headcount - Undergraduate (Resident)</td>
<td>$ -</td>
<td>$ 210,758</td>
</tr>
<tr>
<td>Headcount - Undergraduate (Non-Resident)</td>
<td>$ -</td>
<td>$ 2,000,000</td>
</tr>
<tr>
<td>Headcount - Masters (Resident)</td>
<td>$ -</td>
<td>$ 175,000</td>
</tr>
<tr>
<td>Headcount - Masters (Non-Resident)</td>
<td>$ -</td>
<td>$ 120,000</td>
</tr>
<tr>
<td>Headcount - Doctorate (Resident)</td>
<td>$ -</td>
<td>$ 120,000</td>
</tr>
<tr>
<td>Headcount - Doctorate (Non-Resident)</td>
<td>$ -</td>
<td>$ 120,000</td>
</tr>
<tr>
<td>Course Fees</td>
<td>$ -</td>
<td>$ 210,000</td>
</tr>
<tr>
<td>State Appropriations (LRR or Performance Funding)</td>
<td>$ -</td>
<td>$ -</td>
</tr>
<tr>
<td>Practice Plan Net Revenue</td>
<td>$ -</td>
<td>$ -</td>
</tr>
<tr>
<td>Faculty Salary Savings from Grants</td>
<td>$ -</td>
<td>$ -</td>
</tr>
<tr>
<td>F&amp;A Disbursement</td>
<td>$ -</td>
<td>$ 618,750</td>
</tr>
<tr>
<td>IP</td>
<td>$ -</td>
<td>$ -</td>
</tr>
<tr>
<td>Total Cash Inflow</td>
<td>$ -</td>
<td>$ 1,752,244</td>
</tr>
</tbody>
</table>

### Less:

- **Faculty Instructional Costs**
  - Chair & Professor: $ -
  - Professor: $ -
  - Assoc Professor: $ -
  - Assistant Professor: $ -
  - Instructor: $ -
  - Adjunct: $ -
- **Administration Costs**
  - Administration: $ -
- **Lab Tech**
  - Graduate Assistants (0.5 FTE)
- **Benefits**
- **Tuition Waivers**
- **Computers/Supplies Expense**
- **Furniture**
- **Other**

**Total Cash Outflow**

|      | $ (319,000) | $ (2,224,814) | $ (4,951,714) | $ (2,986,935) | $ (2,208,044) | $ (3,630,989) | $ (14,483,766) |

**Net Cash Flows from Operating Activities**

|      | $ (319,000) | $ (474,572) | $ (166,192) | $ 4,463,692 | $ 4,891,113 | $ 5,741,800 | $ 14,091,206 |

### Cash Flows from Investing Activities

- **Research Start-ups**
- **Initial Investment in Facilities**
- **Facilities Lease**
  - Equipment - Instructional: $ (300,000)
- **Equipment - Research**
- **Equipment Replacement Costs**

**Total Cash Flows from Investing Activities**

|      | $ (462,951) | $ (2,560,952) | $ (2,610,925) | $ (2,770,925) | $ (3,010,925) | $ (12,927,995) |

### Cash Flow

|      | $ (571,951) | $ (2,435,647) | $ (2,217,417) | $ 1,792,183 | $ 2,120,188 | $ 2,725,675 | $ 1,373,608 |
Assumptions:
Tuition Assumptions: Calculated on earned tuition and 70% of differential tuition
Student Credit Hours: Based on enrollment metrics from College of Engineering
Student Headcount Growth Rate: Based on having 250 undergrads, 100 masters, and 45 PhD by Yr. 5
Course Fees: Calculated at $50 fee per a credit hour (Undergrad 2 credits for 2 courses; masters 1 course at 2 credit hrs.)
LBR: Plan to submit $3.5LBR for recurring support or receive revenue from performance funding
Practice Plan: Plan to hire 2 procedure based MD's and revenue after salary expense will flow to dept. (Exempt from Practice Overhead for 5 yrs.)
Faculty Salary Savings: Based on faculty covering add'1 10% of salary as they already need to cover 30% for Summer - Chair covers 50%
F&A Distribution: Based on a 100% return of total earned F&A. (Chair w/ 2 RO1s, xfer faculty w/ 1 RO1, new faculty w/1.25 RO1s
IP Revenue: By year 5 will generate IP revenue for dept.
Personnel & Salaries: Will have 9 ranked xfer faculty, one will be interim chair, then recruit 2 new faculty each yr. starting in yr. 3 and ending in yr. 5 (n=6 new ranked faculty)
Personnel & Salaries: Faculty salaries are based on a typical Engineering faculty 9 month appointment
Personnel & Salaries: Adjunct = 3 classes per a yr. (1 a term) @ $6K ea. = $18K; plus have 2 instructors
Personnel & Salaries: Need 6 new staff (Dept. Administrator, Fiscal Team, Ed Coord, etc.)
Personnel & Salaries: Need 1 Dept. common lab tech
Note: 2% COL for Salaries
Doctoral Students and Tuition Waivers: Estimated that 25% would be TA's and not have tuition funded from grants, other 75% of tuition covered by grants
Computer & Supplies: Estimated amount needed to run dept.
Furniture: Furnish 25,000sqft location
Space: Need approx. 25,000 sqft of office and lab space and plan to lease at $25sqft
Equipment: Need equipment for 2 teaching labs
Start-up: Faculty that transfer into dept. will get a $300K package (package will be paid over 3 yrs.)
Start-up: New faculty will be given a $1.2M package paid over 3 yrs. (this would cover summer salary if needed)
Note: 100% of Revenue returned back to dept. - current depts. may need to continue to fund xfer faculty