FAU
BOARD OF TRUSTEES
Florida Atlantic University

Item: AS: A-1

COMMITTEE ON ACADEMIC AND STUDENT AFFAIRS

Tuesday, February 14, 2023

SUBJECT: REQUEST FOR APPROVAL OF A NEW DEGREE PROGRAM - CIP 14.0501

PROPOSED BOARD ACTION

Request for re-approval of the following New Degree Program – CIP 14.0501

- Bachelor of Science in Biomedical Engineering (B.S.B.M.E.)

BACKGROUND INFORMATION

The objective of the proposed degree program is to produce undergraduates in engineering, medicine or the sciences and/or professional practice as a biomedical engineer, medical systems researcher, medical professional in government or industry.

The proposed B.S. in Biomedical Engineering degree program has four areas of focus: 1 - Biomaterials and Tissue Engineering, 2 - Smart Health Systems, 3 - Bio-Robotics, 4 - Bioimaging and 5 - Bioinformatics. The degree program is the first to offer the Nursing Technologist track and an interface with FAU's artificial intelligence center that will add benefits to the Bio-Robotics and Smart Health system focus areas.

The degree program is intended to meet all requirements for receiving ABET accreditation and be completed with 120 credits. Most of the required classes currently exist and are being offered by the university in other degree programs. The key advantages of the proposed FAU Biomedical Engineering program are:

- All five tracks are easily achievable in 4 years and as a result, the 4-yr graduation rates are expected to be high.
- The program fits the needs and the focus of the region on health-related jobs and issues.
- The tracks are designed for its students to seamlessly continue toward a combined BS/MS in Biomedical Engineering or continue to medical school

IMPLEMENTATION PLAN/DATE

Effective Fall 2023, pending approval by the Florida Atlantic University Board of Trustees.

Fiscal Implications

The degree program uses courses generally taught for other majors to compile its program. These courses are generally offered by the College of Engineering and Computer Science or the College of Science on a regular basis. As a result, there is no need to add resources at the start of the program in the college.

Supporting Documentation: New Degree Proposal Form
Presented by: Dr. Russ Ivy, Vice Provost
Phone: 561-297-2353

STATE UNIVERSITY SYSTEM OF FLORIDA

Board of Governors, State University System of Florida

REQUEST TO OFFER A NEW DEGREE PROGRAM

In Accordance with BOG Regulation 8.011

(Please do not revise this proposal format without prior approval from Board staff)

Florida Atlantic University **Institution Submitting Proposal**	**Spring 2023** **Proposed Implementation Term**
College of Engineering and Computer Science **Name of College(s) or School(s)**	**Dean's Office of the College of Engineering and Computer Science** **Name of Department(s)/Division(s)**
Biomedical Engineering **Academic Specialty or Field**	**Bachelor of Science in Biomedical Engineering (B.S.B.M.E.)** **Complete Name of Degree**
14.0501 **Proposed CIP Code (2020 CIP)**	

The submission of this proposal constitutes a commitment by the university that, if the proposal is approved, the necessary financial resources and the criteria for establishing new programs have been met prior to the initiation of the program.

Date Approved by the University Board of Trustees	**President's Signature** **Date**
Board of Trustees Chair's Signature **Date**	**Provost's Signature** **Date**

PROJECTED ENROLLMENTS AND PROGRAM COSTS

Provide headcount (HC) and full-time equivalent (FTE) student estimates of majors for Years 1 through 5. HC and FTE estimates should be identical to those in Table 1 in Appendix A. Indicate the program costs for the first and the fifth years of implementation as shown in the appropriate columns in Table 3 in Appendix A. Calculate an Educational and General (E&G) cost per FTE for Years 1 and 5 (Total E&G divided by FTE).

Implementation Timeframe	HC	FTE	E&G Cost per FTE	E&G Funds	Contract & Grants Funds	Auxiliary/ Philanthropy Funds	Total Cost
Year 1	10	8	$8,680	$69,443	0	0	$69,443
Year 2	25	20					
Year 3	50	40					
Year 4	75	60					
Year 5	100	80	$2,680	$214,388	0	0	$214,388

*Note: This outline and the questions pertaining to each section **must be reproduced** within the body of the proposal to ensure that all sections have been satisfactorily addressed. Tables 1 through 4 are to be included as Appendix A and not reproduced within the body of the proposals because this often causes errors in the automatic calculations.*

Introduction

I. Program Description and Relationship to System-Level Goals

A. Briefly describe within a few paragraphs the degree program under consideration, including (a) level; (b) emphases, including majors, concentrations, tracks, or specializations; (c) total number of credit hours; and (d) overall purpose, including examples of employment or education opportunities that may be available to program graduates.

The following paragraphs directly address the five areas of concern expressed in this statement:

(a) The objective of the degree program is to produce undergraduates in engineering, medicine or the sciences and/or professional practice as a biomedical engineer, medical systems researcher, medical professional in government or industry.

(b) The proposed new B.S. in Biomedical Engineering degree program has four areas of focus: 1 - Biomaterials and Tissue Engineering, 2 - Smart Health Systems, 3 - Bio-Robotics, 4 - Bioimaging and 5 - Bioinformatics. The proposed Biomedical Engineering degree program is the first to offer the Nursing Technologist track and an interface with FAU's artificial intelligence center that will add benefits to the Bio-Robotics and Smart Health system focus areas.

(c) The degree program is intended to meet all requirements for receiving ABET accreditation and be completed with 120 credits. Most of the required classes currently exist and are being offered by the university in other degree programs. The key advantages of the proposed FAU Biomedical Engineering program are:

- All five tracks are easily achievable in 4 years and as a result, the 4-yr graduation rates are expected to be high.
- The program fits the needs and the focus of the region on health-related jobs and issues.
- The tracks are designed for its students to seamlessly continue toward a combined BS/MS in Biomedical Engineering or continue to medical school.

(d) The purpose of the degree program is to supply a host of businesses and organizations with undergraduates with the skill set to help them accomplish their mission. Many of these opportunities will be in medical research and healthcare. For example, this degree program will exist at the cross-section the FAU Brain Institute (I-Brain) and the FAU Biomedical Research Institute (I-Heal) and will encompass tools developed by FAU's Sensing and Smart Systems pillar and the artificial intelligence center in the College of Engineering and Computer Science. There are opportunities with the Max Planck Institute on the Jupiter campus for research in the medical industry.

Per Marquette University (https://www.marquette.edu/explore/what-can-you-do-with-a-major-in-biomedical-engineering.php): "Biomedical engineering is an expanding field that is vital to the future of health care in our world." … a BSBME degree "will prepare you for work in a multitude of fields, including:

- Software and hardware engineering
- Medical device industry
- Innovative design and development
- Research and development
- Manufacturing
- Equipment testing and field servicing
- Clinical patient evaluation
- Technical documentation
- Sales
- Hospital equipment selection and support
- Teaching
- Management

- Undergraduate preparation for medicine, dentistry or law

The website further notes that "Approximately half of our biomedical engineering majors go to graduate, medical, dental or law school after graduation." Indeed.com (https://www.indeed.com/career-advice/finding-a-job/biomedical-engineering-companies) identifies the types of industries hiring BSBME graduates are:

- Universities employ biomedical engineers to help their research teams design and test medical tools and equipment. ...
- Research laboratories. ...
- Hospitals. ...
- Pharmaceutical companies. ...
- Medical device manufacturers. ...
- Government agencies. ...
- Software development companies.

Others go straight into the workforce. Table 1 outlines the industries hiring B.S. in Biomedical Engineering graduates from Bureau of Labor Statistics (BLS) data (https://www.bls.gov/oes/current/oes172031.htm). Some will progress to graduate studies in engineering or the medical field.

Table 1 The Industries Hiring Biomedical Engineers (B.S.) and the Associated Annual Wage

Industry	Employment (1)	Percent of industry employment	Hourly mean wage	Annual mean wage (2)
Scientific Research and Development Services	4,840	0.61	$ 50.39	$ 104,820
Medical Equipment and Supplies Manufacturing	2,480	0.78	$ 48.67	$ 101,230
Pharmaceutical and Medicine Manufacturing	1,300	0.41	$ 51.56	$ 107,240
Navigational, Measuring, Electromedical, and Control Instruments Manufacturing	1,270	0.32	$ 56.19	$ 116,880
Professional and Commercial Equipment and Supplies Merchant Wholesalers	1,110	0.17	$ 47.66	$ 99,140

The BLS notes that Florida is among the top 10 states for Biomedical engineering positions (see Figure 1), with southeast Flroida being among the highest in the county (see Figure 2).

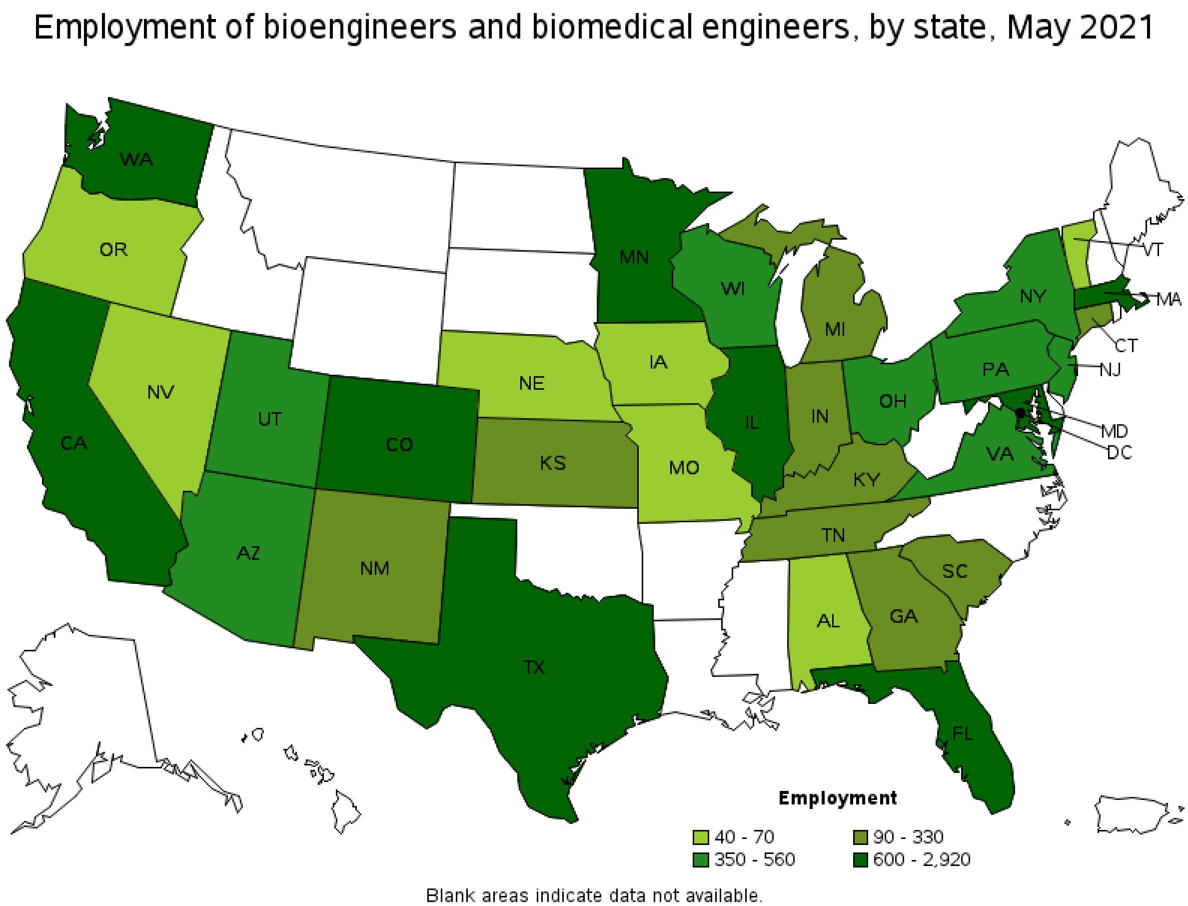

Figure 1 States with the highest employment level in Bioengineers and Biomedical Engineers

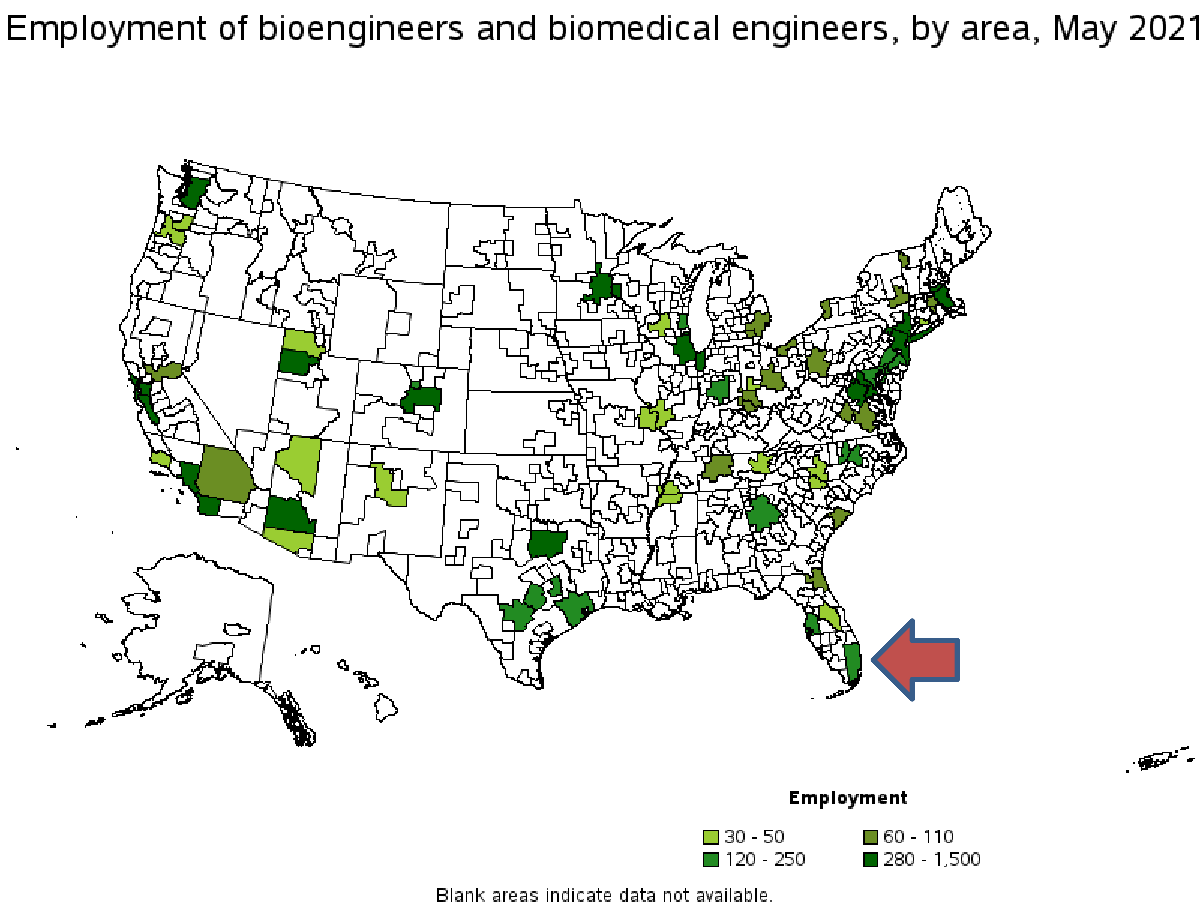

Figure 2 Metropolitan areas with the highest employment level in Bioengineers and Biomedical Engineers:

Typical Employers of Biomedical Engineers of Florida ([Biomedical Engineer salary in Florida (indeed.com)]- advertised positions are:

Guardant Health	$130,000 per year
Comtec	$122,110 per year
Pfizer	$117,656 per year
Engineering Resource Group	$117,172 per year
Department of Health and Human Services	$109,856 per year
US Air Force	$107,820 per year
United States Department of Defense	$103,811 per year
Analog Devices	$ 98,023 per year
Veterans Engineering	$ 96,511 per year
US Department of Veterans Affairs	$ 95,445 per year

With respect to B.S. in Biomedical Engineering degree starting salaries for graduates with no experience, the salaries from Zip Recruiter indicate the average in SE Florida is $56,576 (see Figure 3). Table 3 shows variations across different communities.

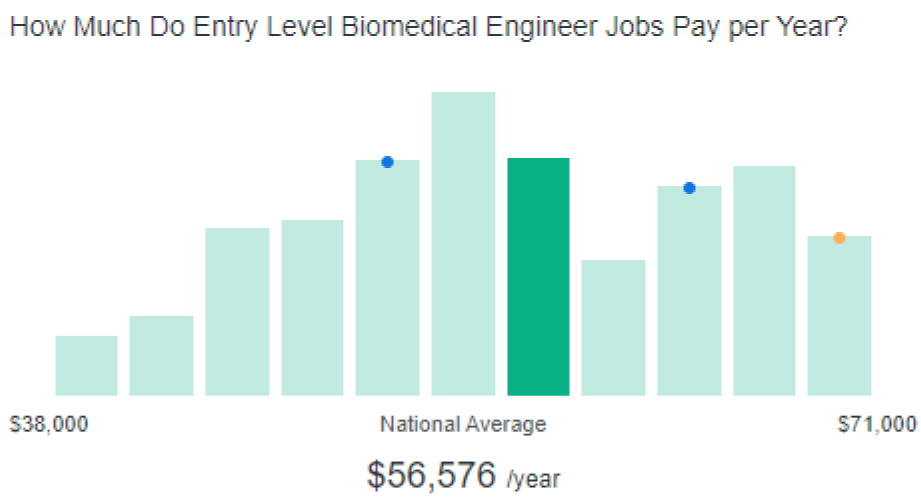

Figure 3-

Figure 3 Average BSBME undergraduate Starting Salary – SE Florida (https://www.ziprecruiter.com/Jobs/Entry-Level-Biomedical-Engineer_)

Table 3 Annual starting Salaries for Biomedical Engineering undergraduates students (Ziprecuiter.com)

City	Annual Salary	Hourly Wage
Coral Springs	$56,291	$27.06
Miami Gardens	$56,124	$26.98
Jacksonville	$56,043	$26.94
Sunrise	$55,547	$26.71
Miramar	$55,376	$26.62
Pompano Beach	$55,309	$26.59
Orlando	$55,268	$26.57
Port St. Lucie	$55,225	$26.55
Palm Bay	$55,218	$26.55

B. Please provide the date when the pre-proposal was presented to CAVP (Council of Academic Vice Presidents) Academic Program Coordination review group. Identify any concerns that the CAVP review group raised with the pre-proposed program and provide a brief narrative explaining how each of these concerns has been or is being addressed.

The degree proposal was presented on 9/2/2021 and approved with no issues raised. FIU suggested collaboration on biomaterials before the meeting, which FAU is interested in doing. FAU's Dean for Engineering and Computer Science had a discussion with FIU's Dean after the meeting in the Fall 2021, and prior to preparation of this proposal. The concept would be to offer the opportunity for our students and theirs to take biomaterials classes that meet student needs at either institution up to 6 cr.

C. If this is a doctoral level program please include the external consultant's report at the

end of the proposal as Appendix D. Please provide a few highlights from the report and describe ways in which the report affected the approval process at the university.

This proposal is for a B.S. in Biomedical Engineering. FAU currently has a MS in Biomedical Engineering and discussions with the medical schools suggests that a pipeline for undergraduates to either college is of interest. Our degree program has been developed to substantially comply with the requirements for admission to medical school upon graduation with the B.S. in Biomedical Engineering if that is the student's desire.

D. Describe how the proposed program is consistent with the current State University System (SUS) Strategic Planning Goals. Identify which specific goals the program will directly support and which goals the program will indirectly support (see link to the SUS Strategic Plan on the resource page for new program proposal).

The biomedical engineering degree is a degree is a program of Strategic Emphasis per the BOG September 2020 meeting - 14.0501 Bioengineering and Biomedical Engineering. The proposed B.S. in Biomedical Engineering program meets this strategic goal.

In reviewing the 2025 System Strategic Plan (amended October, 2019 - https://www.flbog.edu/wp-content/uploads/2025_System_Strategic_Plan_2019.pdf) the BOG indicates that Florida must have well-educated citizens who are working in diverse fields, from science and engineering to medicine and bioscience to computer science, the arts, and so much more. The proposed B.S. in Biomedical Engineering program supports this strategic goal as the degree will include facets of science, engineering, medicine, bioscience and computer science.

In addition, specific university goals were set to increase the number of graduates with degrees in the science, technology, engineering, and math (STEM) fields. The proposed B.S. in Biomedical Engineering program supports this strategic goal as all students will be STEM (Engineering) graduates.

The 2025 System Strategic Plan notes that the Board of Governors are committed to a deliberate strategy to increase the number of undergraduate and graduate degrees in science, technology, engineering, and mathematics (STEM) and health and other Programs of Strategic Emphasis disciplines. The proposed B.S. in Biomedical Engineering program supports this strategic goal as all students will be Degrees in STEM.

In reviewing the 2025 System Strategic Plan, the B.S. in Biomedical Engineering program at FAU would meet with 5 of the strategic performance indicators.

Strategic Performance Indicator 18 is the number and percent of bachelor's degrees in programs of strategic emphasis. This metric is based on the number and percentage of baccalaureate and graduate degrees awarded within the programs designated by the Board of Governors as 'Programs of Strategic Emphasis.' The proposed B.S. in Biomedical Engineering program supports this strategic goal as all students will be Degrees in STEM and Health.

Strategic Performance Indicator 19 is the number and percent of bachelor's degrees in STEM and health. This metric is based on the number and percentage of baccalaureate degrees that are classified as STEM or health disciplines by the Board of Governors in the Academic Program Inventory. The proposed B.S. in Biomedical Engineering program supports this strategic goal as all students will be Degrees in STEM and Health.

Strategic Performance Indicator 24 is the percent of undergraduates engaged in research: The concept focuses on the number of graduating seniors who completed an honors thesis, worked on their own research and/or creative activity topic with the guidance of a faculty member, worked on research with a faculty member (individually or jointly), submitted an article or research for publication or exhibition, or presented or exhibited research at a professional/academic conference (individually or jointly). The denominator includes graduating seniors who completed the survey. The College of Engineering and Computer Science is extensively engaged in the university's Office or Undergraduate Research and Inquiry, and FAU's award winning undergraduate program that links students with faculty advisors in the pursuit of research. In addition, certain classes offered in the college may be designated as "research intensive." Four such classes, permits the student to receive a research certificate in recognition of their research efforts. All engineering students are encouraged to be involved in some form of research. Hence the proposed B.S. in Biomedical Engineering program supports this strategic goal.

Strategic Performance Indicator 31 is the percent of bachelor's graduates employed and earning $30,000+ or continuing their education (REVISED METRIC 2019). This metric is based on the percentage of a graduating class of bachelor's degree recipients who are enrolled or employed and earning at least $30,000. The proposed B.S. in Biomedical Engineering program will produce graduates, all of whom are expected to exceed this strategic goal.

Strategic Performance Indicator 32 is that the median wages of bachelor's graduates employed full-time one year after graduation (NEW METRIC 2019) exceeds $43,200 based on wage data from the fourth fiscal quarter after graduation for bachelor's recipients. The demand for engineers is significant. As noted in Figure 4, the percent of students getting a job within 6 months of graduating is significant and the average salaries excel $60,000. Hence the proposed B.S. in Biomedical Engineering program fits within this strategic goal will exceed the goal of $43,200.

The strategic plan has a specific goal to increase the number of degrees awarded in stem/health and other programs of strategic emphasis, increase student access and success in degree programs in the STEM/health fields and other Programs of Strategic Emphasis that respond to existing, evolving, and emerging critical needs and opportunities. The proposed B.S. in Biomedical Engineering program supports within this strategic goal.

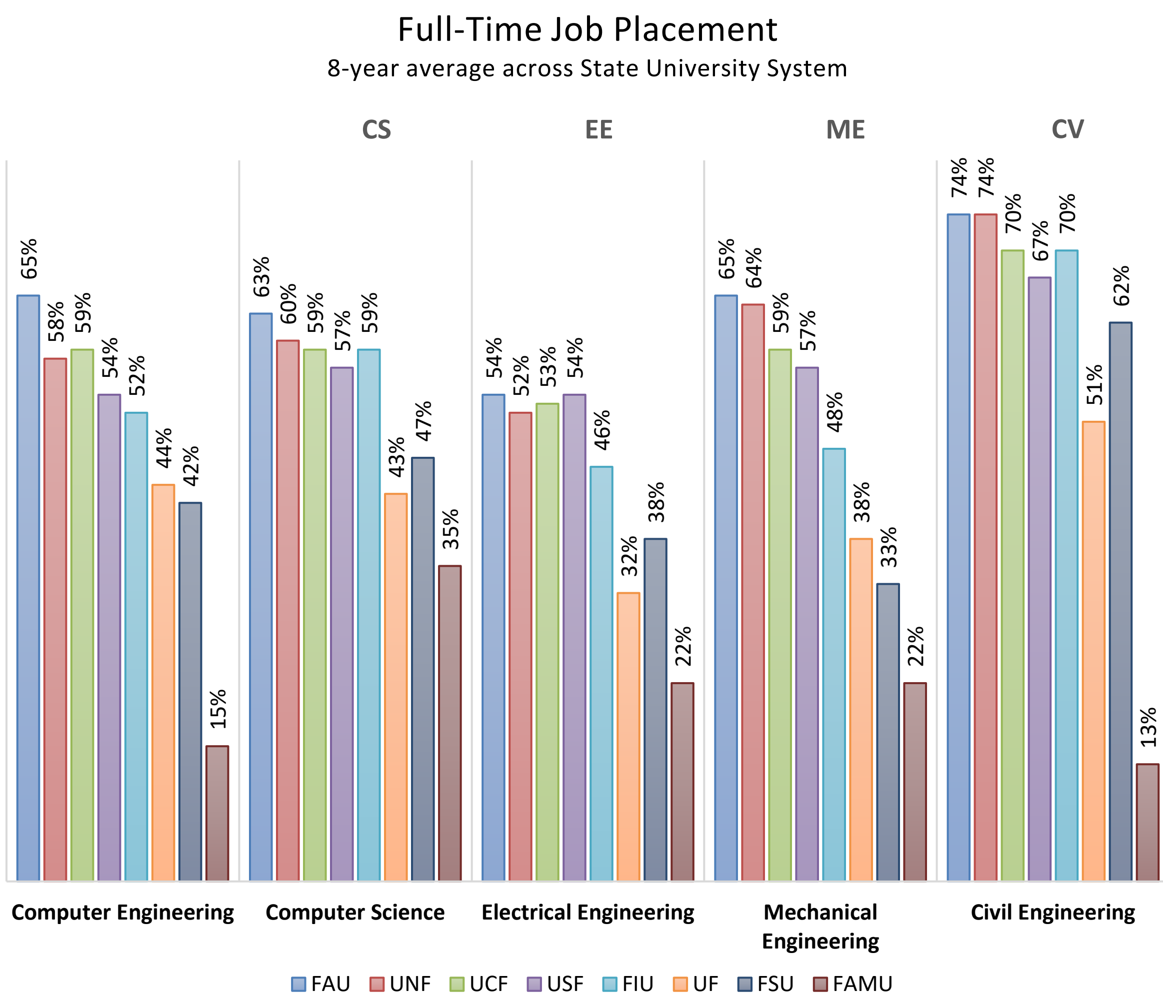

Figure 4 – Current FAU Engineering programs with greater than 10 graduates/year and more

than 10 years of existence. FAU ranks #1 among the SUS schools for securing employment for its engineering graduates (source BOG website).

The Board of Governors continues to expect the state universities to provide academic programs of the highest quality; to produce world-class, consequential research; and to reach out and engage Florida's communities and businesses in a meaningful and measurable way. FAU already has major consequential research initiatives in the medical field through its Brain Institute. A lack of engineering expertise hampers advancement to a degree. The proposed B.S. in Biomedical Engineering program would enhance FAU's efforts to meet this BOG expectation.

Specifically, the Board of Governors will more sharply focus the research agenda for the State University System by identifying the research strengths and priorities and by strengthening research collaboration among the universities. The Board expects state university research endeavors to be directly applicable to Florida's most critical challenges and to more directly lead to commercialization, jobs, and new businesses, with a stronger linkage to local, regional, and state economic development entities. Given that FAU already has major consequential research initiatives in the medical field through its Brain Institute and ongoing technology transfer initiatives via its Tech Runway program, adding undergraduate biomedical engineering expertise would enhance FAU's efforts to meet this BOG expectation and the BOG goals to strengthen the quality and reputation of scholarship, research, and innovation and improve the quality and impact of scholarship, research, and commercialization activities.

E. If the program is to be included in a category within the Programs of Strategic Emphasis as described in the SUS Strategic Plan, please indicate the category and the justification for inclusion. The Programs of Strategic Emphasis Categories are:

- **Economic Development:**

  ☐ Global Competitiveness

  ☒ Science, Technology, Engineering, and Math (STEM)

  Please see the Programs of Strategic Emphasis (PSE) methodology for additional explanations on program inclusion criteria at the resource page for new program proposal.

The biomedical engineering field is one of the fastest growing occupational fields in the United States. The growth of the field has four major driving forces including i) the increasing size of the aging population, ii) the increasing cost of healthcare, iii) the emerging technological revolution in diagnosis & monitoring of individual's health as well as just in time healthcare delivery and iv) the need to develop new solutions to medical challenges. The biomedical engineering field increasingly provides solutions to world health challenges by altering how patients are treated.

Unlike other more established fields, this field is in a constant state of flux mainly due to advances in technology and changes in health challenges. At the forefront of factors that are accelerating the growth of the field is the integration of Artificial Intelligence and Biomedical Devices. A future is envisioned in which the clothing and accessories that we wear will serve as sensors of a multitude of parameters that together with machine learning and AI will enable each individual to detect and address health related issues early and also suggest solutions including prompts to visit medical professionals. Universities and their biomedical engineering programs play the key role in developing these technologies and it is a major source of research from the National Institute of Health and other federal agencies. Development of research at medical schools can be enhanced with biomedical engineering programs on the campus as it provides opportunities to integrate medicine and engineering. Engineers will lead the technological revolution in many areas of the healthcare delivery as the opportunities are limitless and the needs for will continue to proliferate. Universities that position themselves to be contributors to this healthcare revolution will benefit in many ways including financial gains through increased research, tuition, and prestige. FAU must position itself to be part of this incoming wave of medical advances.

Florida Atlantic University has all the elements necessary to be part of this healthcare revolution: A newly established, young and energetic medical school with outstanding potential to compete with top medical schools in the nation, two highly prestigious pillars including the FAU Brain Institute (I-Brain) and the Biomedical Research Institute (I-Heal). In addition, FAU has a partnership with two world class research entities – Max Plank and Scripps at the Jupiter campus. In addition to these medical pillars, the Sensing and Smart Systems pillar and the College of Engineering and Computer Science will play a major role by developing medical devices and the FAU Harbor Branch pillar will contribute through development of natural pharmaceuticals. What is missing from this equation is the establishment of a Biomedical Engineering Program that will connect all the above entities in a meaningful and well-structured manner to position FAU for outstanding growth in the medical field. Without this program, we can still make progress but it will be at a much lower pace. The new program has the potential to enhance and accelerate growth in the following ways:

- Create a link among all stakeholders through joint appointments
- Increase potential for new and cutting edge medical research from NIH, NSF, and DoD
- Create the next generation of engineers and nurses that will create new devices and technologies
- Elevate the stature of FAU through production of MD-PhD degrees

The time is appropriate for such an investment at FAU.

F. Identify any established or planned educational sites at which the program is expected to be offered and indicate whether it will be offered only at sites other than the main campus.

The degree program will be offered only at the Boca Raton main campus.

Institutional and State Level Accountability

II. Need and Demand

A. Need: Describe national, state, and/or local data that support the need for more people to be prepared in this program at this level. Reference national, state, and/or local plans or reports that support the need for this program and requests for the proposed program which have emanated from a perceived need by agencies or industries in your service area. Cite any specific need for research and service that the program would fulfill.

The biomedical engineering field is one of the fastest growing occupational fields in the United States. The growth of the field has four major driving forces including i) the increasing size of the aging population, ii) the increasing cost of healthcare, iii) the emerging technological revolution in diagnosis & monitoring of individual's health as well as just in time healthcare delivery and iv) the need to develop new solutions to medical challenges. The biomedical engineering field increasingly provides solutions to world health challenges by altering how patients are treated. FAU hired the Hanover organization to review the program. Hanover found that relevant jobs are also expected to grow faster-than average in an already-strong state labor market." In addition, the Hanover report states that the "most recent relevant job posts only required a bachelor's degree, so graduates of a biomedical engineering program should be career-ready without needing to pursue graduate school." Finally, they noted that "Relevant occupations are projected to grow faster than average across geographic levels. Florida's labor market is generally strong across fields, as all occupations are projected to increase at an annualized rate of 9.0 percent from 2018-2028 (Hanover report p 6). Even given that strong market, biomedical engineering positions are projected to grow at an annualized rate of 9.7 percent (Hanover report p 6), slightly faster than the strong average rate." FAU is poised to address this need here in south Florida. 85% of biomedical postings require a bachelor's degree (Hanover report p 7).

The Hanover report FAU commissioned indicates that enrollment trends for Biomedical Engineering undergraduate programs in Florida suggest that student demand has been increasing steadily over the past 10 years. Career Explorer (https://www.careerexplorer.com/careers/biomedical-engineer/job-market/), notes that the projected demands for Biomedical Engineering at the undergraduate level over the next ten years is 7%/year making it one of the fastest growing fields among all engineering fields. Career Explorer estimates average salaries in Florida at $93,000 per year.

The Bureau of Labor statistics (Bioengineers and Biomedical Engineers : Occupational Outlook Handbook: : U.S. Bureau of Labor Statistics (bls.gov)) indicates that there were 19,300 positions nationwide in 2020, with a growth rate of 6% by 2030 (see Table 4). The average salary is $97,410. Table 5 shows national, Florida and southeast Florida employment and salaries.

Table 4. Employment projections data for bioengineers and biomedical engineers, 2020-30 (https://www.bls.gov/ooh/architecture-and-engineering/biomedical-engineers.htm#tab-6)

Occupational Title	SOC Code	Employment, 2020	Projected Employment, 2030
Bioengineers and biomedical engineers	17-2031	19,300	20,500

Table 5 Employment and Salaries for Bioengineers and Biomedical Engineers(SOC Code172031) source: BLS

Area Name	Employment(1)	Annual mean wage(2)
National(0000000)	17,190	$101,020
Florida(1200000)	750	$81,880
Miami-Fort Lauderdale-West Palm Beach, FL(0033100)	140	$88,200

Table 6 outlines the number of openings for jobs that biomedical engineering undergraduates would qualify for. There are 26,000 jobs nationwide each year. There are 2700 new jobs per year expected per onetonline.org. Tables 7 to 9 showed the industries that the BLS indicates hire biomedical engineers, their wages, and employment nationally.

Table 6. The Nationwide Projected Growth in Professions that hire B.S. in Biomedical Engineering degree program recipients (https://www.asee.org/documents/papers-and-publications/publications/college-profiles/2017-Engineering-by-Numbers-Engineering-Statistics.pdf)

Area	Field	Base	Projected	Change	%Change	Avg. Annual Openings	Median Salary
USA	Engineers, All Fields	132,500	141,000	8,500	7.4	9,500	
USA	Biomedical Engineers	21,300	22,800	1,500	7.2	1,600	$88K
USA	Biological Technicians	82,100	90,400	8,300	10.1	8,900	$45K

USA	Biological Science Teachers, Postsecondary	62,300	71,700	9,400	15.1	6,000	$78K
USA	Total	298,200	325,900	27,700	39.8	26,000	$211K

Table 7 Industries with the highest number of Bioengineers and Biomedical Engineering undergraduates (https://www.bls.gov/oes/current/oes172031.htm)

Industry	Employment	Percent of industry employment	Hourly mean wage	Annual mean wage
Scientific Research and Development Services	4,840	0.61	$ 50.39	$ 104,820
Medical Equipment and Supplies Manufacturing	2,480	0.78	$ 48.67	$ 101,230
Pharmaceutical and Medicine Manufacturing	1,300	0.41	$ 51.56	$ 107,240
Navigational, Measuring, Electromedical, and Control Instruments Manufacturing	1,270	0.32	$ 56.19	$ 116,880
Professional and Commercial Equipment and Supplies Merchant Wholesalers	1,110	0.17	$ 47.66	$ 99,140

Table 8. Industries with the highest concentration of employment in Bioengineers and Biomedical Engineering undergraduates with annual salaries (https://www.bls.gov/oes/current/oes172031.htm)

Industry	Employment	Percent of industry employment	Hourly mean wage	Annual mean wage
Medical Equipment and Supplies Manufacturing	2,480	0.78	$ 48.67	$ 101,230
Electronic and Precision Equipment Repair and Maintenance	720	0.70	$ 34.89	$ 72,570
Scientific Research and Development Services	4,840	0.61	$ 50.39	$ 104,820
Pharmaceutical and Medicine Manufacturing	1,300	0.41	$ 51.56	$ 107,240
Navigational, Measuring, Electromedical, and Control Instruments Manufacturing	1,270	0.32	$ 56.19	$ 116,880

Table 9. Top paying industries for Bioengineers and Biomedical Engineering undergraduates (https://www.bls.gov/oes/current/oes172031.htm)

Industry	Employment	Percent of industry employment	Hourly mean wage	Annual mean wage
Wholesale Electronic Markets and Agents and Brokers	(8)	(8)	$ 81.77	$ 170,080
Semiconductor and Other Electronic Component Manufacturing	120	0.03	$ 64.34	$ 133,830
Navigational, Measuring, Electromedical, and Control Instruments Manufacturing	1,270	0.32	$ 56.19	$ 116,880
Other Ambulatory Health Care Services	40	0.01	$ 55.07	$ 114,550
Computer Systems Design and Related Services	(8)	(8)	$ 54.44	$ 113,240

The potential for FAU to fill a need in industry is driven by three major driving forces i) the increasing size of southeast Florida's aging population, ii) the increasing cost of healthcare, and iii) the emerging technological revolution in diagnosis & monitoring of a patient's health as well as just in time healthcare delivery. The College currently has a significant amount of Biomedical Engineering research in the College of Engineering and Computer Science ($3.7M), a biomedical engineering program could help the college increase its biomedical research grants to $7.5M in 5 years after the establishment of the program.

At the forefront of factors that are accelerating the growth of the field is the integration of Artificial Intelligence and Biomedical Devices that will enable individuals to detect and address health related issues early. Florida Atlantic University has all the elements necessary to be part of this healthcare revolution: a newly established medical school with outstanding potential to compete with top medical schools in the nation. What is missing from this equation is the establishment of a Biomedical Engineering Program that will connect all the above entities in a meaningful way to position FAU for growth in the medical field.

B. Demand: Describe data that support the assumption that students will enroll in the proposed program. Include descriptions of surveys or other communications with prospective students.

Over the past years as the college has been talking about biomedical engineering. The college has begun to field inquiries about the B.S. in Biomedical Engineering. The interested parties are incoming freshman, high schools students and students within the electrical, computer and mechanical engineering program today. Each of those programs has a major role in biomedical engineering, and faculty from all three programs will be utilized to launch the B.S. in Biomedical Engineering degree program. All three programs currently have courses related to the field that will be leveraged to support implementation.

In the past 9 months, the advisors and recruiting events have generated at least 7 documented instances where students have asked when the program will become available. Hence there is student interest. Because all students in engineering take the same classes as freshman, the mechanical and electrical students have been advised that enrolling at FAU and registering for classes will not waste any degree programs. The students indicate they are attracted to the idea of helping others to integrate new technology to improve the lives of others. That is exactly what biomedical engineering students will do in their careers. The associate Dean for Undergraduate Studies and Community Outreach has fielded 3 of these inquires.

Students ask our advisors about a biomedical options and the few course we currently offer have full enrollment. Enrollment at FIU, USF, FSU and UF continue to grow. All were in support of our developing this program, noting our emphasis was different that theirs. Anecdotal evidence from the colleges suggest local students are beginning to inquire about the starting point for the degree program, so there appears to be interest from students in the program despite it only recently appearing on the College website.

The new program has the potential to accelerate enrollment in the following ways:

- Create a link among students and industry stakeholders through internship opportunities
- Increase potential for new and cutting edge undergraduate research opportunities with faculty grants from NIH, NSF and DoD
- Encourage students to be innovative in their design work toward development of new devices and technologies

All of this comports with the findings of the Hanover report commissioned by FAU found "enrollment trends for Biomedical Engineering undergraduate programs in Florida suggest that student demand has been increasing steadily over the past 10 years. For instance, the undergraduate Biomedical Engineering enrollment has grown from 213 (2008) to 246 (2017) students at Florida International University, and 105 (2012) to 393 (2017) at University of Florida. The University of South Florida and University of Miami also have biomedical engineering programs which Florida Gulf Coast University has a bioengineering program" (Hanover Report p 8.)

Hanover reported that "In 2019, Florida's 294 conferrals accounted for 17.3 percent of all regional conferrals—only North Carolina reported more statewide conferrals at 352. Furthermore, as regional conferrals increased at an annualized rate of 7.5 percent from 2015-2019, the number of programs in the region also slightly increased from 28 to 31. FAU would best position itself within the market if it marketed its new biomedical engineering program to nonresident students in other Southeastern states in addition to Florida residents (Hanover Report p 8.). The Hanover Report is included as Appendix D.

C. If substantially similar programs (generally at the four-digit CIP Code or 60 percent similar in core courses), either private or public exist in the state, identify the institution(s) and geographic location(s). Summarize the outcome(s) of communication with such programs with regard to the potential impact on their enrollment and opportunities for possible collaboration (instruction and research). In Appendix E, provide data that support the need for an additional program.

Table 11 shows that three state universities offer the B.S. in Biomedical Engineering Program

Table 11 Undergraduate Enrollment/Degrees Awarded History (note SUS dashboards being updated so more recent enrollment data not available)

	2013	2014	2015	2016	2017	2018	2019	2020	2021
FGCU	180/9	189/13	196/25	180/17	168/38	30	24	26	30
FIU	460/31	501/46	466/48	392/66	366/74	96	90	80	89
UF	165/0	228/0	303/17	357/22	404/34	35	89	88	103
USF						0	0	1	10
FSU/FAMU								0	14

In Florida, four state universities offer the Biomedical Engineering undergraduate program: the University of Florida (UF), Florida International University (FIU), Florida State/FAMU (started in 2019) and University of South Florida (USF started in 2017 so has no real data) and one more has a bioengineering degree (Florida Gulf Coast University). Based on the data in Table 8, all programs reporting appear to be very healthy in terms of an impressive rate of growth. Enrollment data missing for the last several years.

D. Use Table 1 - Appendix A (1-A for undergraduate and 1-B for graduate) to categorize projected student headcount (HC) and Full Time Equivalents (FTE) according to primary sources. Generally undergraduate FTE will be calculated as 30 credit hours per year

and graduate FTE will be calculated as 24 credit hours per year. Describe the rationale underlying enrollment projections. If students within the institution are expected to change majors to enroll in the proposed program at its inception, describe the shifts from disciplines that will likely occur.

Table A-1 outlines the projected student headcount (HC) and Full Time Equivalents (FTE) estimated by the college. For Table 1 in Appendix A, we expect there will be students transferring from mechanical and electrical engineering to this degree program based on inquiries made to the advising staff in the past year (7). The college has been indicating that a B.S. in Biomedical Engineering is expected in the near future. Given that the first-year courses are basically the same for all engineering majors and the passage of calculus 1 and physics 1 is required to declare a major in the college, admittance to a different engineering degree program will pose no challenge for students admitted to our majors. We expect 8 to 10 each year from within the college. In addition, we expect that a few students will see the opportunity for job growth from Physics, chemistry or biology given the number of courses from those programs that biomedical engineering students will be required to take. The college always receives a few transfers from other institutions and given the location and job record of the college, we expect that there will be 3 to 5 of SUS transfer students each year along with 10 to 20 new freshmen entering each year. The college has always received students from the colleges with AA degrees, and we expect that this program will garner similar interest to the mechanical and civil degrees. With all of these avenues for student entry, the expectation that after 5 years, projecting 100 students is reasonable. Given the makeup our non-traditional student population, about 20 percent are anticipated to be part-time students.

E. Indicate what steps will be taken to achieve a diverse student body in this program. If the proposed program substantially duplicates a program at FAMU or FIU, provide, (in consultation with the affected university), an analysis of how the program might have an impact upon that university's ability to attract students of races different from that which is predominant on their campus in the subject program. The university's Equal Opportunity Officer shall review this section of the proposal and then sign and date Appendix B to indicate that the analysis required by this subsection has been completed.

FAU is a Hispanic serving institution with broad access to underserved and disadvantaged students in its service area and a growing need for the region. The tri-County populations are:

County	2019 Estimate	10 year Change
Miami Dade County	2,716,940	+8.76%
Broward County	1,952,778	+11.71%
Palm Beach County	1,496,770	+13.38%
Total	6,166,488	+10.78%

The racial makeup of the population of the Miami area [6,066,387] as of 2016:[34]

- White Hispanic: 31.1%
- White Non-Hispanic: 39.2%
- Black or African American: 21.1%

- Native American and Alaskan Native: 0.2%
- Asian: 2.6%
- Native Hawaiian and Pacific Islander: 0%
- Other races: 3.4%
- Two or more races: 2.6%
- Hispanic or Latino (of any race) were 46.1% of the population

Given the demographic make-up of the southeast Florida community, the college has an advantage when recruiting local students as they are among the most diverse in the county, let alone the state. To this end, the college has hired a new recruiting direction to re-imagine its ongoing outreach efforts to recruit more students to FAU from local high schools and community colleges. Among the efforts the college pursues currently are:

- Inviting high school students to events
- Personal tours of campus
- Meet and greets with faculty and current students
- Invitations to student events
- Special recruiting events for individual schools at FAU
- Larger college recruiting events where students are invited
- Attendance at scholar events across the state

New items the college will implement in 2022/23 are

- Communication via a revamped website
- Direct mail contact with 9th and 10th grade students
- Development of student profile
- Voice videos from students and their experiences
- Email contact with student videos

The college has in mid concepts to enhance the learning opportunities for disadvantaged students including:

- Funding for scholarships for disadvantaged students
- Highlighting student success form disadvantaged communities
- Internships reserved for disadvantaged students.
- Design projects to help disadvantaged communities
- Student event in disadvantaged communities.

In addition, the college has investigated means to transition students on a 3+2 model from the local colleges to the degree programs in the College. The college is in the process of completing articulation agreements to accept state college students with AA degrees directly into the programs while fostering advising from the college to the state colleges (Broward and Palm Beach State). These colleges have significant minority populations that can easily migrate to FAU for their bachelor's degree. Likewise, the college has discussed a model where students are conditionally accepted to the engineering degree programs, while assigning the students to the state colleges to complete IFP, math and other courses so they are ready to matriculate to FAU. In recent ABET visits, the diversity of FAU's engineering programs was noted.

Within the academic programs, the College has devised a series of on-line canvas modules for diversity, equity and inclusion training that will be required of all students at the freshman, senior and graduate level. The modules will be monitored and reported to SACS and ABET, our accreditation entities. These modules focus on the need to understand and embrace all cultures. A major goal is to help disadvantaged and traditionally underrepresented communities feel comfortable at FAU, so they can pursue their studies without distractions. Given the Male-centric nature of the profession, a focus on female recruitment as well as diversity related to background is included.

The ultimate goal is to create a culture in the College where everyone embraces **diversity in the classroom**, which ultimately creates a positive impact across the university. When this happens, a school community creates a safe, supportive and purposeful environment for students and staff which, in turn, allows students to grow — academically *and* socially. In an increasingly fragmented society, the ability to connect with peers, coworkers and neighbors with diverse backgrounds and abilities is invaluable. Diversity improves critical-thinking skills, builds empathy and encourages students to think differently. This includes many different factors: race, ethnicity, gender, sexual orientation, socioeconomic status, ability, age and religious belief.

III. Budget

A. Use Table 3 - Appendix A to display projected costs and associated funding sources for Year 1 and Year 5 of program operation. Use Table 4 - Appendix A to show how existing Education & General funds will be shifted to support the new program in Year 1. In narrative form, summarize the contents of both tables, identifying the source of both current and new resources to be devoted to the proposed program. (Data for Year 1 and Year 5 reflect snapshots in time rather than cumulative costs.)

Appendix A Table 3 outlines the budget for the degree program. Building off Table A-2 where the amount of FTE faculty time was developed for the first and fifth years, the first year 34% of an FT faculty assignment was carried to column 1, row 2. Given that there is a new degree program, 12.5% of time for an advisor was assigned to the project to help facilitate the degree program's growth, along with 12.5% of time for staff to help with administration. A cost of $5000 for miscellaneous expenses associated with added laboratory materials in the Fab Lab was included in the budget for a total of $69,443. Between years 1 and 5, the only difference is that the faculty allocation has increased due to the fact that upper division classes are being taught. Hence faculty allocation has risen from 0.34 to 1.31 FTE.

On the far right, the projected increase in student will decrease the E&G cost per FTE from $8680 in year 1 to $2680 in Year 5. Incidental lab or other materials are can be obtained with the $5000 misc. cost per year. The may be lab supplies, materials for the Fab Lab, the cost to replace damaged tools, etc. This is a nominal cost.

From a cost perspective, the degree program uses courses generally taught for other majors to compile its program. These courses are generally offered by the College of Engineering and Computer Science or the College of Science on a regular basis. As a result, there is no need to add resources at the start of the program in the col lge.

Because of the fact that the college only teaches a portion of the courses, Table 4 outlines the reallocation of E&G funds based on an overall increase in enrollment from the proposed degree program. Over a $22.9 million budget the reallocation portion for the new students is calculated to be $69,443, nearly $50,000 (72%) of which is within the College of Engineering and Computer Science. Very minor reallocations occur for the English, Chemistry, Mathematics Biological Sciences and Physics Departments.

B. Please explain whether the university intends to operate the program through continuing education, seek approval for market tuition rate, or establish a differentiated graduate-level tuition. Provide a rationale for doing so and a timeline for seeking Board of Governors' approval, if appropriate. *Please include the expected rate of tuition that the university plans to charge for this program and use this amount when calculating cost entries in Table 3.*

The degree will not be offered through continuing education, seek approval for market tuition rate, or establish a differentiated graduate-level tuition.

The current tuition is $4,879 for In-state tuition and $17,324 for out-of-state tuition. These are not expected to change measurably in the future.

C. If other programs will be impacted by a reallocation of resources for the proposed

program, identify the impacted programs and provide a justification for reallocating resources. Specifically address the potential negative impacts that implementation of the proposed program will have on related undergraduate programs (i.e., shift in faculty effort, reallocation of instructional resources, reduced enrollment rates, greater use of adjunct faculty and teaching assistants). Explain what steps will be taken to mitigate any such impacts. Also, discuss the potential positive impacts that the proposed program might have on related undergraduate programs (i.e., increased undergraduate research opportunities, improved quality of instruction associated with cutting-edge research, improved labs and library resources).

The expectation is that our current faculty and classes will be realigned for this program. Most of the classes needed are currently being offered in other current degree programs. Faculty teaching these courses are currently in place. No impact to existing programs is anticipated; the expectation that the program will increase the number of degree-seeking students in the college.

The student experience will be enhanced with research opportunities. As noted previously, the College of Engineering and Computer Science is extensively engaged in the university's Office or Undergraduate Research and Inquiry, and FAU's award winning undergraduate program that links students with faculty advisors in the pursuit of research. In addition, certain classes offered in the college may be designated as "research intensive." Four such classes, permits the student to receive a research certificate in recognition of their research efforts today. The B.S. in Biomedical Engineering degree program will have classes converted to the "RI" designation in the future. All students will be encouraged to be involved in some form of research in this degree program.

Added research funding may lead to updated labs, improved quality of instruction associated with cutting-edge research, and added research opportunities integrated with paid positions for students.

Comments from industry people all indicate that having a B.S. in Biomedical Engineering degree program will enhance the ability for the college to attract research dollars and increase student and faculty opportunities for cutting edge federally funded research. There is a mutual desire for research collaboration between FAU's College of Medicine and the College of Engineering and Computer Science. The College of Medicine's Associate Dean noted this would be a huge opportunity for FAU to secure research grant opportunities. An ABET reviewer from Johns Hopkins University concurred that this could be the means by which FAU significantly increases its research portfolio.

D. Describe other potential impacts on related programs or departments (e.g., increased need for general education or common prerequisite courses, or increased need for required or elective courses outside of the proposed major).

We anticipate there will be no impacts on other programs. No new classes outside the college are required. The added number of students per year to outside classes in biology and chemistry is minimal compared to the number of students currently in those classes (biology has over 2500 declared majors whereby our program is expected to have only 100 declared majors in 5 years – 4% of that of biology - http://biology.fau.edu/home/biology_department.php).

E. Describe what steps have been taken to obtain information regarding resources (financial and in-kind) available outside the institution (businesses, industrial organizations, governmental entities, etc.). Describe the external resources that appear to be available to support the proposed program.

We have engaged our college industrial advisory board. We have also pursued grants and other means to support the faculty and program already (see Table 12) and will continue to do so.

T**able 12 – Existing FAU Research in Biomedical Engineering**

Biomedical Engineering Research	PI	Source	Funds
Placenta-on-a-Chip Sensing Platform to Study Malaria	Sarah Du	NIH	$ 400,154.00
Development of an Artificial Hand Exhibit	Erik Engeberg	SFCSA	$ 84,433.00
Virtual Neuro-prosthesis: Restoring Autonomy	Erik Engeberg	NIH	$ 1,441,000.00
Targeting cMyc in the control of Inflammation	Sarah Du	UM/NIH	$ 72,716.00
Dexterous Robotic Manipulator for Semi-Autonomous	Erik Engeberg	FIU/DOE	$ 160,000.00
Development of a 90 Days Expiration Dot	Mike Kim	TLTC	$ 57,772.00
Autotherapy of craniofacial bone defects using immunomodulatory and cell-recruiting bio ceramic scaffolds	Kevin Kang	NIH	$ 142,892.00
Development of an in Vitro 3D Tumor Tissue Engineering Model for Esophageal Cancer	Kevin Kang	NIH	$ 142,285.00
I/UCRC for Center for Health Organization Transformation	Ankur Agarwal	VAR-SOU	$ 150,000.00
Development of a Middleware Framework for Medical Device Integration for Telemedicine	Ankur Agarwal	VAR-SOU	$ 50,000.00
A Mobile Based Care Coordination System for Critical Care	Ankur Agarwal	VAR-SOU	$ 100,000.00
FAU Site Phase-2: I/UCRC for Center for Health Organization Transformation	Ankur Agarwal	NSF	$ 200,000.00
Development of a diagnostic assay for rapid detection and quantification of Zika virus	Waseem Asghar	FDOH	$ 199,280.00
Medical image analysis using deep learning techniques	Oge Marques	VIS-SOU	$ 59,000.00
Development of disposable and refrigeration-free microchip technology for CD4+ T cell counting	Waseem Asghar	NIH	$ 459,580.00

We expect that having a biomedical program, especially in partnership with out medical school, with allow us to double the research and external funding in the first 5 years of the program.

IV. Projected Benefit of the Program to the University, Local Community, and State

Use information from Tables 1 and 3 - Appendix A, and the supporting narrative for “Need and Demand” to prepare a concise statement that describes the projected benefit to the university, local community, and the state if the program is implemented. The projected benefits can be both quantitative and qualitative in nature, but there needs to be a clear distinction made between the two in the narrative.

The biomedical engineering field is one of the fastest growing occupational fields in the United States. Unlike other more established fields, this field is in a constant state of flux mainly due to advances in technology and changes in health challenges. Universities and their biomedical engineering programs play the key role in developing these technologies and it is a major source of research from the National Institute of Health and other federal agencies. Development of research at medical schools can be enhanced with biomedical engineering programs on the campus as it provides opportunities to integrate medicine and engineering. Engineers will lead the technological revolution in many areas of the healthcare delivery as the opportunities are limitless and the needs for will continue to proliferate. Universities that position themselves to be contributors to this healthcare revolution will benefit in many ways including financial gains through increased research, tuition, and prestige. FAU must position itself to be part of this incoming wave of medical advances.

Florida Atlantic University has all the elements necessary to be part of this healthcare revolution: The FAU Brain Institute (I-Brain) and the Biomedical Research Institute (I-Heal), plus the Sensing and Smart Systems pillar and the College of Engineering and Computer Science will play a major role by developing medical devices. What is missing from this equation is the establishment of a Biomedical Engineering Program that will connect all the above entities in a meaningful and well-structured manner to position FAU for accelerating growth in the medical field. According ASEE data, enrollment in Biomedical Engineering has grown by 85% over ~10 years from 2008 through 2017. According to ASEE data, awarded Biomedical Engineering degrees have grown by 107% over ~10 years, from 2008 (3237 degrees) through 2017 (6725 degrees). The projections for growth in jobs for Biomedical Engineering and related fields are even more impressive at the state level.

Hence development of a B.S. in Biomedical Engineering degree program will facilitate the university's efforts to become a biomedical and technology leader, contribute substantially to the current needs for biomedical engineers in southeast Florida industry. The development of the biotechnology field in southeast Florida will create good paying jobs to retain biomedical engineers in southeast Florida, thereby contributing to the local economy. The program meets or exceeds the BOG's goals for STEM degrees and education.

Likewise the State will benefit by adding to the state medical research economy which is over $4.7 billion per year and increasing (see Figure 5). The Sunshine State is home to some of the nation's most highly-regarded research centers, more than 1,100 biotech, pharmaceutical and medical devices companies, and a foundation of more than 46,000 healthcare establishments—including 720+ hospitals. Global industry leaders including Johnson & Johnson, Zimmer Biomet, Medtronic, Stryker-Mako, and Arthrex have all established locations across the state, and more companies are moving here to take advantage the state's unmatched quality of life, highly-skilled workforce and low taxes.

Florida has a growing life sciences sector with new companies, more jobs and a significant number of bioscience-related patents. A 2020 Economy/BIO profile notes these highlights:

- Florida ranks in the top quintile for bioscience industry employment, establishments, bioscience R&D and number of bioscience and related patents.
- 93,534 - Bioscience employment.
- 6,700 - Bioscience establishments.
- $705 million National Institute of Health funding, FY2019.
- $1.27 billion Bioscience venture capital investments, 2016-19.
- $1.53 billion - Academic bioscience R+D expenditures, FY2018.

With a growing workforce and vibrant universities and research facilities, Greater Fort Lauderdale offers an ideal ecosystem for life science companies. For decades, the area has been home to one of the most dynamic biomedical sectors in the country. Today, Allergan, Stryker and Teva are among the major medical device, biomedical, pharmaceutical and clinical research companies with R&D, manufacturing and distribution facilities in the area.

As a region, South Florida offers convenient access to leading research institutes and academic institutions. In Greater Fort Lauderdale – a longtime home for many biomedical companies – Nova Southeastern University is expanding its life science research facilities. To the north are Scripps Florida, Max Planck Florida Institute, and Torrey Pines Institute for Molecular Studies.

Life sciences companies benefit from a trained 13,000-person workforce, and a value chain that includes suppliers, manufacturers, distributors, and science, technology, engineering and mathematics (STEM) workforce training programs.

South Florida is home to approximately 1,500 bioscience businesses and institutions that generate over $4 billion in annual sales (a significant portion of the state total), according to recent estimates. Leading life science companies in Greater Fort Lauderdale include:

- **Allergan** is a brand/generic pharmaceutical company whose pharmaceutical manufacturing and warehousing facility in Davie manufactures about 2.2 billion units annually. It is approved by the U.S. Food and Drug Administration, Health Canada, and the European Medicines Agency.

- **Aveva Drug Delivery Systems** is a global leader in transdermal drug delivery systems. The Miramar company is part of Apotex, Canada's largest pharmaceutical company.
- **DNA Labs International** provides forensic DNA analysis. The Deerfield Beach company is adding jobs and making a $7.5 million capital investment in its facility.
- **Florida Supplement** is a nutraceutical manufacturer and packager of nutritional supplements in tablets, capsules, liquids and power blend forms. Located in Miramar, Florida Supplement has manufactured nutritional supplement products for customers in the United States, Latin America and Europe.
- **Goodwin Biotechnology, Inc.** is a fully integrated contract manufacturing organization of monoclonal antibodies and recombinant proteins for preclinical and phase I/II/III clinical trials. Plantation-based GBI has worked with companies of all sizes.
- **Hema Diagnostic Systems, LLC** produces a full line of rapid diagnostic assays for major infectious disease testing. The Miramar company was acquired by Generex Biotechnology Corporation in 2018.
- **Lupin Limited,** a pharma-research company based in Mumbai, India has expanded its laboratory facility in Coral Springs, which focuses on inhalation products for the treatment of asthma, allergic rhinitis, chronic obstructive pulmonary diseases and other lung diseases.
- **OmniComm Systems, Inc.** is a Fort Lauderdale-based global provider of e-clinical solutions. It was acquired by Anju Software in 2019.
- **OrbusNeich** is a global medical device company that develops therapies for vascular disease at its Advanced Research and Development facility in Fort Lauderdale.
- **SHL Pharma** recently expanded its manufacturing and R&D facility in Deerfield Beach. SHL Pharma is part of SHL Group, the world's largest privately-owned designer, developer and manufacturer of advanced drug delivery systems.
- **Stryker-MAKO Surgical Corp.** is a Stryker medical device company in Davie that markets its RIO® Robotic-Arm Interactive Orthopedic system and its proprietary RESTORIS® implants for minimally invasive orthopedic knee procedures.
- **Terumo Aortic** in Sunrise develops products for endovascular aortic treatment, including its Relay Thoracic Stent-Graft with Plus Delivery System, a life-saving technology for patients with thoracic aortic aneurysms.
- **Teva Pharmaceutical Industries, Ltd.,** is an Israel-based company with engineering, information technology and purchasing services at its facility in Weston.
- **Trividia Health,** a subsidiary of China-based Sinocare Group, has a large facility in Fort Lauderdale that makes glucose-monitoring equipment and related products for diabetics.
- **Vigilant Biosciences**, is a leading innovator and developer of solutions that aid in the early detection and intervention of cancer.
- **Vital Pharmaceuticals, Inc. (VPX)** develops, manufactures and distributes sports medicine-related nutraceuticals, functional foods and beverages. The company is adding jobs and making a capital investment of $181 million in Pembroke Pines.

Given the southeast Florida is rapidly becoming a hub for biomedical engineering technology, the proposed degree program will fulfill a need for graduate engineers capable of participating in the invention and development of technology to help with public health advances for the population. Given the significant older and disadvantaged populations of the area, development of new opportunities to improve health care are a significant advantage of the program to the area.

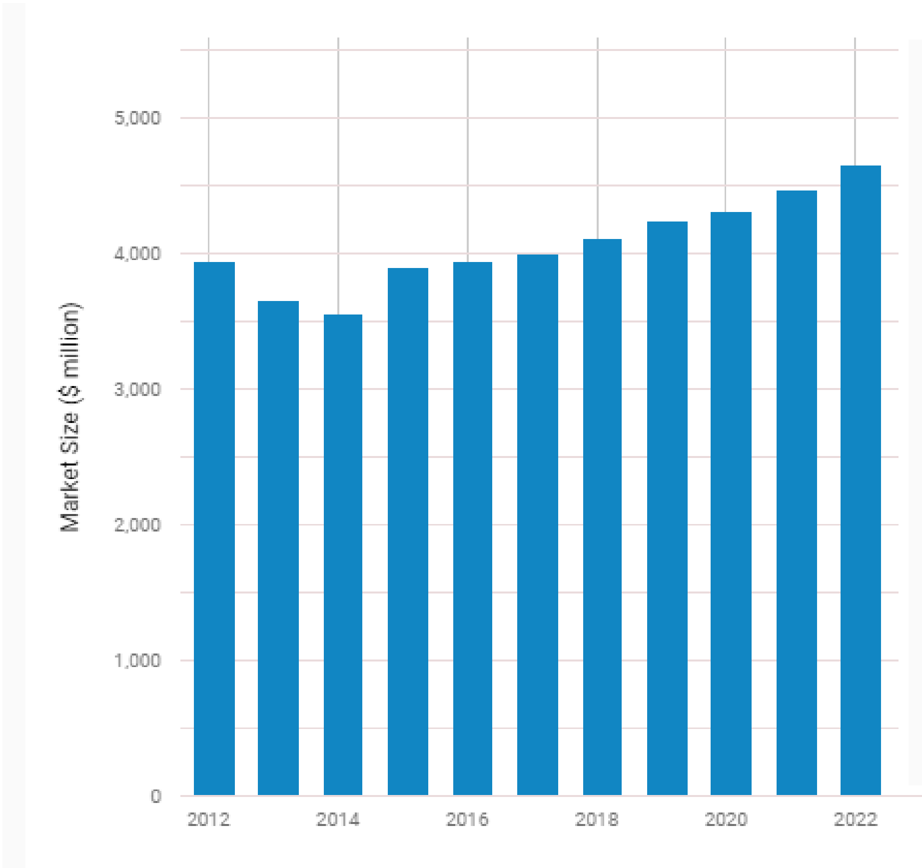

Figure 5 Biomedical industry in Florida

V. Access and Articulation – Bachelor's Degrees Only

A. If the total number of credit hours to earn a degree exceeds 120, provide a justification for an exception to the policy of a 120 maximum and submit a separate request to the Board of Governors for an exception along with notification of the program's approval. (See criteria in Board of Governors Regulation 6C-8.014)

The degree program is 120 cr.

B. List program prerequisites and provide assurance that they are the same as the approved common prerequisites for other such degree programs within the SUS (see link to the Common Prerequisite Manual on the resource page for new program proposal). The courses in the Common Prerequisite Counseling Manual are intended to be those that are required of both native and transfer students prior to entrance to the major program, not simply lower-level courses that are required prior to graduation. The common prerequisites and substitute courses are mandatory for all institution programs listed, and must be approved by the Articulation Coordinating Committee (ACC). This requirement includes those programs designated as "limited access.

If the proposed prerequisites are not listed in the Manual, provide a rationale for a request for exception to the policy of common prerequisites. NOTE: Typically, all lower-division courses required for admission into the major will be considered prerequisites. The curriculum can require lower-division courses that are not prerequisites for admission into the major, as long as those courses are built into the curriculum for the upper-level 60 credit hours. If there are already common prerequisites for other degree programs with the same proposed CIP, every effort must be made to utilize the previously approved prerequisites instead of recommending an additional "track" of prerequisites for that CIP. Additional tracks may not be approved by the ACC, thereby holding up the full approval of the degree program. Programs will not be entered into

the State University System Inventory until any exceptions to the approved common prerequisites are approved by the ACC.

The program will follow the common pre-requisite requirements for engineering programs as defined in the Common Prerequisites for Entry into Undergraduate Engineering Programs in the State University System of Florida in the SUS Common Pre-Requisites manual. The degree components are listed below.

Intellectual Foundations Program		
College Writing 1	ENC 1101	3
College Writing 2	ENC 1102	3
Intellectual Foundations Program: Society and Human Behavior Courses		6
Intellectual Foundations Program: Global Citizenship Courses		6
Intellectual Foundations Program: Humanities Courses		6

Foundations of Math and Quantitative Reasoning		
Calculus with Analytic Geometry 1 (1,4)	MAC 2311	4
Calculus with Analytic Geometry 2 (1,4)	MAC 2312	4
Foundations of Science and the Natural World		
General Chemistry 1 (1,5)	CHM 2045	3 **and**
General Chemistry Lab 1	CHM 2045L	1
General Physics for Engineers 1 (1,5,7)	PHY 2048	3 **and**
General Physics 1 Lab	PHY 2048L	1
Total		**40**

C. **If the university intends to seek formal Limited Access status for the proposed program, provide a rationale that includes an analysis of diversity issues with respect to such a designation. Explain how the university will ensure that Florida College System transfer students are not disadvantaged by the Limited Access status. NOTE: The policy and criteria for Limited Access are identified in Board of Governors Regulation 6C-8.013. Submit the Limited Access Program Request form along with this document.**

The program is not intended to be limited access.

D. **If the proposed program is an AS-to-BS capstone, ensure that it adheres to the guidelines approved by the Articulation Coordinating Committee for such programs, as set forth in Rule 6A-10.024 (see link to the Statewide Articulation Manual on the resource page for new program proposal). List the prerequisites, if any, including the specific AS degrees which may transfer into the program.**

The transfer to an engineering program with an AS degree creates numerous issues, as a result the program is not proposed to be an AS-BS capstone. However, with an AA degree, a student is normally easily transitioned to engineering degree programs at FAU.

Institutional Readiness

VI. Related Institutional Mission and Strength

A. **Describe how the goals of the proposed program relate to the institutional mission statement as contained in the SUS Strategic Plan and the University Strategic Plan (see link to the SUS Strategic Plan on the resource page for new program proposal).**

In reviewing the 2025 System Strategic Plan, the B.S. in Biomedical Engineering program at FAU would meet with strategic performance indicators as follows:

- The number and percent of bachelor's degrees in programs of strategic emphasis (#18).
- The number and percent of bachelor's degrees in STEM and health (#19).
- The percent of bachelor's graduates employed and earning $30,000+ or continuing their education (#31)
- The median wages of bachelor's graduates employed full-time one year after graduation exceeds $43,200 (#32)

The BOG has specifically focused on high wage professional employment as areas of strategic emphasis when reviewing baccalaureate degrees that are classified as STEM or health disciplines by the Board of Governors in the Academic Program Inventory. Periodically, the Board of Governors' office conducts an environmental scan to identify labor market demand for university graduates. A number of economic and workforce-related reports are reviewed during this process, and trends are identified to assist in updating the Board's official list of academic Programs of Strategic Emphasis (PSE). This process identifies occupational areas with high demand for postsecondary graduates and provides an opportunity to identify emerging and evolving business sectors and occupations. The Board approved updates to the PSE list in October 2019 due to changes in the economy and the job market and, most recently, in September 2020 to accommodate the Classification of Instructional Programs (CIP) 2020 taxonomy implementation.

Based on the BOG website (https://www.flbog.edu/wp-content/uploads/2022/02/Current-PSE-list-approved-by-the-BOG-at-its-September-2020-meeting-XLSX-Rev5.pdf), on p 7.15 the biomedical engineering degree program is listed as a degree program of Strategic Emphasis per the BOG September 2020 meeting - 14.0501 Bioengineering and Biomedical Engineering.

B. Describe how the proposed program specifically relates to existing institutional strengths, such as programs of emphasis, other academic programs, and/or institutes and centers.

At the forefront of factors that are accelerating the growth of the field is the integration of Artificial Intelligence and Biomedical Devices that will enable individuals to detect and address health related issues early. Florida Atlantic University has all the elements necessary to be part of this healthcare revolution: a newly established, medical school with outstanding potential to compete with top medical schools in the nation. What is missing from this equation is the establishment of a undergraduate Biomedical Engineering degree program that will connect all the above entities in a meaningful way to position FAU for growth in the medical field. The new program has the potential to accelerate growth in the following ways:

- Create a link among all stakeholders through joint appointments
- Increase potential for new and cutting edge medical research from NIH, NSF and DoD
- Create the next generation of engineers that will create new devices and technologies
- Elevate the stature of FAU through production of MD-PhD degrees

While the College currently has a significant amount of Biomedical Engineering research in the College of Engineering and Computer Science ($3.7M), a biomedical engineering program could help the college increase its biomedical research grants to $7.5M in 5 years after the establishment of the program.

C. Provide a narrative of the planning process leading up to submission of this proposal. Include a chronology in table format of the activities, listing both university personnel directly involved and external individuals who participated in planning. Provide a timetable of events necessary for the implementation of the proposed program.

Table 13 outlines the communications involving the development of FAU proposed B.S. in Biomedical Engineering degree program.

Table 13 Timeline for development of FAU proposed B.S. in Biomedical Engineering degree program

Date	Item in Program Approval Process
Spr 2018	Discussion initiated within College on BSBME
Spr 2019	Initial proposal developed for program
Spr 2018	Approval by College Advisory Committee to move forward
Fall 2018	Program appears on an approved Accountability Report
Fall 2018	Initial proposal for program Finalized
Spr 2019	Proposal moves through department/school and college committees
Spr 2019	Meet with Senior Associate Provost to discuss the proposed degree program
Feb-21	Conduct market analysis
Apr-21	Review/modify market analysis as needed
21-Aug	Prepare Pre-Proposal Form to be submitted to Senior Associate Provost
9/3/2021	Meet with Senior Associate Provost to receive instructions on the full proposal packet
21-Sep	Senior Associate Provost presents pre-proposal to CAVP ACG
21-Oct	College UG approves Catalog info
21-Dec	Prepare full proposal request packet [Request to Offer a New Degree] to be reviewed by Senior Associate Provost.
22-Feb	Meet w Provost on Proposal
22-May	Submit Revised Proposal
22-May	Senior Associate Provost prepares the proposal packet for submission to the Board of Governors staff for review
22-Sep	Proposal moves to UUPC
22-Oct	Proposal moves to Faculty Senate
Aug 23	Program start

VII. Program Quality Indicators - Reviews and Accreditation

Identify program reviews, accreditation visits, or internal reviews for any university degree programs related to the proposed program, especially any within the same academic unit. List all recommendations and summarize the institution's progress in implementing the recommendations. Please include evidence that teacher preparation programs meet the requirements outlined in Section. 1004.04, Florida Statutes, if applicable.

ABET is the organization that created the standards and applies those standards to accredit engineering degree programs. ABET's goal is for Assessment of student learning, with a focus on continuous improvement, is key to ensuring the quality of our educational programs and preparing our graduates to enter a global workforce. The cumulative result of student learning in our curricula and co-curricular activities enables the career and professional accomplishments of our graduates. In an era of accountability and transparency, outcomes assessment has become an international standard of quality. ABET-accredited programs have processes in place to determine levels of student outcome attainment. Evaluation of the data collected in these processes are used to facilitate evidence-based continuous program improvement. In addition, programs must first establish educational objectives for their graduates consistent with the needs of program constituencies.

ABET accreditation assures that a collegiate program has met standards essential to prepare graduates to enter critical STEM fields in the global workforce. Graduates from an ABET-accredited program have a solid educational foundation and are capable of leading the way in innovation, emerging technologies, and in anticipating the welfare and safety needs of the public.

All programs seeking accreditation from the Engineering Accreditation Commission of ABET must demonstrate that they satisfy all of the following General Criteria for Baccalaureate Level Programs https://www.abet.org/accreditation/accreditation-criteria/criteria-for-accrediting-engineering-programs-2022-2023/:

Criterion 1. Students

Student performance must be evaluated. Student progress must be monitored to foster success in attaining student outcomes, thereby enabling graduates to attain program educational objectives. Students must be advised regarding curriculum and career matters.

The program must have and enforce policies for accepting both new and transfer students, awarding appropriate academic credit for courses taken at other institutions, and awarding appropriate academic credit for work in lieu of courses taken at the institution. The program must have and enforce procedures to ensure and document that students who graduate meet all graduation requirements.

Criterion 2. Program Educational Objectives

The program must have published program educational objectives that are consistent with the mission of the institution, the needs of the program's various constituencies, and these criteria. There must be a documented, systematically utilized, and effective process, involving program constituencies, for the periodic review of these program educational objectives that ensures they remain consistent with the institutional mission, the program's constituents' needs, and these criteria.

Criterion 3. Student Outcomes

The program must have documented student outcomes that support the program educational objectives. Attainment of these outcomes prepares graduates to enter the professional practice of engineering. Student outcomes are outcomes (1) through (7), plus any additional outcomes that may be articulated by the program.

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

7. an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

Criterion 4. Continuous Improvement

The program must regularly use appropriate, documented processes for assessing and evaluating the extent to which the student outcomes are being attained. The results of these evaluations must be systematically utilized as input for the program's continuous improvement actions. Other available information may also be used to assist in the continuous improvement of the program.

Criterion 5. Curriculum

The curriculum requirements specify subject areas appropriate to engineering but do not prescribe specific courses. The program curriculum must provide adequate content for each area, consistent with the student outcomes and program educational objectives, to ensure that students are prepared to enter the practice of engineering. The curriculum must include:

a. a minimum of 30 semester credit hours (or equivalent) of a combination of college-level mathematics and basic sciences with experimental experience appropriate to the program.

b. a minimum of 45 semester credit hours (or equivalent) of engineering topics appropriate to the program, consisting of engineering and computer sciences and engineering design, and utilizing modern engineering tools.

c. a broad education component that complements the technical content of the curriculum and is consistent with the program educational objectives.

d. a culminating major engineering design experience that 1) incorporates appropriate engineering standards and multiple constraints, and 2) is based on the knowledge and skills acquired in earlier course work.

Criterion 6. Faculty

The program must demonstrate that the faculty members are of sufficient number and they have the competencies to cover all of the curricular areas of the program. There must be sufficient faculty to accommodate adequate levels of student-faculty interaction, student advising and counseling, university service activities, professional development, and interactions with industrial and professional practitioners, as well as employers of students.

The program faculty must have appropriate qualifications and must have and demonstrate sufficient authority to ensure the proper guidance of the program and to develop and implement processes for the evaluation, assessment, and continuing improvement of the program. The overall competence of the faculty may be judged by such factors as education, diversity of backgrounds, engineering experience, teaching effectiveness and experience, ability to communicate, enthusiasm for developing more effective programs, level of scholarship, participation in professional societies, and licensure as Professional Engineers.

Criterion 7. Facilities

Classrooms, offices, laboratories, and associated equipment must be adequate to support attainment of the student outcomes and to provide an atmosphere conducive to learning. Modern tools, equipment, computing resources, and laboratories appropriate to the program must be available, accessible, and systematically maintained and upgraded to enable students to attain the student outcomes and to support program needs. Students must be provided appropriate guidance regarding the use of the tools, equipment, computing resources, and laboratories available to the program.

The library services and the computing and information infrastructure must be adequate to support the scholarly and professional activities of the students and faculty.

Criterion 8. Institutional Support

Institutional support and leadership must be adequate to ensure the quality and continuity of the program.

Resources including institutional services, financial support, and staff (both administrative and technical) provided to the program must be adequate to meet program needs. The resources available to the program must be sufficient to attract, retain, and provide for the continued professional development of a qualified faculty. The resources available to the program must be sufficient to acquire, maintain, and operate infrastructures, facilities, and equipment appropriate for the program, and to provide an environment in which student outcomes can be attained.

The last ABET accreditation visit to Florida Atlantic University was in October 2020. All eight BS degree programs in the college were assessed. As a result of the visit, all eight degree programs in the college were given full accreditation for the maximum time of six years. Outcomes from the visit included the need for development of better methods for assessing continued degree program improvements were an outcome that faculty have begun investing in to continue the process. The electrical and computer engineering degree programs, along with computer science were modified to better align the commonalities among those degree programs. These practices are in place for the 2022/23 academic year and will apply to the new B.S. in Biomedical Engineering degree program once it is approved.

The B.S. in Biomedical Engineering degree program will be submitted for accreditation to the Accreditation Board for Engineering and Technology (ABET) at such time as a graduate has completed the program. The program has been designed to meet ABET criteria for the undergraduate degree program in biomedical engineering. No visits have been made at this time as ABET Requires at least one graduate, but our internal accreditation team has reviewed the requirements. Given that we expect the first graduate we will schedule this for our 2026 ABET visit.

FAU also seeks accreditation by the Southern Association of Colleges and Schools (SACS) is an educational accreditor recognized by the United States Department of Education and the Council for Higher Education Accreditation. This agency accredits over 13,000 public and private educational institutions ranging from preschool to college level in the Southern United States. The Commission on Colleges accredits both public and private institutions of higher education in the United States, including some community colleges as well as four-year institutions.

SACS strives to enhance educational quality by ensuring that its member institutions meet selected standards that are recognized by the higher education community as indicators of institutional effectiveness, quality enhancement, continuous improvement, and a focus on student learning. As a member institution of SACS, the University is required to establish and observe policies and procedures that ensure compliance with The Principles of Accreditation as established by SACS. SACS accreditation extends to all of the educational programs offered at the accredited institution, which would include program like biology, physics and chemistry.

FAU Recently decided on its next Quality Enhancement Program (QEP) required for SACS accreditation. This program is designed to bring learning assistants to the classroom in subjects like calculus, chemistry and biology – all classes that impact the proposed degree program. The beta test was Calculus 1. The program was adopted for the university as a result of the success of these efforts in an open competition with other proposed QEPs. The SACS visit in the coming years will evaluate the success of this implementation.

VIII. Curriculum

A. Describe the specific expected student learning outcomes associated with the proposed program. If a bachelor's degree program, include a web link to the Academic Learning Compact or include the document itself as an appendix.

Web Link: https://www.fau.edu/engineering/ome/undergraduate/biomedical/

Biomedical Engineering Educational Objectives and Student Outcomes
The Biomedical Engineering program strongly supports the educational objectives and learning outcomes of the College of Engineering and Computer Science (see the Educational Objectives and Expected Student Learning Outcomes subsections previously listed in this section).

Program Educational Objectives are broad statements that describe the expected accomplishments and professional status of Biomedical Engineering graduates a few years beyond the baccalaureate degree.

The Biomedical Engineering program at Florida Atlantic University is dedicated to graduating engineers who, within a few years after graduation will:

A. Practice biomedical engineering within the general areas of biomaterials and tissue engineering, bio-robotics, bioinformatics, nursing technology and smart health systems in the organizations that employ them;

B. Advance their knowledge of biomedical engineering, both formally and informally, by engaging in lifelong learning experiences including attainment of professional licensure and/or graduate studies;

C. Serve as effective professionals based on strong interpersonal and teamwork skills, an understanding of professional and ethical responsibility and a willingness to take the initiative and seek progressive responsibilities;

D. Participate as leaders in activities that support service to, and/or economic development of, the community, the region, the state and the nation.

The educational objectives of the Bachelor of Science in Biomedical Engineering program are achieved by ensuring that graduates have the following characteristics or student outcomes:

1. An ability to identify, formulate and solve complex engineering problems by applying principles of engineering, science and mathematics;

2. An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety and welfare, as well as global, cultural, social, environmental and economic factors;

3. An ability to communicate effectively with a range of audiences;

4. An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental and societal contexts;

5. An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks and meet objectives;

6. An ability to develop and conduct appropriate experimentation, analyze and interpret data and use engineering judgment to draw conclusions;

7. An ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

B. Describe the admission standards for the program are as follow:

The following units of study in high school are required to be considered for admission to FAU. These are also the only courses that are calculated in the grade point average (GPA) used to determine admissions eligibility:

- English (3 with substantial composition): 4 units
- Mathematics (Algebra 1 level and above): 4 units
- Natural Science (2 with lab): 3 units
- Social Science: 3 units
- Foreign Language (of the same language): 2 units
- Academic Electives: 2 units

Total: 18 units

If students are currently taking or have taken courses that are clearly marked as Honors, Advanced, Gifted, Advanced Placement (AP), Advanced International Certificate of Education (AICE) or International Baccalaureate (IB), additional weight will be given for these courses.

The College is competitive and selective. Foundational coursework in mathematics is key to success in engineering and computer science. The following high school courses are strongly recommended to prepare for the rigors of our programs:

- Algebra 1
- Geometry
- Algebra 2
- Precalculus / Trigonometry
- Calculus 1 / AP Calculus

Pre-engineering students who are not yet prepared for college calculus and who demonstrate a capacity to be successful in college level coursework will be considered for the Engineering Bridge Program.

Graduates from the program will have achieved 120 credits, maintained a 2.0 or greater GPA, 45 cr of engineering coursework, 30 cr of math and science coursework, IFP requirements, a capstone experience, and coursework as outlined in the next section. Note to meet medical school admissions, and to achieve the goals for engineering, the program is prescriptive.

C. Describe the curricular framework for the proposed program, including number of credit hours and composition of required core courses, restricted electives, unrestricted electives, thesis requirements, and dissertation requirements. Identify the total numbers of semester credit hours for the degree.

The degree program requires 120 credits. Coursework will include 24 credits of IFP social Science and Humanities, 12 credits of math/science IFP, 33 credits of science, and 47 credits of engineering classes including 6 credits of capstone design class. There are 5 areas of specialty, as defined in the following program plan:

Intellectual Foundations Program		
College Writing 1	ENC 1101	3
College Writing 2	ENC 1102	3
Intellectual Foundations Program: Society and Human Behavior Courses		6
Intellectual Foundations Program: Global Citizenship Courses		6
Intellectual Foundations Program: Humanities Courses		6

Foundations of Math and Quantitative Reasoning

Calculus with Analytic Geometry 1 (1,4)	MAC 2311	4
Calculus with Analytic Geometry 2 (1,4)	MAC 2312	4
Foundations of Science and the Natural World		
General Chemistry 1 (1,5)	CHM 2045	3 **and**
General Chemistry Lab 1	CHM 2045L	1
General Physics for Engineers 1 (1,5,7)	PHY 2048	3 **and**
General Physics 1 Lab	PHY 2048L	1
Total		**40**

Basic Mathematics and Sciences		
Statistics Restricted Elective		3
Engineering Mathematics 1	MAP 3305	3 or
Differential Equations 1	MAP 2302	3
Biological Principles (5)	BSC 1011	3 **and**
Biological Principles Lab	BSC 1011L	1
General Chemistry 2 (5)	CHM 2046	3 **and**
General Chemistry 2 Lab	CHM 2046L	1
General Physics for Engineers 2 (5)	PHY 2049	3 **and**
General Physics 2 Lab	PHY 2049L	1
Organic Chemistry	CHM 2210	3
Organic Chemistry 2	CHM 2211	3
Organic Chemistry 2 Lab	CHM 2211L	1
Biochemistry	BCH 3033	3 and
Biochemistry Lab	BCH 3033L	1
Anatomy & Physiology 1	BSC2085	3 and
Anatomy & Physiology 1 Lab	BSC2085L	1
Genetics	PCB 3063	4
Total		**33**

Engineering Fundamentals		
Intro or Fundamentals of Engineering	EGN 1002	3
Engineering Graphics Elective		
Computer Aided Design	CGN 2327	3 **or**
Engineering Graphics	EGN 1111C	3
Intro to Programming in Python	COP 2034	3
Statics	EGN 3311	3
Dynamics	EGN 3321	3
Data Structures and Algorithms with Python (COP 3043) for Bioinformatics track and Smart Health track, or Thermodynamics (EGN 3343) for Biomaterials and Tissue Engineering track and Biorobots track	COP 3043 or EGN 3331	3
Circuits 1	EEL 3111	3
Signal and Digital Filter Design	EEL 3514	3
Introduction to Biomedical Engineering	BME 4001	3
Total		**27**

Capstone Design Core

RI: Engineering Design 1 (5)	EGN 4950C	3
RI: Engineering Design 2 (5)	EGN 4952C	3
Total		**6**

Choose 2 focus areas (for a total of 12 credits, 6 from both areas chosen)

Biomaterials and Tissue Engineering Focus Area (choose 3 from the list)		
Tissue Engineering	BME 4331	3
Stem Cell Engineering	BME 6324	3
Nanotechnology or Intro to Nanobiotechnology	BME 4571 or BME 4574	3
Neural Engineering	BME 4361	3
Total		**6**

Bio robotics Focus Area (choose 2 from the list)		
Intro to Robotics	EML 4800	3
Electro-Mechanical Devices	EGM 4045	3
Introduction to Microfluidics and BioMEMS	BME 4581	3
Total		**6**

Bioimaging Technologist Focus Area (choose 2 from the list)		
Intro to Bioimaging	BME 4512	3
Introduction to Bio signal Processing	BME 4523	3
Total		**6**

Bioinformatics Focus Area (take the following two courses)		
Computational Genomics	CAP 4514	3
Algorithms for Bioinformatics	CAP 4543	3
Total		**6**

Smart Health Systems Focus Area (choose 2 from the list)		
Biosystems Modeling and Control	BME 4741	3
Intro to Artificial Intelligence	CAP 4630	3
Data Mining & Machine Intelligence	CAP 4770	3
Intro to Deep Learning	CAP 4613	
Total		**6**

Technical Electives (Select 2 credits from the list)		
Engineering Professional Internship	EGN 3941 or IDS3949	0-2
For pre-med students – choose biology lab (1 cr) and one other science lab (1))		0-2
Directed Independent Research in Engineering and Computer Science or Directed Independent Research in Science (6)	EGN 4915	0-2
Total		**2**

Notes:

(1) Contributes to University Core Curriculum requirements.

(2) Contributes to Writing Across Curriculum (Gordon Rule) writing requirement.

(3) Intellectual Foundations Program courses, totaling 6 credits,-must be selected to satisfy Writing Across Curriculum (Gordon Rule) writing requirements.

(4) Contributes to Gordon Rule mathematics requirement.

(5) Includes a 1-credit laboratory.

(6) Grading: S/U.

(7) PHY 2048, General Physics 1 (4 credits) is an acceptable substitute, but only 3 credits will apply toward the degree.

Details of the courses are included as follows:

D. Provide a sequenced course of study for all majors, concentrations, or areas of emphasis within the proposed program.

The flight plan is shown in Table 14.

Table 14 – Flight Plan

Fall	Cr	Spring	Cr
Calc 1 MAC 2311	4	Calc 2 MAC 2312	4
Chemistry 1 CHM2045	3	English Comp 2 ENG 1102	3
Chem Lab 1 CHM2045L	1	Physics for Eng. 1 PHY2048	3
English Comp 1 ENG 1101	3	Physics for Eng. 1 lab PHY2048L	1
Biology 1 BSC 1010	3	Chemistry 2 CHM2046	3
Biology 1 Lan BSC 1010L	1	Chem Lab 2 CHM2046L	1
	15		15

Emath MAP 3305	3	Organic Chem 2 CHM 2211	3
Fund of Eng. (EGN1002)	3	Organic Chem 2 CHM 2211L	1
Physics for Eng. 2 PHY2049	3	Biochemistry BCH 3033	3
Statics EGN3311	3	Biochemistry lab BCH 3033L	1
Physics for Eng. 2 lab PHY2049L	1	Statistics Elective	3
Organic Chem 1 CHM 2210	3	Circuits EEL 3111	3
	16		14

Thermo or COP 3043	3	Signals & Digital Filters EEL 3514	3
IFP	3	IFP	3
Intro to Bio Med BME4001	3	Nano or Neural BME 4571/4	3
Anatomy & Phys BSC 2085	3	IFP	3
Anatomy & Phys Lab BSC2085L	1	Drafting class elective	3
Dynamics (EGN3321)	3	Intro to Python (COP2034)	3
	16		18

IFP	3
Sr Design	3
Tech Elective 1	3
Tech Elective 2	3
Internship/DIR/Lab	1
	13

IFP	3
Sr Design	3
Tech Elective 3	3
Tech Elective 4	3
Internship/DIR/Lab	1
	13

120

The major includes five areas of focus: 1- Biomaterials and Tissue Engineering, 2- Smart Health Systems, 3- Bio-robotics, 4- Bio-informatics and 5- Imaging Technologist, each requiring 2 elective courses at minimum and requiring students to choose two areas of focus to complete the major:

Biomaterials and Tissue Engineering Focus Area (choose 3 from the list)		
Tissue Engineering	BME 4331	3
Stem Cell Engineering	BME 6324	3
Nanotechnology or Intro to Nanobiotechnology	BME 4571 or BME 4574	3
Neural Engineering	BME 4361	3
Total		**6**

Bio robotics Focus Area (choose 2 from the list)		
Intro to Robotics	EML 4800	3
Electro-Mechanical Devices	EGM 4045	3
Biomaterials	BME 4100	3
Introduction to Microfluidics and BioMEMS	BME 4581	3
Total		**6**

Bioimaging Technologist Focus Area (choose 2 from the list)		
Intro to Bioimaging	BME 4512	3
Bioinstrumentation and Measurement	BME 4935	3
Introduction to Bio signal Processing	BME 4523	3
Total		**6**

Bioinformatics Focus Area (take the following two courses)		
Computational Genomics	CAP 4514	3
Algorithms for Bioinformatics	CAP 4543	3
Total		**6**

Smart Health Systems Focus Area (choose 2 from the list)		
Biosystems Modeling and Control	BME 4741	3
Intro to Artificial Intelligence	CAP 4630	3
Data Mining & Machine Intelligence	CAP 4770	3
Intro to Deep Learning	CAP 4613	
Total		**6**

Technical Electives (Select 2 credits from the list)		
Engineering Professional Internship	EGN 3941 or IDS3949	0-2
For pre-med students – choose biology lab (1 cr) and one other science lab (1))		0-2
Directed Independent Research in Engineering and Computer Science (6)	EGN 4915	0-2
Total		**2**

E. **Provide a one- or two-sentence description of each required or elective course.**

<u>Required Courses</u> (course credits vary):

Course	Cr	Description
Calc 1 MAC 2311	4	Continuity, differentiability, differential approximation, optimization and curve sketching of functions and inverse functions of a single variable, including treatment of trigonometric functions. Mean value theorem and L'Hopital's Rule. Introduction to integration.
Calc 2 MAC 2312	4	Continuation of MAC 2311. Logarithmic, Exponential, hyperbolic, and inverse trigonometric functions, techniques of integration, partial fractions, area, trapezoid and Simpson's rules, volume, work; analytic geometry; Taylor approximations; sequences and series; polar representation of complex numbers. This is a General Education course
Chemistry 1 CHM2045	3	An introduction to chemical principles, including atomic structure, chemical bonding, kinetics, thermodynamics and properties of the elements. A prerequisite to all other chemistry courses in science programs.
Chem Lab 1 CHM2045L	1	An introduction to experimental techniques in chemistry designed to demonstrate basic chemical principles. This is a General Education course
English Comp 1 ENG 1101	3	Reading examples of effective expository prose and writing essays practicing the forms of rhetoric.
English Comp 2 ENG 1102	3	A continuation of College Writing 1.
Biology 1 BSC 1010	3	A comprehensive treatment of biological principles, including the scientific method, evolution and natural selection, cell biology, energy transformation, reproduction, development, genetics and molecular biology. This is a General Education course.
Biology 1 Lan BSC 1010L	1	An introduction to general laboratory procedures to demonstrate the basic principle of biology. This is a General Education course
Physics for Eng. 1 PHY2048	3	This is the first course in a two-semester sequence on calculus-based introductory physics. Covers mechanics, linear and rotational motion, fluids, waves, and heat. There is an emphasis on mathematical analysis of physical problem
Physics for Eng. 1 lab PHY2048L	1	Experiments in mechanics, fluids, heat, wave motion and sound comprise this course. Several classes cover developing theoretical problem solving techniques.
Physics for Eng. 2 PHY2049	3	Intended for engineering majors, the course surveys fundamental laws and phenomena of electricity, magnetism, and optics. Emphasis on mathematical analysis of physical problems.
Physics for Eng. 2 lab PHY2049L	1	Intended for science majors, the course surveys fundamental laws and phenomena of electricity, magnetism, and optics. Emphasis on mathematical analysis of physical problems.
Chemistry 2 CHM2046	3	An introduction to chemical principles including atomic structure, chemical bonding, kinetics, thermodynamics and properties of the elements. A prerequisite to all other chemistry courses in science programs

Chem Lab 2 CHM2046L	1	An introduction to chemical principles including atomic structure, chemical bonding, kinetics, thermodynamics and properties of the elements. A prerequisite to all other chemistry courses in science programs
Organic Chem 1 CHM 2210	3	A study of the compounds of carbon and their physical properties, structures, chemical behavior and reaction mechanisms
Organic Chem 2 CHM 2211	3	Continuation of CHM 2210
Organic Chem 2 CHM 2211L	1	Experimental study of the synthesis, purification, and identification of organic compounds using microscale techniques
Biochemistry BCH 3033	3	The organic chemistry of biological compounds; carbohydrates; amino acids; peptides, and proteins; nucleosides and nucleotides; nucleic acids, replication, transcription and translation; saponifiable lipids; steroids and terpenes
Emath MAP 3305	3	Complex numbers, first order differential equations, second order linear differential equations, solution of equations by Laplace transforms, solution of linear systems of differential equations.
Fund of Eng. (EGN1002)	3	Engineering survival skills: orientation, professionalism, planning, problem solving, creative thinking, software and calculator techniques, time and project management, teaming skills, engineering disciplines, report writing, and technical communications
Statics EGN3311	3	Analysis of force and moment systems for static equilibrium of trusses, beams, frames, and machines; elements of frictions; centroid, center of gravity, center of mass, and moment of inertia
Intro to Python (COP2034)	3	This class is an introduction to programming using the Python language for students who have no prior programming experience. It introduces programming fundamentals, problem-solving methods, algorithm development, unit testing and debugging techniques. The course covers Python data types, control structures, functions, modules, exception handling, input/output, classes and elements of object-oriented programming
Signals & Digital Filters EEL 3514	3	This course covers the principles of linear adaptive filtering, various adaptive filtering techniques, and their relationships to optimal linear filter solutions. Also emphasized are such applications such as adaptive filtering as noise and echo cancellation, adaptive equalization, line enhancement, and beam forming
Circuits EEL 3111	3	Introductory to electric circuit analysis: passive and active sign conventions; Ohm's and Kirchhoff's laws; network analysis, theorems as applied to d-c and a-c circuits; basic op-amp circuits; single time constant transient analysis; phaser representations and sinusoidal steady state; real and reactive single phase power
Anatomy & Phys BSC 2085	3	A study of structure and physiology from the cellular to the system levels in the human body, including integumentary, skeletal, muscular, nervous and endocrine
Anatomy & Phys Lab BSC2085L	1	Laboratory investigations to augment the content of BSC 2085
Dynamics (EGN3321)	3	Dynamics of particles and rigid bodies, applications of free-body diagrams, Newton's second law, the impulse-momentum method and the work-energy principle to solve dynamic problems in mechanical systems
Thermodynamics	3	Structure of material systems from the atomic, micro and macroscopic standpoints. Equilibrium and non-equilibrium structures. Relationship between structure and electrical, thermal, mechanical and failure properties of metals, ceramics and polymeric materials. Strengthening mechanisms in materials
Drafting class elective	3	Fundamentals of graphical and spatial analysis; graphics and drafting principles; computer-aided drafting; 2D and 3D visualization, modeling, and construction; engineering applications
Intro to Bio Med BME4001	3	Course provides a broad perspective of biomedical engineering as applied to topics in contemporary biology, physiology, and medicine, including biotechnology and bioinformatics

Sr Design 1	3	Students develop and present proposals for capstone design projects to be completed in EGN 4952C. Work in interdisciplinary teams is required. Topics include local and global impacts of computing and engineering solutions, multiple constraints, lifelong learning, and ethics
Sr Design 2	3	Continuation and completion of multidisciplinary team projects initiated in EGN 4950C.

Electives (all courses 3 credits):

Elective	Course #	Cr	Description
Tissue Engineering	BME 4331	3	Principles and newest concepts of tissue engineering: concise and comprehensive. Learning and studying molecular, cellular, and tissue culture aspects of TE, and Laboratory work along with highly developed instrumentations for growing tissues
Stem Cell Engineering	BME 6324	3	Focuses on the stem cell's research and engineering to clarify the nature of these cells, their sources and categories, their engineering for different purposes, their role as cellular therapeutic approach, reprogramming of ordinary cells into stem cells through a combination of readings, penetrating discussions and animation of new techniques and tools
Neural Engineering	BME 4361	3	Neural engineering concentrates on the development of technologies for rehabilitation, treatment or compensation of damages in the central and peripheral nervous systems. Modern techniques and signal processing algorithms used in brain machine interface applications, including different brain recording and stimulation methods and closed-loop brain control applications
Intro to Robotics	EML 4800	3	Robot classification, robot systems, economic justification; product design for robot assembly; programming, part feeding, tooling.
Intro to Nanobiotechnology	BME 4574	3	The sensing and characterization of biological entities, processes and events, with novel nanoscale devices and nano-object mediated modalities, have immediate and far-reaching impacts. This course covers the fundamentals of nanotechnology in biological and biomedical research.
Introduction to Microfluidics and BioMEMS	BME 4581	3	A comprehensive introduction to microfluidics, micro-electro-mechanical systems (MEMS) and applications in the life sciences. Topics include laminar flow, viscosity, surface tension, dimensionless numbers, Electro kinetics, photolithography, soft lithography, flow control, flow sensors of micrometer scale as well as applications of microfluidics and MEMS for molecular biology and cell biology
Intro to Bioimaging **PENDING APPROVAL**	BME 4512	3	The course fits within the goals of the college to foster and facilitate interdisciplinary research, and it provides students with the necessary fundamental concepts to do research in biomedical imaging. Topics of the course cover image characteristics, Fourier transforms, image acquisition, image processing and analysis, convolution, sampling, resolution, contrast, filtering; principle of imaging tools such as radiography, CT, ultrasound, MRI and optical imaging
Bioinstrumentation and Measurement	BME 4935	3	This course covers design of biomedical instrumentation and diagnostic devices (aspects of electronic, mechanics, chemical and biological components) to measure physiological parameters.
Introduction to Bio-signal Processing **PENDING APPROVAL**	BME 4523	3	This course covers the generation of bioelectrical signals, their acquisition, modeling, and analysis. Modeling and analysis tools cover adaptive filtering, time-frequency analysis, model-based spectral analysis, stochastic signals and signal representation in orthogonal bases, such as wavelet transforms. The physiology of electrical signal generation covers ionic transport in cellular membranes and propagation of electrical signals in cells and tissues

Computational Genomics **PENDING APPROVAL**	CAP 4514	3	This course focuses on the computational analysis of modern high throughput genomic data. In particular, the course covers the application of R packages in performing exploratory data analysis, predictive modeling and addressing questions about different types of genomic data
Algorithms for Bioinformatics **PENDING APPROVAL**	CAP 4543	3	This course covers the data structures and algorithms commonly used in the field of bioinformatics. Emphasis is on topics related to classical and modern techniques employed for biological sequence analysis.
Biosystems Modeling and Control	BME 4741	3	This is a basic "Systems Level" - electrical, mechanical, electromechanical, biological, chemical, fluid, thermal, aerospace, economic etc. may obey the same type of mathematical descriptions.
Intro to Artificial Intelligence	CAP 4630	3	A broad introduction to the core concepts of artificial intelligence, including intelligent agents, problem solving by search, knowledge representation and reasoning and learning from examples. Programming in Python and possibly other software environments.
Data Mining & Machine Intelligence	CAP 4770	3	This course teaches the principles of data mining and machine learning. Topics include classical machine learning algorithms, such as regression, classification and clustering, feature selection methods and applications of machine learning
Intro to Deep Learning	CAP 4613	3	This course teaches students basic concepts of deep learning. The course covers three major topics, including statistical machine learning, neural network structures and deep neural networks. Detailed topics include introduction to machine learning algorithms, perceptron learning, multi-layer neural networks, and deep neural network structures and learning algorithms.
Biomaterials	BME 4100	3	This course covers a comprehensive introduction of biomaterials science, the properties of biomaterials, the classes of biomaterials and the applications of biomaterials in medicine. The content of this course includes preparation, characterization and biological evaluations of biomaterials. Specific biomaterials such as bio-ceramics, polymers and hydrogels are discussed

F. For degree programs in the science and technology disciplines, discuss how industry-driven competencies were identified and incorporated into the curriculum and indicate whether any industry advisory council exists to provide input for curriculum development and student assessment.

This data was gathered from industry trends for southeast Florida developed from employers and employee trending sites like Indeed.com and ZIpRecuiter.com, Bureau of Labor Statistics, the Hanover market study and the advisory committees for the mechanical and electrical engineering degree programs and college advisory committee.

Additional data on course offering and academic trends was gathered from a survey of the top 12 BSBME programs (including #1 Johns Hopkins University, #2 Georgia Tech, #3 MIT, #4 Duke University, #5 Stanford University, #6 University of Michigan, #7 Cal-Berkeley, #8 Rice University, #9 UCSD, #10, University of Pennsylvania, #11 Boston University, #12 Northwestern University), the 4 other Florida schools, University of Iowa, Washington State University and University of Rochester, consultation with ABET on degree program requirements, and discussions with several ABET reviewers (all of whom encouraged us to pursue the B.S. in Biomedical engineering as a game changer). The latter were most useful in discussing how education was changing (one was from Johns Hopkins University). See Table 15 for comparisons.

Table 15 – Typical Biomedical Engineering Programs – Other Schools

Class	FAU	UF	USF	FIU	FGCU	J. Hopkins #1	Ga. Tech #2	MIT #3	Duke #4	Stanford #5	Michigan #6	Berkeley #7	Rice #8	UCSD #9	Penn #10	Boston U #11	Northwestern $12	Wash State	Miami	iowa	Rochester
Calc 1	4	4	4	4	4	4	2	2	4	5	4	4	4	4	4	4	4	4	5	4	4
Calc 2	4	4	4	4	4	4	4	2	4	5	4	4	4	4	4	4	4	4	4	4	4
Calc 3		4	4	4	4	4	4	2	4	5	4	4	4	4	4	4	4	4			4
Diff Eq	3	3		3	3	4	4	2	5		4	3	4			4	4	2	3	3	2
Statistics	3	3	3	3	3	3	3			5		3	3		4	4	3	3	3	3	4
Matrix Alg	3																	2		2	
linear alg							2		2							2					2
Num methods													3					3	3		
English	6	6	9	6	6		6		3							4	9	6	6	4	8
SS & Hum	15	12	12	15	21	18	21		18	21	16	21	30		28	20	21	12	18	15	16
Fund Of Engg			3	2							4	2		1		2		2	5	4	
Seminar				3																4	
Intro to computer	3	5	3	3	2	3	3	8	3	5	4	3	3	3	4	4		3	3	3	1
Chemisty 1	3	3	3	3	3	4	4	3	3	5	3	3	3		6	4	4	3	3	4	3
Chem 1 lab	1	1	1	1	1			1	1			1	1					1	1		1
Chemistry 2	3	3	3	3	3	4		3	4		4	4	3		6	4	4	3	3	4	3
Chem 2 lab	1	1	1	1	1			1			1	1	1					1	1		1
Physics 1	3	3	3	3	3	5	4		4	4	5	3	3	5	4	4	4	4	3	4	3
Physics 1 lab	1	1	1	1	1							1	1	2							1
Physics 2	3	3	3	3	3	5	4			4	5	3	3	5	4	4	4	4	3	4	3
Physics 2 Lab	1	1	1	1	1							1	1						1		1
Physics 3																			4		
Biology	4	4	4	4	4				4	4	4	8	3		6			4	4		4
Organic Chem	8	2	5		4		3	8	4	5			3				3	2			4
Add Science																					4
Neurobiology						3															
Molecular Chem/bio		3															3				
Biochem	3	2								4	4										
physiology	3	4	3		6		3			4					4	4	9		3	3	
Fluids					3												3		3	3	
immunology	3																				
Thermo		3	3					8			4		3			4	3			3	
Biomechanics	3				3		3				4		3		4		3		3		4

Class	FAU	UF	USF	FIU	FGCU	J. Hopkins #1	Ga. Tech #2	MIT #3	Duke #4	Stanford #5	Michigan #6	Berkeley #7	Rice #8	UCSD #9	Penn #10	Boston U #11	Northwestern $12	Wash State	Miami	iowa	Rochester
Cell Biology/Eng		3	3			3	3	8	4		3		3	1	4			3		3	
Quant. Physiology		3			3		7		4		3										4
Materials	6	3	3	3	6		3		4		4		3		4		3	4	3	7	4
Bio dynamics			3			3													6	3	
Clinical rotation				3																	
Bio Lab			2	6		6		10		4	4		3		4		3				
microbio	3																				
Cell Biology/Eng								8													
Biomed Instrumen	3	4	3	3	3	3	1	8	4		4		6		4	4	3	3	4	3	
Intro to Biomed	3	4	3	3			4			4	3	4	3		2			1			4
Circuits	3	3	3	4	3	3	2		4		4		3			4	3	3	4	3	4
statics	3	3	3	6	4		2		4	4			3			4			2	3	
ethic			3							3		4						1			
systems biology	3					6				3			6				3	3			
Biosystem proto lab										4											
genetics								8		4											
physical bio										4									3		
biotransport		3	3	3			3	8					3		4		3	3	3		
modeling Anal& design lab															8		3	2			
Tech Electives	6	15	9	18	6	21	27	24	20	12	14	40	9		8	28	6	18	7	21	16
Gen Electives			6			13		8	6		11					2					16
Deisgn	6	6	6	3	5	6	9	8	8	8	4	4	6		8	6		6	3	8	6
Biomed research	3	3																			
tissuelab													3				3		3		
BioChem Sensors		3			6				4							4	3	3	6		
Comp Genomics																	3				
Medical imaging		3															3		3		4
Bio Models and Simul			3	9		3			4									3	3	3	
Entrepenuership					3																
career					1	1															
Health Care					3																
drawing					3														1		
	120	131	126	128	129	129	131	130	129	126	128	121	134	29	128	128	128	120	133	125	135

The advisory committees for the mechanical and electrical engineering degree programs are available to provide input for curriculum development and student assessment.

G. For all programs, list the specialized accreditation agencies and learned societies that would be concerned with the proposed program. Will the university seek accreditation for the program if it is available? If not, why? Provide a brief timeline for seeking accreditation, if appropriate. For degree programs in medicine, nursing, and/or allied health, please identify the courses that meet the requirements in Section 1004.08, Florida Statutes for required patient safety instruction.

As state engineering boards were being organized in the early 20th century, there was a need to do comparisons between colleges offering an engineering education nationally. The Accreditation Board for Engineering and Technology (ABET) was established in 1932 as a means to create a structured program for engineering guidance, training, education, and recognition.

Accreditation is a non-governmental, voluntary peer-review process that acts as an assurance that a program or institution meets established quality standards. The goal is to ensure that students graduating with a degree meet certain quality requirements and obtain certain outcomes established by industry. ABET is the organization that created the standards and applies those standards to accredit engineering degree programs. Since its origins, accreditation via ABET has served as the basis of quality against which professional engineers are held for licensure by state licensing boards. Because many states require applicants for engineering licensure to graduate from ABET accredited undergraduate programs, so nearly all engineering, colleges zealously try to maintain ABET accreditation every 6 years.

ABET is a nonprofit, non-governmental organization with ISO 9001:2015 certification (ABET website, 2019). Originally ABET was founded as the Engineers' Council for Professional Development (ECPD) with a mission to enhance the education of engineering professionals and students in the United States (ABET website). Within the engineering disciplines, ABET educational standards are developed from the member professional societies that commission the evaluation of degrees, the initial societies were (ABET, 2019):

- American Society of Civil Engineers (ASCE)
- American Institute of Chemical Engineers (AIChE)
- American Institute of Mining and Metallurgical Engineers, now the American Institute of Mining, Metallurgical, and Petroleum Engineers (AIME)
- American Society of Mechanical Engineers (ASME)
- American Institute of Electrical Engineers (now IEEE)
- National Council of State Boards of Engineering Examiners
- Society for the Promotion of Engineering Education, now the American Society for Engineering Education (ASEE)

ABET looks for the input these groups provide, and departments are expected to address, their comments in the curriculum. ABET coordinates with the National Association of Colleges and Employers (NACE) which establishes career readiness criteria and competencies among college graduates.

The college plans to accredit the program via the Accreditation Board for Engineering and Technology (ABET) which requires that there be at least one graduate of the program before accreditation can be applied for. As a result, the anticipation is that the college will seek ABET accreditation in 2026 at the same time as our other engineering degrees. If there are graduates prior to 2025/26, we will ask that they retroactively have their degrees accredited (standard practice). The College has been successful in the past with accreditation for all its bachelor of science degree programs.

The last ABET accreditation visit was 2020 when all 8 BS degree programs in the college were assessed. As a result of the visit, all 8 degree programs in the college were given full accreditation for the maximum time of six years. Hence the 2026 date for the next visit.

Outcomes from the visit included the need for development of better methods for assessing continued degree program improvements were an outcome that faculty have begun investing in to continue the process. The electrical and computer engineering degree programs, along with computer science were modified to better align the commonalities among those degree programs.

H. For doctoral programs, list the accreditation agencies and learned societies that would be concerned with corresponding bachelor's or master's programs associated with the proposed program. Are the programs accredited? If not, why?

The proposal is for a bachelor's degree program that will seek ABET accreditation. This degree is not a doctoral program.

I. Briefly describe the anticipated delivery system for the proposed program (e.g., traditional delivery on main campus; traditional delivery at branch campuses or centers; or nontraditional delivery such as distance or distributed learning, self-paced instruction, or external degree programs). If the proposed delivery system will require specialized services or greater than normal financial support, include projected costs in Table 3 in Appendix A. Provide a narrative describing the feasibility of delivering the proposed program through collaboration with other universities, both public and private. Cite specific queries made of other institutions with respect to shared courses, distance/distributed learning technologies, and joint-use facilities for research or internships.

The anticipated course delivery is traditional delivery on main campus.

IX. Faculty Participation

A. Use Table 2 in Appendix A to identify existing and anticipated full-time (not visiting or adjunct) faculty who will participate in the proposed program through Year 5. Include (a) faculty code associated with the source of funding for the position; (b) name; (c) highest degree held; (d) academic discipline or specialization; (e) contract status (tenure, tenure-earning, or multi-year annual [MYA]); (f) contract length in months; and (g) percent of annual effort that will be directed toward the proposed program (instruction, advising, supervising internships and practica, and supervising thesis or dissertation hours).

Appendix A Table 2 outline faculty participation in the first year and over the first 5 years of the program. The columns note the name, code, rank contract status and when they will participate. All faculty are on 9 month salaries, which is 75 percent (0.75) of a full time academic year. In column H, the percentage of the effort in the contractual year is noted. For example, Robert Lubarsky will allocate 5% of his time to the biomedical engineering program as this will be one of several majors taking his classes (based on the current students in his classes versus expected BSBME students as a percentage of those same classes). Column 9 is the multiplication of columns 7 and 8. For Lubarsky, the result indicates that over the full calendar year 3.75 (rounded to 4) percent of his time will be devoted to the program. Likewise the next 3 columns show that over the 5 year program, his time will be similar.

There are faculty like Sara Du and Erik Engeberg who only teach senior level classes. As a result, the first year they are not expected to have nay students in the BSBME program in their classes. However as both teach classes that involve the BSBME program at the upper level, their percentage of time will increase based on current students. Hence both will have about 7.5 percent (rounded to 8) of their time associated with teaching to BSBME students.

Since all the faculty are code A, in total the percent of FTE in the first year is only 0.38 (ore 38% of one Full time faculty). At the end of 5 years, it represents only 1.3 full time faculty time associated with the program. Hence because most of the classes required from the degree program are already part of the offerings of the college, the college is not seeking additional faculty.

B. Use Table 3-Appendix A to display the costs and associated funding resources for existing and anticipated full-time faculty (as identified in Table 2-Appendix A). Costs for visiting and adjunct faculty should be included in the category of Other Personnel Services (OPS). Provide a narrative summarizing projected costs and funding sources.

Appendix A Table 3 outlines the budget for the degree program. Building off Tale A-2 where the amount of FTE faculty time was developed for the first and fifth years, the first year 34% of an FT faculty assignment was carried to column 1, row 2. Given that there is a new degree program, 12.5% of time for an advisor was assigned to the project to help facilitate the degree program's growth, along with 12.5% of time for staff to help with administration. A cost of $5000 for miscellaneous expenses associated with added laboratory materials in the Fab Lab was included in the budget for a total of $69,443. Between years 1 and 5, the only difference is that the faculty allocation has increased due to the fact that upper division classes are being taught. Hence faculty allocation has risen from 0.34 to 1.31 FTE.

On the far right, the projected increase in student will decrease the E&G cost per FTE from $8680 in year 1 to $2680 in Year 5. Funding is expected to come from student tuition which is $4,879 In-state and $17,324 out-of-state tuition.

No additional capital, lab space, computer labs or classroom space is required. No classes outside the college are required. The added number of students per year to outside classes in biology and chemistry is minimal compared to the number of students currently in those classes (biology has over 2500 declared majors whereby our program is expected to have only 100 declared majors in 5 years – 4% of that of biology - http://biology.fau.edu/home/biology_department.php). Incidental lab or other materials are can be obtained with the $5000 misc. cost per year.

C. Provide in the appendices the abbreviated curriculum vitae (CV) for each existing faculty member (do not include information for visiting or adjunct faculty).

See attached Appendix C which includes a 2 page CV for each faculty member in the college that is expected to contribute to the degree program. These CVs are in the form used by the ABET accrediting agency and outline their education, research areas, awards and other significant contributions each faculty member has made tot eh college and can contribute to this degree program.

D. Provide evidence that the academic unit(s) associated with this new degree have been productive in teaching, research, and service. Such evidence may include trends over time for average course load, FTE productivity, student HC in major or service courses, degrees granted, external funding attracted, as well as qualitative indicators of excellence.

A brief summary of current grants is as follows:

Biomedical Engineering Research	**PI**	**Source**	**Funds**
Placenta-on-a-Chip Sensing Platform to Study Malaria	Sarah Du	NIH	$ 400,154.00
Development of an Artificial Hand Exhibit	Erik Engeberg	SFCSA	$ 84,433.00
Virtual Neuroprosthesis: Restoring Autonomy	Erik Engeberg	NIH	$ 1,441,000.00
Targeting cMyc in the control of Inflammation	Sarah Du	UM/NIH	$ 72,716.00
Dexterous Robotic Manipulator for Semi-Auton	Erik Engeberg	FIU/DOE	$ 160,000.00
Development of a 90 Days Expiration Dot	Mike Kim	TLTC	$ 57,772.00
Autotherapy of craniofacial bone defects using immunomodulatory and cell-recruiting bioceramic scaffolds	Kevin Kang	NIH	$ 142,892.00
Development of an in Vitro 3D Tumor Tissue Engineering Model for Esophageal Cancer	Kevin Kang	NIH	$ 142,285.00
I/UCRC for Center for Health Organization	Ankur Agarwal	VAR-SOU	$ 150,000.00

Transformation			
Development of a Middleware Framework for Medical Device Integration for Telemedicine	Ankur Agarwal	VAR-SOU	$ 50,000.00
A Mobile Based Care Coordination System for Critical Care	Ankur Agarwal	VAR-SOU	$ 100,000.00
FAU Site Phase-2: I/UCRC for Center for Health Organization Transformation	Ankur Agarwal	NSF	$ 200,000.00
Development of a diagnostic assay for rapid detection and quantification of Zika virus	Waseem Asghar	FDOH	$ 199,280.00
Medical image analysis using deep learning techniques	Oge Marques	VIS-SOU	$ 59,000.00
Development of disposable and refrigeration-free microchip technology for CD4+ T cell counting	Waseem Asghar	NIH	$ 459,580.00

See Appendix C for data on CV and activities

X. Non-Faculty Resources

A. Describe library resources currently available to implement and/or sustain the proposed program through Year 5. Provide the total number of volumes and serials available in this discipline and related fields. List major journals that are available to the university's students. Include a signed statement from the Library Director that this subsection and subsection B have been reviewed and approved.

The Florida Atlantic University (FAU) Libraries include the S.E. Wimberly Library on the Boca Raton campus, plus various on line journals, inter-library loan options and books housed in the college. The total number of volumes and serials available in this discipline and related fields and the list of major journals that are available to the university's students is included in the Letter from the Dean of Libraries in Appendix B.

B. Describe additional library resources that are needed to implement and/or sustain the program through Year 5. Include projected costs of additional library resources in Table 3-Appendix A. Please include the signature of the Library Director in Appendix B.

No added resources are needed – see Appendix B statement from the Dean of Libraries.

C. Describe classroom, teaching laboratory, research laboratory, office, and other types of space that are necessary and currently available to implement the proposed program through Year 5.

The College of Engineering and Computer Science has four laboratory facilities at the college level that support student education. The four facilities are a machine shop and an electronics lab at each of the Boca Raton and SeaTech campus locations. The Boca Raton facilities are housed in Building 36 Engineering West. These facilities are available for use by all students within the COECS. Each of the machine shops included both manual and CNC milling machines, manual lathes, along with other supporting equipment such as saws, surface grinders, welding equipment, and a number of hand tools.

The major limitation in the past was the need for a fabrication laboratory, with 3 D printers, laser cutters, fabrication tools, etc. The new Fabrication lab (Fab Lab) on the first floor of Engineering East was dedicated in 2020 to address this, among other challenges students faced with fabrication. The state-of-the-art facility is one of three in Flroida. It is designed to facilitate Student efforts in research and design. The lab includes laser cutters, 3D printers, metal work and a host of other equipment. Students will be introduced to the lab in the Fundamentals of Engineering class their freshman year.

The Electrical Engineering and Computer Science programs use the second floor of the Engineering East Building to conduct all of its lab-related instructions. The laboratories include:

- Electronics Lab
- Microprocessor/Microcontroller Lab
- Controls Lab
- Engineering Design Lab
- Computer Lab I
- Computer Lab II
- Computer Lab III
- RF and Communications Lab

There is one teaching lab on the fifth floor of that building.

The electronic labs on the second floor of Engineering East have the necessary equipment to produce custom electronic devices as well as diagnose malfunctioning equipment. Core hours of all the facilities are 9 am to 4:30 pm and are normally available outside these hours. The machine shops are only available with technical staff supervision and appointments can be made between 8 am and 10 pm to have someone available outside of core hours. The electronics lab at Boca is available 8 am to 5 pm with supervision and available until 10 pm with swipe card access. Descriptions of these laboratories are available on the College of Engineering and Computer Science website under the heading Student Resources and then Electronics Labs and Machine Shops or directly at (http://eng.fau.edu/student-labs-shops/).

The College maintains several Bioengineering research labs on the fifth floor of the FAU Behavioral Sciences in the Boca Raton campus. The labs serve faculty members from CEECS, OME and CEGE departments. The entire fifth floor of that building is rated “Bio-safety Level 2”. These labs, along with the Environmental Engineering Lab in Building 36 (Engineering West), are the only “wet labs” that our College has in the Boca Raton campus. Hence lab space is sufficient to deliver the program.

Computer labs are an important part of an engineering program. The following laboratories are available in the College (Engineering East Building 96, Engineering West Building 36):

College Open Use Labs:

EG 170 – Student Open Lab and Lounge (8 Computers)
EE 207 - Engineering Open Use Computing & Teaching Lab (30 Computers, 60 Seats)
EE 213 - Engineering Open Use Computing & Teaching Lab (18 Computers, 36 Seats)

College Research, Teaching & Computer Labs:

Engineering West Building 36 Labs:
EG 132 - Experimental Methodology Lab

Instructional Services Building 4 Labs:
IS 123 - AutoCAD Lab
IS 117 - CITSS Transportation Lab

Engineering East Building 96 Labs:
EE 203 - Microprocessor, Logic Design, Microcontroller Lab
EE 205A - Engineering Student Work Lab
EE 208 - Senior Projects, Design I and II Lab
EE 209 - Controls Lab
EE 210 – Electronics Lab
EE 212 – I-SENSE Lab
EE307 – I-SENSE Undergraduate and Graduate Lab
EE 408B - Signal Image & Video Processing Lab
EE 409 - Multipurpose Lab (CSI)
EE 410A - Web Development Lab
EE 410B - Digital Signal Processing Lab
EE 413 - Mobile Computing, Sensor and Wireless Lab
EE 507A - Empirical Software Engineering Lab (ESEL)

EE 507B – Data Science Lab and Bidtellect Lab
EE 508 - RF, Microwave and Communications Lab

Computer lab availability is sufficient to support the degree program.

As the courses required for the B.S. in Biomedical Engineering degree program are mostly in place at this time, no added faculty are needed. Hence office space, which is sufficient now per our most recent ABET visit in 2020, will suffice for the program.

Likewise, since the courses are being offered today, additional classroom space, which is controlled by the Registrar's office, will not be required either.

D. Describe additional classroom, teaching laboratory, research laboratory, office, and other space needed to implement and/or maintain the proposed program through Year 5. Include any projected Instruction and Research (I&R) costs of additional space in Table 3-Appendix A. Do not include costs for new construction because that information should be provided in response to X (E) below.

No added facilities are needed to start the program.

E. If a new capital expenditure for instructional or research space is required, indicate where this item appears on the university's fixed capital outlay priority list. Table 3-Appendix A includes only Instruction and Research (I&R) costs. If non-I&R costs, such as indirect costs affecting libraries and student services, are expected to increase as a result of the program, describe and estimate those expenses in narrative form below. It is expected that high enrollment programs in particular would necessitate increased costs in non-I&R activities.

No added capital facilities are needed.

F. Describe specialized equipment that is currently available to implement the proposed program through Year 5. Focus primarily on instructional and research requirements.

No added facilities needed based on current equipment that is currently located in the labs in Engineering East and Engineering West. Computers are located in both buildings. Centers for sensors and AI are located in Engineering East. Machine shops are available in Engineering West. The college's new fabrication lab is available for research efforts on the first floor of Engineering East.

G. Describe additional specialized equipment that will be needed to implement and/or sustain the proposed program through Year 5. Include projected costs of additional equipment in Table 3-Appendix A.

No added equipment needed as noted in the prior paragraphs.

H. Describe any additional special categories of resources needed to implement the program through Year 5 (access to proprietary research facilities, specialized services, extended travel, etc.). Include projected costs of special resources in Table 3-Appendix A.

No added equipment needed as noted in the prior paragraphs.

I. Describe fellowships, scholarships, and graduate assistantships to be allocated to the proposed program through Year 5. Include the projected costs in Table 3-Appendix A.

There are no fellowships or graduate assistantships for the undergraduate program. However, the college offers a series of scholarships that students can apply for:

College of Engineering and Computer Science Scholarships

Eric Alexander Engineering and Computer Science Scholarship

Awards are available to undergraduate engineering or computer science students who have a minimum 3.0 GPA and who have completed more than 30 credit hours. Preference will be given to students from the Treasure Coast area (Martin and St. Lucie Counties). This scholarship may be renewed for up to four consecutive years if 3.0 GPA is maintained. Pre-engineering students are not eligible for this award.

Fall Scholarship | (4) $1,000 | Application

Gary & Wendy Enzor First Generation Scholarship Fund

Award available to a full-time College of Engineering and Computer Science student who has a minimum 3.25 *Cumulative* FAU GPA and demonstrated financial need (as determined by the current year's FAFSA). Preference will be given to first generation students (as determined by the current year's FAFSA). This scholarship is to be used for tuition and fees only.

Fall Scholarship | $1,000 | Application

Karl K. Stevens Student Scholarship

Award available to all junior or senior engineering or computer science students who have displayed leadership while in college.

Spring Scholarship | $1,000 | Application

FAU SECME Scholarships

Awards of $3,000 per year are available to a limited number of students from SECME High Schools in Broward and Palm Beach counties.

Selection Criteria: Students must meet the academic requirements for admission to FAU and have participated in the SECME program for a minimum of one year. Renewable for up to four years based on academic achievement. Applicants must major in Engineering, Mathematics or Science, achieve a minimum score of 1450 (all three sections) on the SAT or a 21 on the ACT and submit the items listed below.

DEADLINE: March 30 by 5 p.m. | SECME Application

Computer Engineering or Computer Science Scholarship

Racal-Datacom Award of Excellence

Award available to a senior undergraduate student majoring in computer engineering, electrical engineering, or computer science. This scholarship is based on financial need, academic achievement, and involvement/interest in the telecommunications field. Extra consideration will be given to minority or female applicants, and to applicants who have not previously won a scholarship at FAU.

Spring Scholarship | $1,000 | Application

Electrical Engineering Scholarships

AT&T Scholarship

Awarded per term for a limit of 4 terms to an FAU electrical engineering student that maintains a minimum GPA of 3.3. Preference is given to minorities and deserving and academically qualified non-traditional-age women studying electrical engineering.

Fall Scholarship | $1,000 | Application

Racal-Datacom Award of Excellence

Award available to a senior undergraduate student majoring in computer engineering, electrical engineering, or computer science. This scholarship is based on financial need, academic achievement, and involvement/interest in the telecommunications field. Extra consideration will be given to minority or female applicants, and to applicants who have not previously won a scholarship at FAU.

Spring Scholarship | $1,000 | Application

Mechanical Engineering Scholarships
Andrew Montano Memorial Scholarship Open to an incoming freshman, sophomore, junior or senior with a minimum GPA of 3.0, who possesses unmet financial need, (as determined by the current year's FAFSA) and is a mechanical engineering major. Fall Scholarship | (2) $1,000 | Application Please note: As completion of a recent FAFSA is a requirement of this scholarship, only US Citizens, US Permanent Residents, and other eligible non-citizens may apply for this scholarship. For more information about who may complete a FAFSA, please visit: https://studentaid.gov/understand-aid/eligibility/requirements
ASME Student Membership Scholarship Award available to a full-time junior or senior mechanical engineering major. The scholarship recipient must be an active member of the American Society of Mechanical Engineers (ASME) and in good standing with the University. All students are encouraged to apply regardless of GPA. Fall & Spring Scholarship | (2) $500 | Application
CAPTAIN CHARLES F. AND ISABEL HILL MEMORIAL SCHOLARSHIP Award open to a full-time undergraduate student majoring in mechanical engineering with an overall 3.5 GPA or higher. Preference will be given to female students and/or US veterans studying mechanical engineering. **SPRING | $1,000**

J. Describe currently available sites for internship and practicum experiences, if appropriate to the program. Describe plans to seek additional sites in Years 1 through 5.

The college has a part-time embedded Career Center liaison in its advising office. The goal of the effort between the college and the Career center is to ensure any student wanting an internship, can get one. Credit can be offered for internships under certain circumstances through joint action of the Dean's office and the Career Center. The average number of internships (reported) over the past 3 years exceed 200 per year in the college, peaking at over 300 just before the pandemic. All are paid positions. As we have with current internship positions, the college fully anticipated reaching out to location biomed companies for internship opportunities. We expect that from the Sophomore year onward, every student will be able to obtain a paid internship prior to graduation.

APPENDIX A

TABLE 1-A
PROJECTED HEADCOUNT FROM POTENTIAL SOURCES
(Baccalaureate Degree Program)

Source of Students (Non-duplicated headcount in any given year)*	Year 1 HC	Year 1 FTE	Year 2 HC	Year 2 FTE	Year 3 HC	Year 3 FTE	Year 4 HC	Year 4 FTE	Year 5 HC	Year 5 FTE
Upper-level students who are transferring from other majors within the university**	10	8	8	6.4	5	4	0	0	0	0
Students who initially entered the university as FTIC students and who are progressing from the lower to the upper level***	0	0	10	8	30	24	60	48	85	68
Florida College System transfers to the upper level***	0	0	4	3.2	10	8	10	8	10	8
Transfers to the upper level from other Florida colleges and universities***	0	0	3	2.4	5	4	5	4	5	4
Transfers from out of state colleges and universities***	0	0	0	0	0	0	0	0	0	0
Other (Explain)***	0	0	0	0	0	0	0	0	0	0
Totals	**10**	**8**	**25**	**20**	**50**	**40**	**75**	**60**	**100**	**80**

* List projected annual headcount of students enrolled in the degree program. List projected yearly cumulative ENROLLMENTS instead of admissions.
** If numbers appear in this category, they should go DOWN in later years.
*** Do not include individuals counted in any PRIOR CATEGORY in a given COLUMN.

APPENDIX A
TABLE 1-B
PROJECTED HEADCOUNT FROM POTENTIAL SOURCES
(Graduate Degree Program)

Source of Students (Non-duplicated headcount in any given year)*	Year 1 HC	Year 1 FTE	Year 2 HC	Year 2 FTE	Year 3 HC	Year 3 FTE	Year 4 HC	Year 4 FTE	Year 5 HC	Year 5 FTE
Individuals drawn from agencies/industries in your service area (e.g., older returning students)	0	0	0	0	0	0	0	0	0	0
Students who transfer from other graduate programs within the university**	0	0	0	0	0	0	0	0	0	0
Individuals who have recently graduated from preceding degree programs at this university	0	0	0	0	0	0	0	0	0	0
Individuals who graduated from preceding degree programs at other Florida public universities	0	0	0	0	0	0	0	0	0	0
Individuals who graduated from preceding degree programs at non-public Florida institutions	0	0	0	0	0	0	0	0	0	0
Additional in-state residents***	0	0	0	0	0	0	0	0	0	0
Additional out-of-state residents***	0	0	0	0	0	0	0	0	0	0
Additional foreign residents***	0	0	0	0	0	0	0	0	0	0

Other (Explain)***	0	0	0	0	0	0	0	0	0	0
Totals	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

* List projected annual headcount of students enrolled in the degree program. List projected yearly cumulative ENROLLMENTS instead of admissions.

** If numbers appear in this category, they should go DOWN in later years.

*** Do not include individuals counted in any PRIOR category in a given COLUMN.

APPENDIX A
Table 2
Faculty Participation

Faculty Code	Faculty Name or "New Hire" Highest Degree Held Academic Discipline or Specialty	Rank	Contract Status	Initial Date for Participation in Program	Mos. Contract Year 1	FTE Year 1	% Effort for Prg. Year 1	PY Year 1	Mos. Contract Year 5	FTE Year 5	% Effort for Prg. Year 5	PY Year 5
A	Robert Lubarsky, Ph.D Mathematics	Senior Instructor	MYA	Spring 2023	9	0.75	0.05	0.00	9	0.75	0.05	0.04
A	Shelby Johnson, Ph.D. English	Assistant Professor	Tenure Earning	Spring 2023	9	0.75	0.05	0.04	9	0.75	0.05	0.04
A	Grigoriy Kreymerman, Ph.D. Physics	Associate Scientist	MYA	Spring 2023	9	0.75	0.02	0.02	9	0.75	0.02	0.02
A	Tito Sempertegui, Ph.D. Chemistry	Senior Instructor	MYA	Spring 2023	9	0.75	0.05	0.04	9	0.75	0.05	0.04
A	Stephane Roche, Ph.D. Chemistry	Associate Professor	Tenure	Spring 2023	9	0.75	0.02	0.02	9	0.75	0.02	0.02
A	Deguo Du, Ph.D. Chemistry/Biology	Associate Professor	Tenure	Spring 2023	9	0.75	0.02	0.02	9	0.75	0.02	0.02
A	Dolores DeGroff, Ph.D. Electrical Engineering	Associate Professor	Tenure	Spring 2023	9	0.75	0.05	0.04	9	0.75	0.05	0.04
A	Vivian Merk, Ph.D. Materials Science/Chemistry	Assistant Professor	Tenure Earning	Spring 2023	9	0.75	0.02	0.02	9	0.75	0.02	0.02
A	Valentine Aalo, Ph.D. Computer Science	Professor	Tenure	Spring 2023	9	0.75	0.02	0.02	9	0.75	0.02	0.02
A	William Brooks, Ph.D. Biology	Professor	Tenure	Fall 2024	9	0.75	0.02	0.02	9	0.75	0.02	0.02

A	Yuan Wang, Ph.D. Mathematics	Professor	Tenure	Fall 2024	9	0.75	0.02	0.02	9	0.75	0.02	0.02
A	Angelica Hotiu, Ph.D. Physics	Instructor	MYA	Fall 2024	9	0.75	0.02	0.02	9	0.75	0.02	0.02
A	Javad Hashemi, Ph.D. Mechanical Engineering	Professor	Tenure	Fall 2024	9	0.75	0.10	0.08	9	0.75	0.10	0.08
A	Elijah St. Germain, Ph.D. Chemistry	Instructor	MYA	Fall 2024	9	0.75	0.02	0.02	9	0.75	0.02	0.02
A	Matthew Lovelace, MS Biology	Instructor	MYA	Fall 2024	9	0.75	0.02	0.02	9	0.75	0.02	0.02
A	Sarah Du, Ph.D. Mechanical Engineering	Associate Professor	Tenure	Spring 2024	0	0.00	0.00	0.00	9	0.75	0.10	0.08
A	Erik Engeberg, Ph.D. Mechanical Engineering	Professor	Tenure	Spring 2024	0	0.00	0.00	0.00	9	0.75	0.10	0.08
A	Yunqing Kang, Ph.D. Mechanical Engineering	Associate Professor	Tenure	Spring 2024	0	0.00	0.00	0.00	9	0.75	0.10	0.08
A	Ankur Agarwal, Ph.D. Computer Engineering	Professor	Tenure	Spring 2024	0	0.00	0.00	0.00	9	0.75	0.10	0.08
A	Behnaz Ghoraani, Ph.D Electrical Engineering	Associate Professor	Tenure	Spring 2024	0	0.00	0.00	0.00	9	0.75	0.10	0.08
A	KwangSoo Yang, Ph.D Computer Science	Associate Professor	Tenure	Spring 2024	0	0.00	0.00	0.00	9	0.75	0.10	0.08
A	Michael DeGiorgio, Ph.D Biostatics	Associate Professor	Tenure	Fall 2025	0	0.00	0.00	0.00	9	0.75	0.10	0.08
A	Mirjana Pavlovic, Ph.D. Biomedical Sciences	Instructor	MYA	Fall 2025	0	0.00	0.00	0.00	9	0.75	0.10	0.08
A	Oge Marques, Ph.D. Computer Engineering	Professor	Tenure	Fall 2025	0	0.00	0.00	0.00	9	0.75	0.10	0.08
A	Raquel Assis, Ph.D. Biotechnology	Associate Professor	Tenure	Fall 2025	0	0.00	0.00	0.00	9	0.75	0.10	0.08
A	Waseem Asghar, Ph.D.	Associate	Tenure	Fall 2025	0	0.00	0.00	0.00	9	0.75	0.10	0.08

	Electrical Engineering	Professor										
A	Xingquan Zhu, Ph.D Computer Science	Professor	Tenure	Fall 2025	0	0.00	0.00	0.00	9	0.75	0.10	0.08
A	Sarah Milton, Ph.D Biology	Professor	Tenure	Fall 2025	0	0.00	0.00	0.00	9	0.75	0.05	0.04
	Total Person-Years (PY)							**0.34**				**1.31**

Faculty Code	Code Description	Source of Funding	PY Workload by Budget Classification		
			Year 1		**Year 5**
A	Existing faculty on a regular line	Current Education & General Revenue	0.34		1.31
B	New faculty to be hired on a vacant line	Current Education & General Revenue	0.00		0.00
C	New faculty to be hired on a new line	New Education & General Revenue	0.00		0.00
D	Existing faculty hired on contracts/grants	Contracts/Grants	0.00		0.00
E	New faculty to be hired on contracts/grants	Contracts/Grants	0.00		0.00
F	Existing faculty on endowed lines	Philanthropy & Endowments	0.00		0.00
G	New faculty on endowed lines	Philanthropy & Endowments	0.00		0.00
H	Existing or New Faculty teaching outside of regular/tenure-track line course load	Enterprise Auxiliary Funds	0.00		0.00
		Overall Totals for	**0.34**		**1.31**

APPENDIX A

TABLE 3
ANTICIPATED REALLOCATION OF EDUCATION & GENERAL FUNDS*

Budget Line Item	Reallocated Base* (E&G) Year 1	Enrollment Growth (E&G) Year 1	New Recurring (E&G) Year 1	New Non-Recurring (E&G) Year 1	Contracts & Grants (C&G) Year 1	Philanthropy/ Endowments Year 1	Enterprise Auxiliary Funds Year 1	**Subtotal Year 1**	Continuing Base** (E&G) Year 5	New Enrollment Growth (E&G) Year 5	Other*** (E&G) Year 5	Contracts & Grants (C&G) Year 5	Philanthropy/ Endowments Year 5	Enterprise Auxiliary Funds Year 5	**Subtotal Year 5**
Faculty Salaries and Benefits	44,343	0	0	0	0	0	0	**$44,343**	189,288	0	0	0	0	0	**$189,288**
A & P Salaries and Benefits	20,100	0	0	0	0	0	0	**$20,100**	20,100	0	0	0	0	0	**$20,100**
USPS Salaries and Benefits	0	0	0	0	0	0	0	**$0**	0	0	0	0	0	0	**$0**
Other Personal Services	0	0	0	0	0	0	0	**$0**	0	0	0	0	0	0	**$0**
Assistantships & Fellowships	0	0	0	0	0	0	0	**$0**	0	0	0	0	0	0	**$0**
Library	0	0	0	0	0	0	0	**$0**	0	0	0	0	0	0	**$0**
Expenses	5,000	0	0	0	0	0	0	**$5,000**	5,000	0	0	0	0	0	**$5,000**
Operating Capital Outlay	0	0	0	0	0	0	0	**$0**	0	0	0	0	0	0	**$0**
Special Categories	0	0	0	0	0	0	0	**$0**	0	0	0	0	0	0	**$0**

Total Costs	$69,443	$0	$0	$0	$0	$0	$0	$69,443	$214,388	$0	$0	$0	$0	$0	$214,388

*Identify reallocation sources in Table 3.

**Includes recurring E&G funded costs ("reallocated base," "enrollment growth," and "new recurring") from Years 1-4 that continue into Year 5.

***Identify if non-recurring.

Faculty and Staff Summary

Total Positions	Year 1	Year 5
Faculty (person-years)	0.34	1.31
A & P (FTE)	0.25	0.25
USPS (FTE)	0	0

Calculated Cost per Student FTE

	Year 1	Year 5
Total E&G Funding	$69,443	$214,388
Annual Student FTE	8	80
E&G Cost per FTE	$8,680	$2,680

Table 2 Column Explanations

Reallocated Base* (E&G)	1	E&G funds that are already available in the university's budget and will be reallocated to support the new program. Please include these funds in the Table 3 – Anticipated reallocation of E&G funds and indicate their source.
Enrollment Growth (E&G)	2	Additional E&G funds allocated from the tuition and fees trust fund contingent on enrollment increases.
New Recurring (E&G)	3	Recurring funds appropriated by the Legislature to support implementation of the program.
New Non-Recurring (E&G)	4	Non-recurring funds appropriated by the Legislature to support implementation of the program. Please provide an explanation of the source of these funds in the budget section (section III. A.) of the proposal. These funds can include initial investments, such as infrastructure.
Contracts & Grants (C&G)	5	Contracts and grants funding available for the program.
Philanthropy Endowments	6	Funds provided through the foundation or other Direct Support Organizations (DSO) to support the program.
Enterprise Auxiliary Funds	7	Use this column for continuing education or market rate programs and provide a rationale in section III.B. in support of the selected tuition model.

Continuing Base** (E&G)	9	Includes the sum of columns 1, 2, and 3 over time.
New Enrollment Growth (E&G)	10	See explanation provided for column 2.
Other*** (E&G)	11	These are specific funds provided by the Legislature to support implementation of the program.
Contracts & Grants (C&G)	12	See explanation provided for column 5.
Philanthropy Endowments	13	See explanation provided for column 6.
Enterprise Auxiliary Funds	14	Use this column for continuing education or market rate programs and provide a rationale in section III.B. in support of the selected tuition model.

APPENDIX A
Table 4

Program and/or E&G account from which current funds will be reallocated during Year 1	Base before reallocation	Amount to be reallocated	Base after reallocation
TAG000155 Chemistry	2,588,155	8,940	**$2,579,215**
TAG000159 Mathematics	3,394,934	2,116	**$3,392,818**
TAG000167 Physics	2,187,755	2,397	**$2,185,358**
TAG000173 Biological Sciences	2,894,651	3,196	**$2,891,455**
TAG000229 English	3,115,857	3,043	**$3,112,814**
TAG000275 Mechanical Engineering	3,063,242	29,855	**$3,033,387**
TAG000279 Electrical Engineering & Computer Science	5,646,263	19,896	**$5,626,367**
	0	0	**$0**
Totals	$22,890,857	$69,443	**$22,821,414**

*** If not reallocating E&G funds, please submit a zeroed Table 4**

APPENDIX B

Please include the signature of the Equal Opportunity Officer and the Library Director.

Signature of Equal Opportunity Officer

Signature of Library Director

Date

Date

This appendix was created to facilitate the collection of signatures in support of the proposal. Signatures in this section illustrate that the Equal Opportunity Officer has reviewed section II.E of the proposal and the Library Director has reviewed sections X.A and X.B.

The total number of volumes and serials available in this discipline and related fields is 31,435 monograph volumes and 1,663 journal titles.

A list major journals that are available to the university's students is as follows:

Nature Biotechnology
Nature Biomedical Engineering
IEEE Reviews in Biomedical Engineering
Advanced Healthcare Materials
Acta Biomaterialia
Lab on a Chip - Microfluidic & Nanofluidic Technologies for Chemistry, Physics, Biology, and Bioengineering
Tissue Engineering Part B: Reviews
Biomaterials Science
Biomaterials Research
Current opinion in biotechnology

Amy Kornblau
Signature of Library Director

8/12/22
Date

APPENDIX C

Table 1 Current Grant Funding

Biomedical Engineering Research	PI	Source	Funds
Placenta-on-a-Chip Sensing Platform to Study Malaria	Sarah Du	NIH	$400,154.00
Development of an Artificial Hand Exhibit	Erik Engeberg	SFCSA	$84,433.00
Virtual Neuroprosthesis: Restoring Autonomy	Erik Engeberg	NIH	$1,441,000.00
Targeting cMyc in the control of Inflammation	Sarah Du	UM/NIH	$72,716.00
Dexterous Robotic Manipulator for Semi-Auton	Erik Engeberg	FIU/DOE	$160,000.00
Development of a 90 Days Expiration Dot	Mike Kim	TLTC	$57,772.00
Autotherapy of craniofacial bone defects using immunomodulatory and cell-recruiting bioceramic scaffolds	Kevin Kang	NIH	$142,892.00
Development of an in Vitro 3D Tumor Tissue Engineering Model for Esophageal Cancer	Kevin Kang	NIH	$142,285.00
I/UCRC for Center for Health Organization Transformation	Ankur Agarwal	VAR-SOU	$150,000.00
Development of a Middleware Framework for Medical Device Integration for Telemedicine	Ankur Agarwal	VAR-SOU	$50,000.00
A Mobile Based Care Coordination System for Critical Care	Ankur Agarwal	VAR-SOU	$100,000.00
FAU Site Phase-2: I/UCRC for Center for Health Organization Transformation	Ankur Agarwal	NSF	$200,000.00
Development of a diagnostic assay for rapid detection and quantification of Zika virus	Waseem Asghar	FDOH	$199,280.00
Medical image analysis using deep learning techniques	Oge Marques	VIS-SOU	$59,000.00
Development of disposable and refrigeration-free microchip technology for CD4+ T cell counting	Waseem Asghar	NIH	$459,580.00

APPENDIX C –Faculty Resumes

APPENDIX D – Hanover Market Survey Report

APPENDIX E – Need for the Program

The biomedical engineering field is one of the fastest growing occupational fields in the United States. The growth of the field has four major driving forces including i) the increasing size of the aging population, ii) the increasing cost of healthcare, iii) the emerging technological revolution in diagnosis & monitoring of individual's health as well as just in time healthcare delivery and iv) the need to develop new solutions to medical challenges. The biomedical engineering field increasingly provides solutions to world health challenges by altering how patients are treated. FAU hired the Hanover organization to review the program. Hanover found that relevant jobs are also expected to grow faster-than average in an already-strong state labor market.

As FAU is in the middle of the tri-County area in southeast Flroida, and the demand for medical innovation is increasing, the potential for FAU to fill a need in industry is driven by three major driving forces i) the increasing size of southeast Florida's aging population, ii) the increasing cost of healthcare, and iii) the emerging technological revolution in diagnosis & monitoring of a patient's health as well as just in time healthcare delivery.

In Florida, three state universities offer the Biomedical Engineering Program including University of Florida (UF), Florida International University (FIU), and University of South Florida (USF which started in 2017) and one more has a bioengineering degree (Florida Gulf Coast University). All programs reporting appear to be very healthy in terms of enrollment with an impressive rate of growth. However, the focus areas are different.

The State of Florida currently has three biomedical engineering programs and one bio-engineering program in the SUS. The youngest of the Biomedical engineering programs is at USF. This program, started in 2017. The program is a biomedical engineering education through a joint venture between the Morsani College of Medicine and the College of Engineering. The program has limited access. The focus appear to be primarily on electro-mechanical devices as they relate to resolving medical issues based on the core specialization. This is a minimal overlap to what FAU is proposing. The program is ABET accredited.

At FIU, the department is clustered into three major areas: Research in Tissue Engineering Model Systems, Diagnostic Bio-Imaging, and Sensor Systems, and Therapeutic and Reparative Neurotechnology. These three areas are served by technological advancements in bio-imaging and bio-signal processing, bioinstrumentation, biomaterials, bio-nanotechnology, biophotonics, cellular and tissue engineering, computational modeling, devices, and sensors, and neural engineering. Note that the tissue engineering arena is one where FIU requested, and FAU has agreed to collaborate. The program is ABET accredited.
UF's program is limited access. It is less than 15 years old. The focus, from coursework, appears to be on bioinstrumentation, signal transports and cellular engineering. The UF focus is not similar to the proposed for FAU. The program is ABET accredited.
By contract, the FGCU B.S in Bioengineering emphasizes the application of new technology to biomaterials, biomechanics, and biomedical tools and procedures. The focus, from coursework, appears to be focused on these areas. There is limited overlap with the proposed FAU program. The program is ABET accredited.

The proposed FAU program focuses on five areas:

- **Biomaterials and Tissue Engineering Focus Area**
- **Biorobotics**
- **Bioimaging Technologist**
- **Bioinformatics**
- **Smart Health Systems**

Table E1 compares the focus areas among the other SUS school programs and FAU's proposed degree program. While all biomedical engineering degree programs include focus areas on biomaterials and tissue engineering as they are the foundation of the study area, the table shows that of the other four focus areas, only the bioimaging focus area overlaps with any of the other programs (and the context is different at FAU as is related to nursing). However all five of FAU's prosed focus areas are directly related to industry demands in southeast Florida.

Table E-1 Focus Areas for SUS schools in Biomedical Engineering

Focus Area	FAU	UF	USF	FIU	FGCU
Biomaterials and Tissue Engineering Focus Area	x	x		x	x
Biorobotics	x				
Bioimaging Technologist	x			x	
Bioinformatics	x				
Smart Health Systems	x				
Electro-mechanical devices			x		
Sensor Systems		x		x	
Bioinstrumentation		x			
Cellular engineering		x			
Biomechanics					x
Biomedical tools and procedures					x

Florida Atlantic University has all the elements necessary to be part of this healthcare revolution: A newly established, young and energetic medical school with outstanding potential to compete with top medical schools in the nation.