



University Council

March 8, 2024

UNIVERSITY CURRICULUM COMMITTEE – 2023-2024

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Graduate Student Representative – Kelsey Wohlford

Dear Colleagues:

The attached proposal from the College of Engineering to offer a new Undergraduate Certificate in Aerospace Engineering will be an agenda item for the March 15, 2024, Full University Curriculum Committee meeting.

Sincerely,

Susan Sanchez, Chair

cc: Provost S. Jack Hu

Dr. Marisa Pagnattaro

PROPOSAL FOR A CERTIFICATE PROGRAM

Date: October 31, 2023

School/College/Unit: College of Engineering

Department/Division: School of Environmental, Civil, Agricultural and Mechanical Engineering (ECAM)

Certificate Title: Undergraduate Certificate in Aerospace Engineering

CIP: 14020100

Effective Term: Fall 2024

Which campus(es) will offer this certificate? Athens

Level (Undergraduate, Graduate, or Post-Baccalaureate): Undergraduate

Program Abstract:

The proposed Undergraduate Certificate in Aerospace Engineering seeks to provide a focused multidisciplinary undergraduate experience in an emerging area of aerospace engineering involving design, development, and implementation of aerospace technologies. Many local and national employers recruit graduates with expertise in aerospace engineering, including Gulfstream Aerospace, Boeing, Delta Airlines, Lockheed Martin, SpaceX, Northrop Grumman, the U.S. Department of Defense, Textron, Rockwell Collins Aerospace, and others.

This certificate represents the first attempt to leverage aerospace faculty excellence into an innovative undergraduate program in the College of Engineering and to provide engineering students with the opportunity to specialize their study towards aerospace engineering and technologies. The certificate will be restricted to students in the Mechanical Engineering (B.S.M.E.), Computer Systems Engineering (B.S.C.S.E.), and Electrical and Electronic Engineering (B.S.E.E.) majors, and require completion of a minimum of 22 credit hours including senior capstone design courses. Students must obtain at least a "C" (2.0) in each of these courses to be successful.

1. Purpose and Educational Objectives

State the purpose and educational objectives of the program. How does this program complement the mission of the institution?

This certificate is designed to prepare students for careers in the aerospace industries which comprise aerospace design, analysis, and performance of aerospace systems for commercial and military applications as well as unmanned vehicles. It also provides students with

knowledge of several foundational topics including aerodynamics, structures, dynamics, propulsion, and multidisciplinary design that address aerospace technologies. With the required coursework and capstone design project experience, students will be prepared to take jobs in emerging aerospace industries in Georgia and beyond.

The Program Educational Objectives are:

- Demonstrate a high level of expertise in aerospace sciences/engineering with innovative solutions that address needs of the aerospace industries.
- Establish leadership positions in the aerospace profession and their community.
- Maintain the integrity of the engineering profession and the field of aerospace engineering.

2. Need for the Program

Explain why this program is necessary. In addition, provide the following information:

- a. Semester/Year of Program Initiation – Fall 2024**
- b. Semester/Year of Full Implementation of Program – Fall 2024**
- c. Semester/Year First Certificates will be awarded – Spring 2025**
- d. Annual Number of Graduates expected (once the program is established) – 15-20**
- e. Projected Future Trends for number of students enrolled in the program – 25/year**

There is a local and national demand for graduates trained in aerospace engineering. Potential employers of these graduates include Gulfstream Aerospace, Boeing, Delta Airlines, Lockheed Martin, SpaceX, Northrop Grumman, the U.S. Department of Defense, Textron, Rockwell Collins Aerospace, and others. In the state of Georgia, only Georgia Tech offers undergraduate degrees in aerospace engineering. Kennesaw State University offers a minor in aerospace engineering. Other colleges have aviation technician programs in the state.

The University of Georgia's College of Engineering is recognized for its excellence in innovative engineering education as evidenced not only by the recognition and Accreditation Board for Engineering and Technology (ABET) accreditation, but also by faculty who are involved in multidisciplinary research related to aerospace engineering field. This certificate aims to leverage the existing engineering curriculum along with the faculty research excellence in aerospace related applications into a high-quality undergraduate certificate.

It is anticipated that the certificate will be offered beginning the fall semester of 2024, with full implementation the same semester. The first certificates will be awarded in the spring semester of 2025. The School of ECAM expects 15-20 students will obtain the certificate each year once the program is established.

3. Student Demand

- a. Provide documentation of evidence of student demand for this program, including a student survey.**
- b. Provide evidence that demand will be sufficient to sustain reasonable enrollment.**

c. To what extent will minority student enrollments be greater than, less than, or equivalent to the proportion of minority students in the total student body?

As a precursor to the development of this undergraduate certificate, ENGR 4825/6825, Aerospace Design and Optimization, was offered for the first time in spring 2023. The course enrollment for this initial offering was capped at the maximum room capacity of 25. Based on waitlists for previous terms, student demand for the course exceeds 40 students. The School is already considering course scheduling and/or course implementation changes that will increase capacity to approximately 50 students.

Originally a student-led club, Student Aerospace Initiative (SAI) was started in 2019 with ten students. Now the club has grown to 100 students representing multiple engineering disciplines, demonstrating high student interest in aerospace related activities. This club has actively participated in many rocketry competitions as well as outreach activities. In order to be professionally recognized, this SAI club was reorganized as an AIAA (American Institute of Aeronautics and Astronautics) Student Chapter in 2022 and was approved by the national AIAA society. As part of this chapter, students presented papers in regional conferences and forged networks and connections. The AIAA Atlanta section supports the UGA AIAA Student chapter as well as involvement in aerospace engineering activities (<https://aiaa-atlanta.org/aiaa-atlanta-supports-the-student-aerospace-initiative-at-university-of-georgia/>).

Given the growing interest from many current students, high societal demand for aerospace systems (<https://www.bls.gov/ooh/architecture-and-engineering/aerospace-engineers.htm>), and the increased awareness among engineering disciplines for the need to focus training in this emerging area, it is reasonable to assume that the level of interest in this certificate will remain high. Also, due to many aerospace companies relocating to Atlanta and other regions in the state, there is a need to educate more aerospace engineers in Georgia. The Bureau of Labor Statistics projects that employment for aerospace engineers will increase by 6%, or nearly 4,000 jobs, in the next 10 years. It is anticipated that enrollment of underrepresented students in the aerospace engineering certificate will be equivalent to the enrollment of underrepresented students in the College of Engineering majors.

4. Program of Study

Provide a detailed program of study for the certificate program, including:

- a. Specific course prefixes, numbers, and titles**
- b. Identify any new courses created for this program**

Certificate Requirements

Students pursuing an aerospace engineering certificate must be enrolled in the Mechanical Engineering (B.S.M.E.), Computer Systems Engineering (B.S.C.S.E.), or Electrical and Electronic Engineering (B.S.E.E.) majors and complete a minimum of 22 hours including senior capstone design course (AERO 4910 and AERO 4911) with a focus on multidisciplinary aerospace related projects. All courses must be completed with a grade of "C" (2.0) or better.

Completion of a capstone sequence (AERO 4910 and AERO 4911) is a requirement for this certificate. The capstone coordination team identifies both internal and external or corporate-sponsored projects each year during the summer. In the first week of AERO 4910, students express their interest level in the identified projects and the capstone instructors determine capstone project team assignments such that students are assigned to work on one of their high interest projects over the two-course capstone sequence.

Required Courses (12 credit hours)

AERO 2990, Aerospace Systems Engineering (3 hours) – new course

ENGR 4825, Aerospace Design and Optimization (3 hours)

Note: Course prefix change to AERO in progress.

AERO 4910, Aerospace Engineering Design Project I (3 hours)

AERO 4911, Aerospace Engineering Design Project II (3 hours)

Core Courses (6 hours)

Courses will be chosen in consultation with the student's advisor.

Choose 6 hours from the following:

ELEE 4220/6220, Feedback Control Systems (3 hours)

ELEE 4230/6230, Sensors and Transducers (3 hours)

MCHE 4390, Mechanical Vibrations (3 hours)

MCHE 4820, Mechatronics (3 hours)

Elective Courses (6 hours)

Courses will be chosen in consultation with the student's advisor.

Choose 6 hours from the following:

AERO 4810, Aerodynamics and Wind Tunnel Testing (3 hours) – new course

AERO 4820, Aerospace Propulsion and Power (3 hours) – new course

AERO 4830, Aerospace Structures and Materials (3 hours) – new course

AERO 4920, Spacecraft Avionics Systems (3 hours) – new course

AERO 4930, Aerospace Performance and Control (3 hours) – new course

AERO 4975, Independent Study in Aerospace Engineering (3 hours) – new course

ELEE 4220/6220, Feedback Control Systems (3 hours)

ELEE 4275/6275, Advanced Control Systems (3 hours)

ELEE 4280/6280, Introduction to Robotics Engineering (3 hours)

ELEE 4590, Principles of Communication Systems (3 hours)

ENGR 4350/6350, Introduction to Finite Element Analysis (3 hours)

MCHE 4360/6360, Robotic Manipulators (3 hours)

MCHE 4580/6580, Computational Fluid Dynamics (CFD) (3 hours)

MCHE 4820, Mechatronics (3 hours)

In addition to taking the courses, students will have opportunities to participate in the UGA Student Chapter of the American Institute of Aeronautics and Astronautics (AIAA) activities including meetings, field trips, competitions, and social events. This participation will provide a venue for students to broaden their exposure to aerospace related activities.

5. Model Program and Accreditation

- a. **Identify any model programs, accepted disciplinary standards, and accepted curricular practices against which the proposed program could be judged. Evaluate the extent to which the proposed curriculum is consistent with these external points of reference and provide a rationale for significant inconsistencies and differences that may exist.**
- b. **If program accreditation is available, provide an analysis of the ability of the program to satisfy the curricular standards of such specialized accreditation.**

There are few undergraduate programs in aerospace engineering in the United States. Aerospace engineering certificates are offered in a few aerospace and mechanical engineering departments. The proposed program can be judged against Duke University's Aerospace Engineering Certificate program for mechanical engineering majors (seven courses, including two fundamental mechanical engineering courses; one foundation course; one aerospace elective; two engineering electives; and one arts and sciences course). The proposed certificate follows similar content in terms of course work and faculty expertise and is also tailored to the needs of Georgia industries. There is no specific accreditation available for certificate programs.

6. Student Learning Outcomes

Describe the proposed learning outcomes for the certificate program.

Students who complete the aerospace engineering certificate will be able to:

- SLO1 Identify and explain the role of various multidisciplinary components involved in an aerospace system.
- SLO2 Develop systems thinking knowledge for design and performance analysis of aerospace systems.
- SLO3 Apply foundational knowledge related to aerospace systems to perform design, analysis, and simulations.
- SLO4 Demonstrate aerospace engineering technical skills in developing innovative designs and communicate their solutions to a broad audience.

7. Assessment and Admissions

Describe how the learning outcomes for the program will be assessed. Describe the process and criteria for how students will be admitted to and retained in the program.

Assessment of engineering courses follows student outcome assessment practices that align with ABET, the accrediting body which accredits post-secondary education programs in applied and natural sciences, computing, engineering, and engineering technology. ABET has prescribed definitions of student outcomes and requires all ABET accredited programs to maintain a continuous improvement process that involves routine assessment of these student outcomes. Thus, this certificate will use ABET student outcome assessment data that are collected by each degree program from their capstone design sequence (see list of prefixes in the program of study section). To meet ABET accreditation requirements, students are assessed against the following student outcomes as defined by ABET:

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.

These ABET student outcomes (7) can be mapped to the Student Learning Outcomes (SLOs) associated with this certificate program using the following table:

SLO #	ABET Student Outcome
1	1, 2
2	1, 2, 5
3	1, 4, 6
4	3, 5, 6, 7

Any students in the Mechanical Engineering, Computer Systems Engineering, or Electronics or Electrical Engineering majors who express an interest in pursuing the aerospace engineering certificate may enroll. Should demand for the aerospace engineering reach a point where it exceeds capacity, an application process would be put into place where a statement of interest, GPA, and previous experience with aerospace engineering could be evaluated to determine admission to the certificate.

Completion of the aerospace engineering certificate will be determined by successful completion of the courses identified in the certificate program of study with a grade of "C" (2.0) or better.

Documentation of Approval and Notification

Proposal: Undergraduate Certificate in Aerospace Engineering

College: College of Engineering

Department: School of Environmental, Civil, Agricultural and Mechanical Engineering

Proposed Effective Term: Fall 2024

Approvals:

- School of Environmental, Civil, Agricultural and Mechanical Engineering Chair, Dr. Bjorn Birgisson, 2/13/24
- College of Engineering Assistant Dean of Academic and Faculty Affairs, Dr. Mable Fok, 2/13/24
- College of Engineering Dean, Dr. Donald Leo, 2/13/24