SPACEFLIGHT MECHANICS CERTIFICATE

Program Description

This certificate program offers you the opportunity to explore the foundational knowledge you will need to pursue new and exciting opportunities within the fields of aerospace engineering and commercial spaceflight. With the launch of the first privately owned, crewed spacecraft in 2020, the industry is poised for substantial expansion. Researchers predict that the space industry will grow significantly in the coming decade to include not only support for telecommunications, research, and security satellites, but also a new space economy in support of individuals visiting outer space as tourists and passengers.

In this program, you will begin by practicing different ways of measuring space and time when analyzing space systems and planning for orbital maneuvers, thus building your analytical and geometric intuition for how two-body systems work. You will then progress to orbital maneuvers and trajectories, where you will practice applying various mathematical models to understand how to use the propulsive capabilities of your spacecraft to modify or transfer its orbit. Next you will explore the basics of propulsion for space missions, including chemical and electrical propulsion methods as well as future propulsion options such as solar sails and electromagnetic systems.

Understanding and controlling the orientation of a spacecraft is just as crucial as controlling its orbit and position. To comprehend spacecraft orientation — also known as attitude dynamics — you will establish the mathematical formalism of attitude dynamics then turn your attention to the actual control of the spacecraft's orientation. You will conclude this program by identifying the different approaches to determining the spacecraft's orientation and position in inertial space, giving you a strong foundation of modern spacecraft attitude control system design and an ability to recognize current problems and trends in spacecraft operation and development. Throughout the program, you will complete a series of written and MATLAB assignments to help you increase your comfort level with the calculations involved in most astrodynamics problems. The assignments in this program will require you to solve equations of motion (second-order ordinary differential equations) numerically and graphically using MATLAB, as well as analytically via written problem sets.

Spaceflight mechanics is complex. While you do not need to have spaceflight mechanics experience in order to take the program, prerequisites include calculus, differential equations, linear algebra, and experience with MATLAB.

Key Takeaways

- Extend your fluency in the common nomenclature of classical mechanics; i.e., vector algebra and vector calculus
- Master the steps needed to solve dynamics problems
- Build an intuition — both analytical and geometric — for how two-body systems work
- Analyze the effects of perturbing forces on a static two-body problem to understand how more realistic physical systems behave
- Integrate the effects of perturbations in your orbit design
- Leverage the propulsive capabilities of a spacecraft in order to modify its orbit, get it into a particular orbit, transfer it from one orbit to another, and send it from one point to another in the solar system
- Analyze the dynamics of two spacecraft in orbit relative to each other
- Use the impulsive burn model to find analytical expressions for common orbital maneuvers
- Explain how to get a spacecraft to another location in the solar system using the patched-conic approximation model
- Identify what makes a mission design close vs. infeasible
- Analyze chemical and electrical propulsion
- Establish the mathematical formalism of attitude dynamics
- Develop a basic understanding of how to encode orientation
- Identify the basic elements and strategies of attitude control hardware
- Determine the orientation and position of a spacecraft in inertial space
- Use an integration method (DCM based or quaternion based) to estimate the attitude of a spacecraft

What You'll Earn

- Spaceflight Mechanics Certificate from Cornell College of Engineering
- 160 Professional Development Hours (16 CEUs)

Who Should Enroll

- Mechanical engineers
- Aerospace engineers
- Aerospace career starters
- Astronomers
- Astrophysicists
- Earth-observing scientists
- Civil engineers
- Professionals with advanced MATLAB knowledge as well as prior experience in vector algebra and vector calculus

Total Investment

16 weeks to complete the program.

How to Enroll

For more information and to enroll, please visit Spaceflight Mechanics Certificate

Course

Code	Title	Hours
eCornell MAE120	Spaceflight Mechanics	0