BOARD OF GOVERNORS
STATE UNIVERSITY SYSTEM OF FLORIDA
NEW DOCTORAL DEGREE PROPOSAL STAFF ANALYSIS

Program: Ph.D. in Engineering and Computing Education

CIP Code: 14.9999

Institution: Florida International University

Proposed Implementation Date: Fall 2020

Staffed By: Lynda Page

Initial Review Date: 3/25/2019   **Last Update:** 5/17/2019

Projected program costs:

	Total	% & $ Current Reallocated	% & $ New Recurring	% & $ New Non-Recurring	% & $ C&G	% & $ Philanthropy & Endowment	Auxiliary Funds	Cost per FTE	SUS 12-13 Average Cost per FTE
Year 1	$297,282	51% $151,466	0% $0	0% $0	49% $145,816	0% $0	$0	$15,487	$21,881 14 CIP
Year 5	$1,292,101	49% $635,553	0% $0	0% $0	51% $656,548	0% $0	$0	$14,947	

Projected FTE and Headcount are:

	Student Headcount	Student FTE
First Year	12	9.78
Second Year	21	20.63
Third Year	30	29.26
Fourth Year	37	35.89
Fifth Year	44	4253

On March 29, 2007, the Florida Board of Governors approved Board Regulation 8.011, which sets forth criteria for implementation and authorization of new doctorates by the Board of Governors, as well as criteria for implementation and authorization of Bachelor's, Master's and Specialist degrees by Boards of Trustees. The following staff analysis is an assessment of how well the university meets Board Accountability and Readiness criteria for implementation of this degree program.

Proposal Page Numbers:

INTRODUCTION		ACCOUNTABILITY		READINESS				
Program Description	BOG Goals	Overall	Budget	Mission and Strength	Program Quality	Curriculum	Faculty	Resources
2	4	5	8	12	15	15	23	24

A.   Program Description:

Florida International University's College of Engineering and Computing is proposing to offer a Ph.D. in Engineering and Computing Education which, if approved, would be the first such degree program in Florida although the proposal recognizes that other engineering programs in the state have conducted engineering education research. The proposal notes that it would be the first computing education doctoral program in the nation. The program will be offered in a face-to-face format on the main campus (Modesto A. Maidique Campus). The proposed degree program is designed to focus on understanding how people learn engineering and how to improve instruction (p. 2).

The proposed degree program will require 75 credit hours of coursework beyond the baccalaureate degree in engineering, computing, or closely related field. Students entering with a master's degree in engineering or computing may apply some of the master's credit towards the proposed Ph.D. Students will be able to specialize in engineering education, computing education, or both areas. Graduates of the proposed degree program will complete the coursework, qualifying exam, and defense of a dissertation and oral thesis. The proposal notes that graduates of the program will find employment in a variety of areas, including academia, industry, and government while strengthening Florida's efforts in meeting Science, Technology, Engineering, and Mathematics (STEM) and research needs.

The university will charge the institution's current approved graduate rate tuition of $379.95 per credit hour for in-state students and $900.00 per credit hour for out-of-state students. Fees will total $75.69 per credit hour for in-state students and $101.69 per credit hour for out-of-state students. The university does not intend to operate this program through continuing education on a cost-recovery basis, seek approval for market-rate tuition, or establish differentiated graduate-level tuition. Board staff in the University Budgets Office reviewed the budget section of the proposed program and had no concerns.

B.   System-Level Analysis and Evaluation in accordance with BOG Regulation 8.011:

The proposal provides alignment of the program with the State University System's strategic plan, noting that the proposed Ph.D. program directly supports Excellence, Productivity, and Strategic Priorities in the areas of Teaching & Learning and Scholarship, Research & Innovation. It notes that providing access to engineering and computing degree opportunity while increasing the production of such degrees strengthens the quality and reputation of the teaching of graduate and undergraduate engineering and computer science. The research and educational opportunities within the program should lead to an increase in the diversity of the student population,

especially understanding Florida International University's unique service as a Hispanic-serving institution. Additionally, the proposal notes that the proposed program will indirectly support the System Goal of Community and Business Engagement through excellence and productivity.

The proposed CIP code, 14.9999, is designated as a Program of Strategic Emphasis in STEM. It notes that the *SUS 2025 System Strategic Plan* states "…it is widely believed that education in Science, Technology, Engineering and Mathematics (STEM) are vital to the future of both the nation and the planet." Additionally, the proposal indicates that Board of Governors' performance metrics may be supported as the graduate students within the program will be able to assist in the instruction of critical courses and assist in retention and graduation of engineering and computing majors.

Need for Graduates in the Labor Market

The proposal notes that in Florida, as well as elsewhere, engineering and computing graduates are in high demand. The engineering and computing fields have expressed their recognition of the need for research and support of engineering and computing science education. With the national trend to link university funding to performance metrics, such as graduation and retention rates, the proposal notes that engineering and computer science have trailed other disciplines in these areas. Seeking talent to improve outcomes has increased. The proposal notes that the American Society for Engineering Education recognizes that two doctoral programs at Purdue University and Virginia Tech supply the most talent in this area and have consistently reported 100% employment of their doctoral students.

Board staff analyzed labor market data, both nationally and locally, and the job outlook for Engineering, General (CIP 14.9999) is rising. Table 1 reflects the most current projections by the Florida Department of Economic Opportunity and the U.S. Bureau of Labor Statistics.

Table 1: Labor Market Demand, CIP Code 14.9999

Occupations	Employment Change (Percent)		Annual Average Job Openings		Employment Change (Number)		BLS Typical Education Needed for Entry
	FL, 2018-26	National, 2016-26	FL	National	FL, 2018-26	National, 2016-26	
Architectural and Engineering Managers	10.9	5.5	607	13,600	775	9,900	Bachelor's degree
Engineers, All Other	9.2	6.4	459	9,500	540	8,500	Bachelor's degree
Engineering Teachers, Postsecondary	16.9	14.6	183	4,500	303	6,900	Doctoral or professional degree

Sources:
U.S. Bureau of Labor Statistics – https://www.bls.gov/ooh
Florida Department of Economic Opportunity - http://www.floridajobs.org/labor-market-information/data-center/statistical-programs/employment-projections

One challenge in determining labor market demand is that there is no specific Classification of Instructional Programs (CIP) classification for "engineering education" or "computing education." Board staff, however, confirmed that there is at least one other doctoral program at Clemson University in this area that is classified under 14.9999, the desired CIP code for the proposed program at FIU.[1]

As confirmed by Table 1 and noted in the proposal, graduates of the proposed Ph.D. program may find employment as, but not limited to: staff or other administrators in engineering programs or dean's offices, K-12 teachers (with appropriate additional credentials), non-profit foundation staff, corporate trainers, designers of education-based products in industry, and more. This information is confirmed through alumni job placement for Purdue University engineering education doctoral graduates.[2]

To assess the availability of academic jobs, a search for "engineering education" was conducted on the Chronicle of Education's job board on March 30, 2019.[3] The search returned 53 academic postings, including ten located in Florida. There were over 2,000 positions nationally and 110 in Florida when searching by "engineering."

The proposal indicates that announcements from the National Science Foundation (NSF), U.S. Department of Education, U.S. Department of Defense, and others support the need for STEM and engineering and computing research to develop a more competitive workforce. It also recognizes a 2018 House Appropriations bill that "supports [NSF] CISE efforts to work with the Division of Research on Learning in Formal and Informal Settings within Education and Human Resources to build on current efforts to support computer science education in PreK-12 classrooms."[4]

Additionally, a general search for Florida engineering jobs on Engineering.com found 13,188 jobs advertised on May 12, 2019.[5] It is anticipated that there will continue to be a demand for professionals in the field, and the proposed program should provide graduates who may be available to teach the future students of this field of study.

Student Demand for the Program

Board staff found that the FIU Fact Book shows 843, 882, and 990 undergraduate College of Engineering and Computing students graduated in 2015-16, 2016-17, and

[1] Retrieved from: http://www.clemson.edu/institutional-effectiveness/documents/Clemson_University_Program_List.pdf on March 31, 2019
[2] Retrieved from: **https://indd.adobe.com/view/c0c8ea3c-a5e7-491c-864a-5cd39aeb456b**
[3] Retrieved from: https://chroniclevitae.com/job_search/new?cid=UCHETOPNAV on March 30, 2019
[4] Reference https://www.congress.gov/congressional-report/115th-congress/house-report/231/1?q=%7B%22search%22%3A%5B%22Intelligence%22%5D%7D&r=67
[5] Retrieved from: https://www.engineering.com/jobs/florida/

2017-18, respectively.[6] An additional 322, 317, and 288, respectively, graduated with an engineering master's degree.

The proposal notes that a survey of FIU undergraduate engineering majors (n=115) found that 80% were interested in learning more about engineering and computing education degrees. More than 70% indicated an interest in getting a Ph.D., and 40% had a desire to teach.

Besides the interest of local students, the proposal notes that other programs nationally are relatively small compared to the demand. For example, Board staff found that 18 students applied to the Virginia Tech engineering education doctoral program in 2018 and eight (8) enrolled.

Additionally, the proposal recognizes the National Science Foundation's support of a National Pilot High School Engineering Course and Database designed for creating a nationwide high school engineering curriculum and Advanced Placement Exam. It notes that this initiative follows a push in the computer science education field, which is anticipated to create a demand for engineering education researchers and faculty.

Table 2 below notes the historical enrollment in engineering master's programs of SUS institutions.

Table 2: Historical Enrollment Master's Programs (Fall Headcount), CIP Code 14

Institution	2013	2014	2015	2016	2017
FAMU	9	12	21	32	19
FAU	144	137	148	175	187
FGCU	0	0	0	0	10
FIU	350	369	389	360	309
FL POLY	0	8	14	15	6
FSU	135	137	138	115	104
UCF	496	479	470	515	531
UF	1,646	1,331	1,511	1,455	1,344
UNF	35	31	34	49	43
USF	499	460	507	597	674
Total	3.314	2,964	3.232	3,313	3,227

Source: Board of Governors Interactive University Database for Headcount Enrollment, retrieved May 23, 2019

These programs have graduated over 1,000 students with a master's in engineering in each of the past three years, as reflected in Table 3 below:

---

[6] Retrieved form: https://opir.fiu.edu/factbook2016/dash.html on March 31, 2019

Table 3: Historical Master's Degrees Awarded, CIP Code 14

Institution	2015-2016	2016-2017	2017-2018
FAMU	4	9	9
FAU	57	72	94
FIU	243	229	203
FPU		5	3
FSU	113	90	91
UCF	233	220	242
UF	757	797	719
UNF	9	14	19
USF	281	361	394
UWF		**2**	**9**
Grand Total	1,697	1,799	1,783

Source: Board ODA analysis of degrees awarded by CIP, retrieved May 23, 2019

Students graduating from the engineering master's programs may be interested in seeking a doctorate, especially since some of the required master's credit may be applied towards the Ph.D.

External Consultant's Report

Dr. Michael C. Loui, Dale and Suzi Gallagher Professor in Engineering Education, Purdue University, provided an external review for the proposed Ph.D. program. He noted that the growth in enrollments in undergraduate engineering and computing programs, plus the demand for such instruction in K-12 education, has created a growing need for teachers of engineering and computing at all levels. He noted that "Doctoral graduates in engineering and computing education would have substantial technical backgrounds and thus could teach undergraduate courses in their technical fields. They would be able to implement research-based instructional strategies, to improve student learning and success."

Dr. Loui indicated that the proposed program would require the hiring of additional tenure-track faculty members, noting that the university should be able to hire junior faculty members who have recently earned Ph.D. degrees from engineering education programs at other universities. Additionally, he indicated that the program should explain how it would accommodate part-time students. Upon this suggestion, the program reviewed anticipated student enrollment and provided accommodation for part-time student interest.

Finally, the consultant indicates two key factors for the program's success: the intention to emphasize diversity, equity, and the inclusion and a close association with the STEM Transformation Institute. Dr. Loui writes that FIU is "particularly well positioned to offer the proposed program."

Summary

With FIU's strength in reaching diverse populations, the institution is strategically poised to serve underrepresented students in the field of engineering and computer education. The need for programs and continued research in the areas of engineering and computing education are reinforced through the proposal's example of a NSF program solicitation emphasizing the need in this area that will "create knowledge concerning sustainable change in engineering and computer science education that can be scaled and adopted nationally across a wide variety of academic institutions."[7]

C.   Assessment of the University Review Process in accordance with BOG Regulation 8.011:

Due to the system of stair step accountability set in place by the Board of Governors in Regulation 8.011, it is now incumbent upon University Board of Trustees to verify that all doctoral programs coming before the Board of Governors have met the requirements of the regulation. The following is an assessment of the university review process to ensure that all criteria set forth have been considered by the university prior to submission to the Board of Governors office.

<u>ACCOUNTABILITY</u>
Check 'yes' or 'no' box, and make comments beneath criterion as appropriate.

1. *Overall –* *The proposal is in the correct format, includes all necessary signatures, and contains complete and accurate tables for enrollment projections, faculty effort, and the proposed budget.*

YES   NO

X   ☐   **The proposal has been approved by the university board of trustees and includes all required signatures.**

X   ☐   **The university has provided a proposal written in the standard SUS format which addresses new academic program approval criteria outlined in BOG Regulation 8.011.**

X   ☐   **The pre-proposal was reviewed by the Council of Academic Vice Presidents (CAVP) workgroup and any concerns identified by the group have been listed and addressed in the proposal.**

The proposal noted that the CAVP reviewed the pre-proposal on November 17, 2017. Based on suggestions from the group, the proposal added information recognizing engineering education research in Florida schools

---

[7] Reported by: https://www.nsf.gov/pubs/2017/nsf17501/nsf17501.htm#elig

and further documentation of graduates being able to find employment opportunities.

X ☐ **The university has provided data that supports the need for an additional program in the State University System as well as letters of support or concern from the provosts of other state universities with substantially similar programs.**

The proposed degree program would be the first degree program in the State University System in this CIP code. There is no other stand-alone Ph.D. program in Engineering and Computing Education in our state; however, there is an engineering education track as part of a traditional engineering doctoral program at the University of Florida. Additionally, the proposal indicates that there are no doctoral computing education programs in the nation. The National Center for Education Statistics has yet to establish a standard CIP for engineering education or computing education.

The program was reviewed by the Council of Academic Vice Presidents during their November 17, 2017, meeting. No letters of support or concern from the provosts of other state universities were attached.

X ☐ **The university has provided complete and accurate projected enrollment, faculty effort, and budget tables that are in alignment with each other.**

X ☐ **The university has included a statement in the proposal signed by the equity officer as to how this proposal will meet the goals of the university's equity accountability plan.**

The Florida International University Equal Opportunity Officer reviewed and signed the proposal on September 15, 2018. The proposal notes how the program would assist in supporting underrepresented populations in the discipline.

X ☐ **The program does not substantially duplicate programs at FAMU or FIU or, if it does, evidence was provided that consultations have occurred with the affected university on the impact of the new program on existing programs.**

The program does not duplicate programs at Florida Agricultural and Mechanical University.

2. Budget – *The proposal presents a complete and realistic budget for the program consistent with university and BOG policy, and shows that any redirection of funding will not have an unjustified negative impact on other needed programs.*

YES   NO

X   ☐ **The University Board of Trustees has approved the most recent budget for this proposal.**

The University Board of Trustees approved the budget on March 4, 2019.

X   ☐ **The university has reviewed the budget for the program to ensure that it is complete and reasonable, and the budget appears in alignment with expenditures by similar programs at other SUS institutions.**

The projected Educational and General (E&G) cost per full-time equivalent (FTE) in year one is $15,487, and in year five is $14,947. The projected costs for the program is lower than the calculated average cost per FTE of $21,880.59 for CIP 14, as provided in the 2017-18 expenditure analysis report.

☐   X **The proposal indicates that the program will follow the cost-recovery or market-rate funding models. If so, details and timelines for getting approvals for these funding models are included in the proposal.**

The program will operate as a traditional graduate program.

X   ☐ **In the event that resources within the institution are redirected to support the new program, the university has identified this redirection and determined that it will not have a negative impact on undergraduate education, or the university has provided a reasonable explanation for any impact of this redirection.**

Reallocated funds are from the host College of Engineering and Computing with little impact.

READINESS
Check 'yes' or 'no' box, and make comments beneath criterion as appropriate.

3. Program Quality – The proposal provides evidence that the university planning activities have been sufficient and responses to any recommendations to program reviews or accreditation activities in the discipline pertinent to the proposed program have been addressed.

YES   NO

X   ☐ **The university has followed a collaborative planning process for the proposed program in accordance with policies and procedures adopted by the University Board of Trustees.**

The proposal describes a collaborative planning process that involved faculty from the School of Computing and Information Sciences, STEM Transformational Institute, and the School of Education and Human Development in the College of Arts, Sciences & Education. The input was provided by external consultant Dr. Michael C. Loui, the Dale and Suzi Gallagher Professor in Engineering Education at Purdue University. The program continued through the established process for program approval, as noted on page 14 of the proposal.

X ☐ **An external consultant has reviewed the proposal and supports the department's capability of successfully implementing this new program.**

Dr. Loui evaluated the Ph.D. proposal and noted that the institution is well positioned to offer the program as the program would emphasize diversity, equity, and inclusion and would benefit from close association with the STEM Transformation Institution, an institute supporting the interdisciplinary community of discipline-based education researchers at FIU. He noted that the program would be able to teach undergraduate courses in their technical fields and to implement research-based instructional strategies to improve student learning and success. Dr. Loui indicates that the program would be similar to engineering education programs offered at Purdue University, Virginia Tech, Clemson University, Utah State University, and Ohio State University while there are no Ph.D. programs in computing education in the United States. The consultant stressed the need to hire additional tenure-track faculty members and believed that the institution would be able to attract junior faculty members who recently earned Ph.D. engineering education degrees from other universities. He did note that it may be difficult to identify suitable faculty candidates in computing education as there are no current Ph.D. programs in that area. Overall, however, the consultant supports the department's capabilities in implementing the degree program.

X ☐ **The university has found the level of progress that the department has made in implementing the recommendations from program reviews or accreditation activities in the discipline pertinent to the proposed program to be satisfactory.**

The proposal recognizes the need for additional faculty support, as noted in the external consultant's report, through the inclusion of four additional tenure-track faculty members to be added by fall 2022. Additionally, the consultant supported the creation of this program as a new degree instead of

as a track within another degree program. He noted his experience with having students who transfer out of a track-based program. Lacking full department faculty with technical backgrounds who could provide constructive advice on a dissertation in engineering education research was noted as one of the reasons for the transfer.

FIU baccalaureate engineering programs are accredited by the Engineering Accreditation Commission of ABET with the next site review scheduled for 2020. Previously, concerns were raised in spring 2018 related to high student-faculty ratios; however, the college hired 14 new tenure-tracked faculty and several non-tenure track faculty since that time. Internal program reviews performed in 2016-17 of units in the College of Engineering and Computing resulted in recommendations for the college to address graduation rates. The proposal notes that the College formed the School of Universal Computing, Construction, and Engineering Education (SUCCEED) in spring 2018 to address the recommendation and indicates that second-year retention rates in the college have risen to 93%.

☐   X   **The university has analyzed the feasibility of providing all or a portion of the proposed program through distance learning.**

The proposal indicates that the program is expected to be delivered traditionally on the main campus

☐   X   **If necessary, the university has made allowances for licensure and legislative approval to be obtained in a timely manner**

Licensure is not associated with this degree program.

4. Curriculum - *The proposal provides evidence that the university has evaluated the proposed curriculum and found that it describes an appropriate and sequenced course of study, and that the university has evaluated the appropriateness of specialized accreditation for the program.*

YES   NO

X   ☐   **The university has reviewed the curriculum and found that the course of study presented is appropriate to meet specific learning outcomes and industry-driven competencies discussed in the proposal.**

The proposal includes specific learning outcomes in the area of research and research design; design and assessment of engineering and computing courses and curricula; addressing critical issues facing the discipline area, including diversity and inclusion; and, preparation for professional success (p. 15). The program requires the completion of 75 credit hours beyond the

appropriate baccalaureate (15 fewer hours for those with an appropriate master's degree). The core coursework common for all students involves engineering and computing education foundations, engineering pedagogy, research methods/statistics, and specialization coursework, plus dissertation credit hours.

☐   X   **The university anticipates seeking accreditation for the proposed doctoral program, or provides a reasonable explanation as to why accreditation is not being sought.**

        There is no doctoral accreditation for engineering and computing programs.

5. Faculty – The proposal provides evidence that the university is prepared to ensure a critical mass of faculty will be available to initiate the program based on estimated enrollments, and that faculty in the aggregate have the necessary experience and research activity to sustain a doctoral program.

YES   NO

X   ☐   **The university has reviewed the evidence provided and found that there is a critical mass of faculty available to initiate the program based on estimated enrollments.**

        According to Appendix A, Table 4, seven current faculty members will participate in the program. Four of the nine are tenured, with the other three on a tenure-track. The appendix shows an additional four tenure-track or tenured faculty to be in place by fall 2022.

        Additionally, the proposal recognizes the support of additional Engineering, Computer Science, Non-Engineering/Computer Science STEM Transformation, and Education faculty through service on dissertation committees in the later stages of a student's studies.

☐   ☐   **The university has reviewed the evidence provided and found that the faculty in aggregate has the necessary experience and research activity to sustain the program.**

        Appendix A, Table 4, indicates current faculty members having a Ph.D. in Engineering Education or Physics Education.

        The proposal notes that the faculty are active in maintaining enrollments and graduates. For example, undergraduate degrees rose from 680 in 2013-14 to 988 in 2017-18 and that the American Society for Engineering

Education reported that the FIU ratio of baccalaureate recipients-to-faculty ratio (8.8:1) is one of the highest in the nation. Faculty are active in gaining external funding support, including support from the National Science Foundation.

Faculty are recognized nationally. For example, the proposal indicates that Dr. Mark Weiss is a computer science educator who was recognized with the ACM SIGCSE Award for Outstanding Contribution to Computer Science Education and the IEEE Computer Society Taylor L. Booth Education Award.

Although the external consultant from Purdue University recognized the need to hire additional tenure-track faculty members, he did not include it as a concern or suggestion for improvement. Board staff notes that the university anticipates a five-year student headcount of 42.52 with an anticipated faculty total person-year count of 1.94.

X ☐ **The university has reviewed the evidence provided and found the academic unit(s) associated with this new degree to be productive in teaching, research, and service.**

X ☐ **If appropriate, the university has committed to hiring additional faculty in later years, based on estimated enrollments.**

The proposal reflects the anticipated addition of additional faculty.

6. Resources – *The proposal provides evidence that the university has ensured the available library volumes and serials; classroom, teaching laboratory, research laboratory, office space, equipment, clinical and internship sites, fellowships, scholarships, and graduate assistantships will be sufficient to initiate the program, and that if applicable, funding has been secured to make more resources available as students proceed through the program..*

YES   NO

X ☐ **The university has provided a signed statement from the Library Director verifying that the library volumes and serials available are sufficient to initiate the program.**

The library director signed the proposal on September 20, 2018, acknowledging that the institution's library collections is able to support the proposed Ph.D. program.

X   ☐   **The university has ensured that the physical space necessary for the proposed program, including classrooms, laboratories, and office space, is sufficient to initiate the program.**

The proposal noted that no laboratory space was needed specifically for engineering education and that classrooms and offices are already available. No additional space is needed.

X   ☐   **The university has ensured that necessary equipment is available to initiate the program.**

There is no specialized equipment needed to implement the program.

X   ☐   **The university has ensured that fellowships, scholarships, and graduate assistantships are sufficient to initiate the program.**

The proposal shows strong support of graduate assistantships in the program. The majority of the funding of the program, as outlined in Appendix A, Table 2 is anticipated to go towards assistantships.

☐   ☐   **If applicable, the university has ensured that the department has arranged a suitable number of clinical and internship sites.**

Not Applicable.