

STAFF ANALYSIS

**Proposed Ph.D in Materials Science and Engineering
Florida International University
Classification of Instructional Programs (CIP) # 14.1801**

Estimated Costs:

	Total	% & \$ Current	% & \$ New	% & \$ C&G	Cost per FTE	SUS 2004-2005 Average Costs
Year 1	\$754,500	48% \$358,400	\$0	52% \$396,100	\$49,778	\$23,086 for CIP Code 14 at the Doctoral Level
Year 5	\$2,360,375	19% \$448,400	16% \$376,225	65% \$1,535,750	\$28,633	

Projected FTE and headcount are:

	Projected Headcount	Student FTE
First Year	14	7.2
Second Year	25	13.8
Third Year	35	19.8
Fourth Year	45	25.8
Fifth Year	50	28.8

On April 30, 2003, the Florida Board of Governors approved eight criteria, divided into two categories of Readiness and Accountability, by which implementation authorization of new doctorates were to be assessed. The following is an analysis of the University's proposal based on further delineations of those eight criteria.

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READINESS

*1. **Mission and Strength** - The goals of the program are aligned with the university's mission and relate to specific institutional strengths. The program is aligned with goals identified within the State University System Strategic Plan.*

Evidence that the proposed program is responsive to the goals of the current State University System Strategic Plan and the goals of the proposed program relate to the institutional mission statement as contained in the Strategic Plan

The Board of Governors has established specific, measurable goals for: access to and production of degrees; meeting statewide professional and workforce needs; and building world-class academic programs and research capacity, while defining and approving university missions that meet community needs and fulfill unique institutional responsibilities.

The proposed Ph.D in Materials Science and Engineering to be offered at Florida International University is aligned with the 2005-2013 Board of Governor's Strategic Plan goal related to access and production of degrees. By 2012-13, the Board has indicated that the SUS should produce between 941 and 1,317 new emerging technological doctoral degrees, and the proposed program would contribute to this number.

Evidence of a relationship to specific institutional strengths

Florida International University is an urban, multi campus, Research University serving South Florida, the state, the nation and the international community. It fulfills its mission by imparting knowledge through excellent teaching, promoting public service, discovering new knowledge, solving problems through research, and fostering creativity. As part of its strategic theme, the institution is engaged at both the local and global area, with particular emphasis on promoting international understanding; providing unique opportunities for environmental education and research; and establishing partnerships with the local community to provide the research and innovation needed to address social and economic problems in its service area.

Based on information from FIU's website, Florida International University values excellence in teaching and the pursuit of and application of knowledge. The Ph.D in Materials Science and Engineering is aligned with FIU's mission to guide the development in three strategic areas: International Understanding, Community Engagement, and Florida Economic and Environmental Development. The areas of materials engineering and nanotechnology, which are significant components of the proposed Ph.D program, will contribute significantly to research and economic development in South Florida. The program will also support additional research in a number of industries, including biomedical, electronics, and aerospace engineering.

2. Program Quality – 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.

Evidence that planning for the proposed program has been a collaborative process involving academic units and offices of planning and budgeting at the institutional level, as well as external consultants, representatives of the community, etc.

The Ph.D. in Materials Science and Engineering has been a combined effort between faculty from Mechanical and Materials Engineering, Electrical and Computer Engineering, Geology, and Physics. Input from members of the following research centers on campus has also been included in the planning process and will be used as resources for the program: Future Aerospace and Technology Center, the Center for Study of Matter at Extreme Conditions, and the Florida Center for Analytical Electron Microscopy. Faculty associated with the MSMSE program have been awarded over \$15M in funded research.

Evidence of an appropriate timetable of events leading to the implementation of the proposed program.

The proposal provides a timetable for implementation that identifies key events beginning with the planning phases of the proposal, acceptance of the first doctoral class in Materials Science Engineering, and full implementation upon approval by the Board of Governors. Informal planning for the program began fall 2002. Between 2002 and present date, a number of meetings have been held with various offices on campus which centered on curriculum development, needs assessment, submission of a proposal to university administrators, the Board of Trustees, and the Florida Board of Governors. Preparation for the recruitment of students is expected to occur late fall 2006 and admission of students will begin upon approval. The first cohort of students will be enrolled the semester following approval by the Board of Governors.

Evidence that progress has been made in implementing the recommendations from program reviews or accreditation activities in the discipline pertinent to the proposed program

There have been formal reviews of the Department of Mechanical and Materials Engineering, including an internal, university-wide review of the Master's program. The formal reviews of the department were done in conjunction with an accreditation review by Accreditation Board for Engineering and Technology (ABET) and also by the Southern Association of Colleges and Schools (SACS). ABET accreditation is based on an examination of an engineering program's student achievement, program improvement, faculty, curriculum, facilities, and institutional commitment to certain principles of quality and ethics.

The proposed program reflects the breadth of coursework required to meet expected criteria for continued SACS accreditation while also addressing the needs of doctoral

research in this field. However, a formal program or accreditation review of the Master's program in Materials Science Engineering, which may act as a feeder to the doctoral program, is not available due to the time limit in which the program has been in place. Program reviews for individual programs occur on a seven year cycle within the State University System. Since the master's was implemented in the fall of 2002, it has yet had sufficient time to undergo a thorough review.

3. Curriculum - The proposal describes an appropriate and sequenced course of study, admissions and graduation criteria are clearly specified and appropriate, and the appropriateness of specialized accreditation is addressed.

Evidence of an appropriate, sequenced, and fully described course of study; evidence of specific learning outcomes and industry driven competencies are discussed for any science and technology programs

The requirements for admission to the doctoral program in Materials Science and Engineering requires that students with a bachelor's degree have at least a 3.0 GPA in the last 60 hours attempted; a verbal GRE score of 450 and a quantitative score of 650 for a combined score of 1120 or higher; and 3 letters of recommendations. International students must also score at least 550 on the TOEFL. Applicants having a master's degree in Materials Science and Engineering from an accredited institution must also satisfy the above requirements for admission to the doctoral program. In addition, they should have at least a 3.3 grade point average in their Master's program.

Once accepted to the program, students are required to complete a program of study which consists of at least 30 hours of coursework and 24 hours of dissertation credit. Students who enter with a bachelor's degree will complete 75 hours total. Master's degree applicants can transfer in 30 hours of previously completed work from any Engineering discipline. Additional requirements for the program include a: qualifying exam in the first year of doctoral study, a proposal defense in preparation for the dissertation, and a final defense of the dissertation. Course descriptions for each course have been provided. However, evidence of proposed learning outcomes has not been included.

Based on other proposals reviewed by BOG staff and a review of the curriculum on institutional websites, these requirements are similar to other doctoral programs in Materials Science Engineering offered at the University of Florida and University of Central Florida. These doctoral programs require between 72 and 90 hours of credit to complete the doctoral degree. In addition, students in these programs are also required to take a qualifying exam as well as conduct oral and written defenses of the dissertation. The curriculum also matches that of programs in other states, such as the curriculum for Auburn University in Alabama. The doctoral program there requires that students pass qualifying oral exams prior to taking comprehensive examinations.

In addition, the curriculum consists of at least 60 credit hours beyond the master's degree.

Evidence that, if appropriate, the bachelor's and master's degree programs associated with the program are accredited and that the institution anticipates seeking accreditation for the proposed program if available

The Engineering Accreditation Commission of the Accreditation Board for Engineering and Technology (EAC/ABET) accredits engineering programs on a nationwide basis. However the proposal indicates that accreditation is not available for PhD programs. Rather, the graduate programs are usually included in the SACS accreditation process.

Based on a review of FIU's website, the following baccalaureate engineering programs in the college are accredited by ABET, Inc.: Civil Engineering, Computer Engineering, Electrical Engineering, Industrial Engineering and Mechanical Engineering.

Evidence that the institution has analyzed the feasibility of providing all or a portion of the proposed program through distance learning technologies via its own technological capabilities

The mode of delivery for the Ph.D in Materials Science and Engineering will be traditional delivery on the main FIU campus. Courses will also be offered via distance learning and remote teaching when possible. Facilities and equipment necessary for the traditional mode of delivery are already available in the Engineering Information Center. The Florida Engineering Education Delivery System (FEEDS) is also available to deliver any courses offered through distance education. All courses are expected to utilize the Internet to support teaching activities.

4. Faculty – A critical mass of faculty will be available to initiate the program based on estimated enrollments, and faculty in the aggregate has the necessary experience and research activity to sustain a doctoral program

Evidence that there is a critical mass of faculty available to initiate the program based on estimated enrollments

The proposal identifies eighteen existing faculty who will be involved in the program. As the program grows, the department plans to hire three additional faculty in years three, four, and five which will be included in the general revenue at a rate of 0.25 each. Also, in year five, new faculty will be hired at a rate 0.50 funded from contracts and grants. The proposal indicated that additional faculty lines would be necessary to provide the expected level of education, research, and service for a program of this nature and to sustain and seek federal funding.

Evidence that the faculty in aggregate have the necessary experience and research activity to sustain the program

From their vita, it is evident that the faculty have engaged in research, teaching, and service at various levels. The faculty for the proposed program in Materials Science and Engineering have received numerous awards, provided a strong history in productive research and funding, and have been active in service to the University and their profession. Collectively, the faculty have received in excess of \$9M within the past six years, and \$16M throughout their term at FIU. No information was provided on the number of master's theses directed or the number of doctoral dissertations directed. Publications and presentations are also evidenced in each of the faculty members' vitae.

Evidence that, if appropriate, there is a commitment to hire additional faculty in later years, based on estimated enrollments.

The proposal indicates that no additional faculty will be needed to initiate the program. However, by year five, additional faculty with expertise in Materials Science Engineering will be required as the program grows. The first two years of coursework for both the master's and doctoral program are the same. The proposal provides a plan for hiring additional faculty in years three, four, and five at 0.25 FTE funded in the general revenue. Also, in year five, new hires will be funded from contracts and grants at .50 FTE. Additional faculty are needed to provide the expected level of education needed for doctoral research and expertise in the field.

5. Resources – The necessary 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.

Evidence that library volumes and serials are sufficient to initiate the program.

Based on the quantity of materials indicated in the proposal, sufficient library and research materials are available to support the proposed PhD program in Materials Science and Engineering. There are a total of 7650 volumes related to materials engineering currently available in the FIU library. Eighty serials are also currently available.

Evidence that classroom, teaching laboratory, research laboratory, office, and any other type of space that is necessary for the proposed program is sufficient to initiate the program

The proposal provides evidence that the College of Engineering resides in the 250,000 square foot Engineering Center. This facility houses research and teaching laboratories. Engineering faculty offices are currently housed in the Engineering Center, as will be the new faculty in MSE. Approximately 70 percent of research labs associated with faculty in MSE is located in this building. Materials research is also supported by three research centers/institutes, which are also located within the College of Engineering.

Evidence that necessary and sufficient equipment to initiate the program is available

The proposal provides evidence there is currently necessary and sufficient equipment in place to support all teaching and research requirements for the program. A complete metallography facility has been purchased for teaching. Three institutes - the Future Aerospace and Technology Center, Center for Study of Matter at Extreme Conditions, and the Florida Center for Analytical Electron Microscopy- are available to conduct research and experimentation. Each institute is fully equipped with appropriate materials needed to conduct research in this area. Motorola has contributed equipment for the nanoelectromechanical fabrication lab. A full range of instrumentation is available, including devices for field emission, X-ray diffraction, thermal testing, materials processing, mechanical properties testing, and thin film deposition.

Evidence that, if appropriate, fellowships, scholarships, and graduate assistantships are sufficient to initiate the program

The College of Engineering provides eight teaching assistantships to Materials Science and Engineering, which will be used to support Ph.D. students. Additionally, current research funding from faculty contracts and grants will support 14 additional research assistants.

Evidence that, if appropriate, clinical and internship sites have been arranged

Internships will not be required of the doctoral students. However, they may work on industry-sponsored projects and spend time at the sponsoring company's facilities.

ACCOUNTABILITY

6. Need - There is a need for more people to be educated in this program at this level and if the program duplicates other professional and doctorate degrees in Florida, a convincing rationale for doing so is provided.

Evidence that there is a need for more people to be educated in this program at this level

The proposal provides evidence of need and demand for a doctoral program in Material Science and Engineering in South Florida in support of numerous high-tech industries in the area and to meet the demand for access brought about by population growth. The proposal quotes the U.S. Department of Labor finding that the number of materials science and engineering jobs will increase as fast as all other occupations with a strong demand expected for material scientists with advanced degrees. The Ph.D. level employment will increase with greater emphasis on materials research and development, while the B.S. trained materials scientists and engineers will face a shrinking job market with materials manufacturing shifting to off-shore manufacturing. Materials science and engineering is also considered a major research area by various federal funding agencies. This is evidenced by a 20% funding increase for materials science and engineering research.

Information retrieved from the U.S. Department of Labor also states that graduate training is essential for engineering faculty positions and many research and development programs. This type of training enhances their ability to be creative, inquisitive, analytical, and detail oriented, which is particularly important as engineers often interact with specialists in a wide range of fields outside engineering. Specific to FIU, Mechanical and Materials Engineering faculty have received over 80 inquiries regarding the availability of a doctoral program in this area. A questionnaire submitted to prospective students also indicated that a number of master's students would be interested in pursuing a doctoral degree in this area of study at their current institution.

Evidence that the proposed program does not duplicate other SUS or independent college offerings or, otherwise, provides an adequate rationale for doing so

Information from the SUS degree inventories shows that three institutions, including FIU, offer a degree in this area. The University of Florida offers a bachelor, master's, and doctoral program; University of Central Florida offers a master's and doctoral program; and Florida International offers a master's degree. Even though doctoral programs exist at two other universities in the SUS, these locations are not in close proximity to FIU. Adding this program would provide geographic access for students seeking graduate education in south Florida.

Evidence of reasonable estimates of student headcount and FTE who will major in the proposed program, and commitment to a diverse student body

The department anticipates enrollment of 14 students in the first-year increasing to 50 students by year five. Student FTE would be 7.2 in the first year and 28.8 by year five. Average cost per student FTE in the first year totals \$49,778 and \$28,633 in the fifth year. Although the first year cost per student FTE is higher than the average, the fifth year estimated cost of \$28,633 comes closer to the SUS average of \$23,086 for CIP 14 as calculated using the 2004-2005 SUS Expenditure Analysis.

The department has the resources needed to support the projected enrollment. Currently, Materials Science and Engineering faculty support 7 research assistants, and the College provides 8 teaching assistantships to materials science and engineering M.S. students. Most of these assistantships will be reserved for doctoral students if the Ph.D. is approved.

The proposal indicates a commitment on the part of the University, Graduate Studies, and the Department to achieve a diverse student body. A signed EEO statement has been included in the proposal.

*7. **Budget** - A complete and realistic budget for the program is provide, and any redirection of funding will not have an unjustified negative impact on other needed programs.*

Evidence of a budget for the program that is complete and reasonable, and comparable to the budgets of similar programs at other SUS institutions, and reflective of the proposal's text

FIU anticipates that the program will cost \$754,500 during the first year of the program. That includes \$358,400 from the general revenue and additional contributions from contracts and grants. By year five, it is anticipated that the total cost will rise to \$2,360,375. However, 65 percent of that revenue will come from contracts and grants.

The budget includes new faculty hires funded from the general revenue in years four and five; and from contracts and grants in year five. The additional faculty members are needed to support research and anticipated student growth within the program.

Evidence that, in the event that resources within the institution are redirected to support the new program, such a redirection will not have a negative impact on undergraduate education.

The proposed program is expected to complement offerings in several departments by providing additional electives to graduate students majoring in other engineering disciplines. Students may take additional courses currently being offered by these other disciplines. Therefore, no negative impact is expected on existing programs.

8. Productivity - The academic unit(s) associated with this new degree have been productive in teaching, research, and service.

Evidence that the academic unit(s) associated with this new degree have been productive in teaching, research, and service.

Faculty vitas accompanying the proposal provide evidence that they have been active in teaching, research, and service. Collectively, the faculty have received in excess of \$9M within the past six years, and \$16M throughout their term at FIU.