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A. Program Description:

The University of Central Florida’s College of Engineering and Computer Science, Department of Mechanical and Aerospace Engineering, is proposing to establish a research doctoral program in Aerospace Engineering with a proposed classification of instructional program (CIP) code of 14.0201. The purpose of the Aerospace Engineering doctoral program is to prepare highly qualified individuals with graduate education and research training to support the growing aerospace industry both in Florida and nationally (p. 4). Potential employment opportunities include aerospace engineers, postsecondary engineering teachers, and architectural and engineering managers (Source: Florida Department of Economic Opportunity (DEO)).

The Aerospace Engineering doctoral program will require the completion of 72 credit hours beyond the bachelor’s degree, or 42 credit hours beyond the master’s degree. This program requires a minimum of 15 dissertation credit hours. These may include up to a total of 12 credit hours combined of directed, doctoral research, and/or independent study. Additionally students may take up to 6 credit hours of Thesis with an approved program of study. At least 39 credit hours of the Program of Study must consist of formal coursework (p. 33).

According to the Bureau of Labor Statistics’ (BLS) Occupational Outlook Handbook, the entry level degree for an aerospace engineer is a bachelor’s degree with a median hourly wage of \$54.34 (<https://www.bls.gov/ooh/architecture-and-engineering/aerospace-engineers.htm#tab-1>). DEO indicates that a postsecondary engineering teacher requires a master’s degree or higher with a median hourly wage of \$71.64.

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 (SUS) strategic plan. UCF provided alignment of the proposal with all three major SUS Strategic Plan goals: Excellence, Productivity, and Strategic Priorities for a Knowledge Community. Additionally, the Ph.D. in Aerospace Engineering aligns with all five goals outlined in UCF’s Collective Impact Strategic Plan. The Master of Science in Aerospace Engineering has been a very successful program for UCF and the Ph.D.

program will build on that success.

Need for Graduates in the Labor Market

The proposal documents the need for individuals with a high level of education in the field of Aerospace Engineering. It highlights the large growth the Aerospace industry is experiencing in the State of Florida. In addition, the proposal provides examples of aerospace companies within the state, including SpaceX, Northrop Grumman, and NASA, further highlighting the need for the program.

The labor market data is reflected below in Table 1. Board staff reviewed data from both the Florida DEO’s Labor Market Information and the BLS’s Occupational Outlook Handbook.

DEO:

Employment projections included in the charts below follow this order:

- *projected percent change in employment from 2017-2025,
- *number of jobs in 2017, and
- *projected numeric change in employment from 2017-2025.

BLS:

Employment projections included in the charts below follow this order:

- *projected percent change in employment from 2016-2026,
- *number of jobs in 2016, and
- *projected numeric change in employment from 2016-2026.

Table 1: Labor Market Data: Aerospace Engineering

| Source | Occupation | Workforce Need | Entry Level |
|--------|---|---|--------------------|
| DEO | Aerospace Engineer | 4.7% Growth 127 New Positions 1,438 Total Openings | Bachelor’s |
| DEO | Engineering Teachers, Postsecondary | 16.7% Growth 288 New Positions 1,460 Total Openings | Master’s or higher |
| DEO | Architectural and Engineering Managers | 12.2% Growth 835 New Positions 4,609 Total Openings | Bachelor’s |
| BLS | Aerospace Engineer | 6% Growth 4,200 Employment Change 69,600 Total Jobs | Bachelor’s |
| BLS | Postsecondary Teachers | 15% Growth 197,800 Employment Change 1,314,400 Total Jobs | Doctorate |

| Source | Occupation | Workforce Need | Entry Level |
|--------|--|--|-------------|
| BLS | Architectural and Engineering Managers | 6% Growth 9,900 Employment Change 180,100 Total Jobs | Bachelor's |

Sources: U.S. Bureau of Labor Statistics - <https://www.bls.gov/oo>

Florida Department of Economic Opportunity - <http://www.floridajobs.org/labor-market-information/data-center/statistical-programs/employment-projections>

Student Demand for the Program

Regarding the demand, the proposal notes that the University of Central Florida's Master's program in Aerospace Engineering has increased enrollment by more than 1.5 times over the last 10 years. However, the proposal also notes that students from the master's program are leaving the state to pursue their Ph.D.'s because of the limited availability of doctoral programs within the state. The proposal also reports that close to 70% of Aerospace Engineering undergraduate students plan to continue their education at the graduate level (p. 12).

If approved, this program would be the second Ph.D.-level Aerospace Engineering in the State University System. The University of Florida also offers a Ph.D. in Aerospace Engineering.

Table 2: Graduate Level Aerospace Engineering Enrollment (CIP 14.0201)

| | 2013 | 2014 | 2015 | 2016 | 2017 |
|-----------|------|------|------|------|------|
| UCF | 27 | 26 | 38 | 40 | 54 |
| UF* | 77 | 86 | 97 | 98 | 96 |
| SUS Total | 104 | 112 | 134 | 138 | 150 |

*Reflects enrollment in both Masters and Ph.D. Program

Source: Florida Board of Governors, Enrollment by CIP, retrieved August 31, 2018

Table 3: Degrees Awarded in Master's in Aerospace Engineering (CIP 14.0201)

| | 2012 | 2013 | 2014 | 2015 | 2016 |
|-----------|------|------|------|------|------|
| UCF | 11 | 10 | 17 | 8 | 10 |
| UF | 23 | 26 | 23 | 18 | 22 |
| SUS Total | 34 | 36 | 40 | 26 | 32 |

Source: Florida Board of Governors, Degree by CIP, retrieved August 31, 2018

The projected headcount for the program in year 1 is 10 with an increase to 23 by year 5 of the program. The primary source of students in year 1 of the program are individuals transferring from other graduate programs within the university. By year 5 of the program, the primary source of students is projected to be students who have recently graduated from other graduate degree programs at UCF. The projected headcount and enrollment projections seem logical and seem to follow the enrollment trend of the Master's program.

Table 4: Cost of Tuition for other Ph.D. Aerospace Engineering programs in Florida

| | |
|---------------------------------------|--------------------------|
| University of Central Florida* | \$369.65 per credit hour |
| University of Florida | \$530.69 per credit hour |
| Florida Institute of Technology | \$1,241 per credit hour |
| Embry-Riddle Aeronautical Engineering | \$1,433 per credit hour |

*This is an estimated cost based on information available on UCF's website

Source: Information from university websites.

External Consultant's Report

The proposal had two external consultants listed. Anastasios Lyrintzis Ph.D., Chair of the Aerospace Engineering Department at Embry-Riddle Aeronautical University, and Farhan Gandhi, the Rosalind and John J. Redfern Jr. Chair in Engineering and the Aeronautical Engineering Program Director at Rensselaer Polytechnic Institute. Overall, both reviewers felt the program was a good fit for UCF.

Dr. Lyrintzis complimented the proposal as being well written. The reviewer suggested UCF develop an executive summary of the proposed program to highlight the following important points of the proposal.

- A. The program would serve the large aerospace industry presence in the state of Florida.
- B. Increase the number of Aerospace Engineering Ph.D. programs in the State of Florida.
- C. The low cost of implementation because the existing faculty and courses are in place, but high benefit because of the projected increase in research expenditures, industry partnerships, and university reputation.

Dr. Lyrintzis also suggested UCF add a cost-benefit analysis to the proposal to highlight the benefits of the proposed program.

Professor Gandhi encouraged UCF to further differentiate the proposed program from UF's program. This feedback was used to expand the information in section 3C, Similar Programs, of the degree proposal. The reviewer also noted that the level of required coursework seemed a bit high, and the list of suggested elective courses was long. Professor Gandhi encouraged UCF to consider splitting the list into sections of existing, new and increased frequency offerings to make the case for new faculty members for the program. UCF incorporated the feedback from both reviewers into the final version of their proposal.

In addition to the external consultants' report, UCF also created an internal Aerospace Ph.D. program committee to develop a vision for the program and plan its implementation. The committee identified several courses that needed to be offered

more frequently and a course in Vertical Take-off and Landing that needed to be reinstated; and the addition of four new courses to the department. All of these recommendations are reflected in the proposal.

Summary

The proposed program seems to align well with the mission of UCF. It provides an outlet for students in the current master's program to continue their graduate education and provides an avenue for students to enter the program immediately after completing their bachelor's degree. The program does seem to position UCF to meet the growing labor force needs of the Aerospace industry in central Florida. The workforce data both statewide and nationally support the need for this program. Additionally, UCF was able to provide data supporting student interest and demand for the program. Overall, this is a very well written and strong proposal.

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.

ACCOUNTABILITY

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

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

The proposal will be presented at the September 2018 Board of Trustees (BOT) meeting. Past precedent permitted it to be submitted to the Board of Governors pending final BOT approval.

- 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.**

- 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 was presented at the CAVP meeting on March 26, 2016. No concerns were noted.

- 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.**

There is currently one existing Ph.D. in Aerospace Engineering within the State University System at the University of Florida. The preproposal was vetted at the CAVP meeting on March 26, 2016 and no concerns were expressed.

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

All required tables, narratives, and appendices are complete and in alignment.

- 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 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.**

This program does not duplicate a program offered at FAMU or FIU, and the university took steps to communicate with both institutions to verify this information.

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

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

The proposal will be presented at the September 2018 BOT meeting. Past precedent permitted it to be submitted to the Board of Governors pending final BOT approval.

- 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 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 does not intend to seek an alternative tuition or funding model.

- 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.**

UCF will be reallocating funds from within the Mechanical and Aerospace Engineering department to support the new Ph.D. program. The proposal does not indicate a negative impact on existing programs. They state that the new program will complement the existing programs, and will increase funded research opportunities.

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

- 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 includes letters of support from other units from within the university, as well as support from Florida Institute of Technology and Embry-Riddle.

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

Two external consultants reviewed the program proposal.

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

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

Not Applicable

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

- 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 curriculum structure for the proposed program closely mirrors that of the existing Ph.D. in Mechanical Engineering at UCF. A noticeable difference however is that the proposed Ph.D. in Aerospace Engineering does not have a stated minimum number of credit hours that must be taken at the 6000 or 7000-level. While there are no 7000-level courses in the proposed program, aside from the dissertation and research courses, there

are a total of 29 three credit hour 6000-level courses offered in the proposed program. This exceeds the requirements for students entering the program with a bachelor's or master's degree.

UCF also noted that they will have an external advisory board for the program. Members of the advisory board will include:

- Ms. Teresa Kinney, Commercial Crew Program Assistant Chief Engineer at Kennedy Space Center, NASA
- Dr. Gregory Freihofer, Stress Engineer at Northrop Grumman
- Mr. Rusty Irving, Research and Development Executive at GE Global Research

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

The University reports that no specialized accreditation exists for graduate programs in the Aerospace Engineering program.

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

- 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.**

All of the faculty participating in the new program are existing faculty members in the Mechanical and Aerospace Engineering (MAE) Department. The proposal indicates that two faculty members will be hired on existing faculty lines to support the program. One of the two faculty members is scheduled to begin in Fall 2018 and the other in Fall 2019.

- 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.**

- 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.**

The proposal provides evidence of high activity in teaching, research, and service for the Mechanical and Aerospace Engineering Department.

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

According to Table 4 in Appendix A of the proposal, the University plans to hire two new tenure-earning faculty members on existing faculty lines to support the program.

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

- 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 proposal indicates that the library has most of the resources needed to start the program. However, the proposal also mentions that UCF does not currently have access to three key journals that are important to support the program. The total cost to gain access to these journals in year 1 is \$15,000, with an increased subscription cost of \$17,381 by year 5 of the program. (pp. 46-47)

- 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.**

UCF indicates they have the necessary classroom, laboratory, and office space to begin the program. They provide several examples of laboratories that will be available to students in the program. (pp. 47-51)

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

UCF also provides a detailed list of the equipment available to support the program and indicate that no additional equipment will be needed. (pp. 50-51)

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

The AE Ph.D. program will have seven Office of Research and Commercialization (ORC) (internal) Fellowships and two Graduate Teaching Assistantships (GTAs) available in the first year at a projected cost of \$103,112. The MAE Department is committing four of its anticipated ORC Fellowships and two GTAs and the ORC is committing the remaining three Fellowships to help grow the program in each of the first three years. By year 5, the MAE Department expects again to allocate four of its ORC Fellowships and four GTAs at a projected cost of \$157,800. The increased allocation of GTAs parallels the expected ME/AE Ph.D. student distribution within the MAE Department. As the AE Ph.D. program and MAE Department continue to grow, the allocation of GTAs will continue to grow also.

The establishment and growth of the AE Ph.D. program will also benefit from increased external research funding. In year 1, Contracts and Grants (C&G) funds of \$147,530 are expected to provide five Graduate Research Assistantships (GRAs), which will in part supplement the ORC Fellowships to provide the total cost of tuition/stipend and non-ORC share. These numbers should increase rapidly as many of the junior faculty and new hires associated with the Aerospace Engineering program establish and grow their research programs. By year 5, C&G funds of \$397,800 are expected to provide at least 12 more GRAs for AE Ph.D. students. (p. 51)

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

Students in an AE Ph.D. program are not required to participate in an internship/practicum experience. However, the proposal states that there are many such opportunities to enhance the students' graduate school experience. (p. 51)