Ph.D. in Aerospace Engineering

Ph.D. Program

Learn more about the Ph.D. in Aerospace Engineering at the Daytona Beach College of Engineering website.

The Ph.D. in Aerospace Engineering is conferred in recognition of creative work and the ability to investigate scientific and engineering problems independently, as well as completion of the coursework necessary to build a solid foundation for research. In addition to its academic rigor, the degree emphasizes discovery of new knowledge and performance of research of importance to industry and to the aerospace engineering community. Admission to the program is reserved for candidates at the bachelors and masters levels, with high academic achievement and a desire to advance their career through scientific inquiry and knowledge discovery in areas related to aerospace engineering.

Overview

The objective of the Ph.D. in Aerospace Engineering is to provide an opportunity for highly motivated students with a strong science and engineering background to participate in a program of research and course work in the areas of Aerodynamics & Propulsion, Dynamics & Control, and Structures & Materials while earning their doctoral degree.

The degree is conferred primarily in recognition of original research and completion of a dissertation resulting in journal publications. In addition, a minimum number of advanced courses that help students build a solid foundation for Ph.D. level research is required.

Although the program is designed for delivery through traditional residential format, provisions are in place to allow highly qualified working individuals in industry or government to participate, when appropriate arrangements can be made.

Areas of Concentration

There are three areas of concentration in the Ph.D. in Aerospace Engineering:

Aerodynamics & Propulsion focuses on aerodynamics, viscous flows, hypersonic flows, and jet engine and rocket aero-thermodynamics. Courses are offered in these subjects, as well as in specialized topics such as combustion, heat transfer, aeroacoustics, and rotorcraft aerodynamics. Computational Fluid Dynamics (CFD) is offered at an introductory level. Advanced level topics include CFD as well as turbine engine systems. Research topics within the Aero-Propulsion group include: Aeroacoustic modeling and noise mitigation; micro air vehicles and synthetic jets for mitigating icing and flow separation; heat transfer in turbine blades; rocket propulsion simulation; Uncrewed Aerial Vehicles; hypersonic vehicles and hypersonic combustion; pulsed detonation engines; extending stall margins in fans and compressors; rotorcraft aerodynamics; turbulent boundary layer/shear layers and their control; two-phase boundary layers; fluid structure interaction; numerical simulation of plasma for flow control and plasma assisted combustion; and LES of compressible turbulence and high speed combustion.

• **Dynamics & Control** focuses on the modeling of complex dynamical systems and the design, implementation and testing of guidance, navigation and active feedback control of these systems to meet rigorous requirements and high levels of performance. Particular research topics include autonomous unpiloted air and ground vehicles; evolving aerospace structures and formations; control of flexible aerospace structures; networked systems; aircraft guidance control and handling qualities; spacecraft guidance, navigation and control, with emphasis on rendezvous and proximity operations; aviation safety; artificial intelligence; wind energy systems; and control of quantum information systems.

• **Structures & Materials** focuses on the study of aeroelasticity, vibration, fracture mechanics, thermoelasticity, composite materials, nanomaterials, smart materials, structural health monitoring, reliability analysis, computational structural mechanics, and design optimization. Particular research topics include aircraft structural design; aeroelastic tailoring; design for additive manufacturing; optimization of composite structures; smart actuators and systems; guided-wave structural health monitoring; static and impact performance of lightweight materials; use of carbon nanotubes and graphene for strengthening and repair of composites; and molecular dynamic simulation.

Advantages

The Ph.D. in Aerospace Engineering program targets domestic and international students, as well as working professionals with a Masters degree in aerospace engineering (or closely related engineering disciplines), who have exemplary track records of academic achievement in their course work, and demonstrated keen interest and ability for engaging in research and independent inquiry.

Degree Requirements

The Ph.D. in Aerospace Engineering will be conferred primarily in recognition of creative accomplishment and the ability to investigate scientific or engineering problems independently. The doctoral program also requires completion of advanced coursework that helps students build a solid foundation for Ph.D.-level research.

A student in the Ph.D. program is expected to

1. complete an approved plan of study during the first semester as a Ph.D. student
2. pass the qualifying examinations to achieve advancement to candidacy
3. pass the preliminary examination (present a dissertation proposal acceptable to the dissertation committee)
4. complete a program of significant original research
5. prepare and defend a dissertation concerning the research work
6. complete the credit hours requirement listed below

Candidates will have an Aerospace Engineering faculty member assigned as their research advisor and chair of their dissertation committee. The candidate and advisor will work collaboratively to define the research topic, to determine the courses of study and to select appropriate members of the dissertation committee. Working under the auspices and direction of the advisor, the candidate will be responsible for developing a research plan and the dissertation proposal.

While the typical time for completing the Ph.D. in Aerospace Engineering will be three (3) years for students with a Master's degree, it will be the policy of the College of Engineering that the total duration of the doctoral study should not exceed five (5) years beyond the Master's degree. Exceptions will be allowed when justified.

Credit Hours Requirement

For students with a Master's degree, the curriculum requires a minimum of 42 credit hours, including a minimum of 18 credit hours of coursework (including one advanced math course) and a minimum of 24 credit hours of dissertation research.

For students with a BS degree, the student needs to complete the requirements for a Master's degree first in addition to the 42 credit hours mentioned above.

With Advisor and Program Coordinator approval, students may complete a maximum of six hours of non-AE courses (DS, EP, other Engineering, MA).

Other level courses (i.e., 500, 700) may be considered if the student has completed two 600 level courses in their MS degree at ERAU.

Qualifying Examinations

A Ph.D. student must take the qualifying examination in both mathematics and their area of concentration (i.e. Aerodynamics & Propulsion, Structures & Materials or Dynamics & Control).

The qualifying examinations are given once a year in early May. A student must pass the qualifying examination prior to presenting a dissertation proposal.

- See Ph.D. AE Qualifying Examination Procedure for details.

Preliminary Examinations

The purpose of the preliminary examination is to evaluate students' readiness for conducting their proposed research, assess their ability to use their knowledge to carry out independent and creative research and confirm their potential for successful completion of the Ph.D. dissertation. A Ph.D. student must take the preliminary examination within one year after completing the qualifying examinations.

The preliminary examination consists of a written research proposal and an oral presentation, which is made to the examining committee. The preliminary examination is to evaluate student's readiness for completing the proposed research.

Dissertation Defense

The dissertation defense is the candidate's presentation of the work accomplished since the passing of the preliminary examination, and has been deemed sufficient and complete by the candidate's advisor. The defense is administered by the student's dissertation committee, in accordance with Department of Aerospace Engineering, College of Engineering and University guidelines. The purpose of the examination is to evaluate the student's research efforts and written dissertation, to determine if the candidate is qualified to receive a Ph.D. in Aerospace Engineering. The major areas of emphasis of this examination are the quality and originality of the candidate's research, and his/her knowledge and understanding of the general areas of study related thereto.

Advisor and Dissertation Committee

Students must have an advisor from the faculty of the Aerospace Engineering department when he/she is admitted to the doctoral program in aerospace engineering.

A student must work with his/her major advisor to form a plan of study, a proposed calendar of events and a dissertation committee. The dissertation committee is composed of four faculty members of Embry-Riddle Aeronautical University's Daytona Beach Campus, including at least three faculty members from the Aerospace Engineering Department. The fourth member should be a faculty from outside the Aerospace Engineering Department, i.e. faculty in another Engineering Department, or Physics, Mathematics. etc. In the event that a student is involved in collaborative research with an outside institution and/or company, one or more qualified members from these entities may serve on the dissertation committee, in addition to the four faculty members from the Daytona Beach Campus. The student's advisor serves as the chair of the dissertation committee. The dissertation committee must be formed within two semesters of the student's admission to the Ph.D. program.

Annual Progress Review

The dissertation committee will review the progress of the Ph.D. student/candidate once a year. The purpose of the review is to ensure that students continue to make satisfactory progress toward their degree objective. All major recommendations from this annual review will be forwarded to the student, with an assessment of achievements and of areas where improvements are expected.

Students will:

- Analyze and solve engineering problems.
- Conduct independent study.
- Carry out research or special projects.
- Use analytical, computational and experimental techniques.
- Demonstrate critical thinking and problem solving skills.
- Technically communicate their research within the aerospace engineering community.
- Observe ethics in research.