

# Aerospace Engineering (AESE)

## Courses

### **AESE 401 Introduction to Modern Aerospace Engineering 3 Credits**

A rigorous introduction to the fundamentals of aerospace engineering, tailored for graduate students with backgrounds in mechanical engineering, electrical engineering, or physics. Students will develop a strong foundation in aerodynamics, propulsion, flight mechanics, orbital mechanics, aircraft and spacecraft systems, and planetary environments. The course will emphasize both theoretical concepts and practical applications, utilizing real-world examples and case studies from the aerospace industry.

### **AESE 402 Advanced Astrodynamics 3 Credits**

A project-based course that builds upon the knowledge and skills developed in an introductory course in astrodynamics. Topics include orbital perturbations, propagation, industry standard data formats, orbital debris, collision assessment and avoidance, constellation design, cislunar dynamics, and special topics in areas of current research.

### **AESE 403 Space Propulsion Systems 3 Credits**

An introduction to rocket propulsion, covering fundamentals of solid rocket motors and liquid engines, including topics such as propellant thermochemistry, specific impulse calculations, liquid rocket engine cycles, and combustion stability. Advanced topics include airbreathing propulsion for launch vehicles and electric propulsion concepts for deep space vehicles.

### **AESE 404 Guidance, Navigation and Control 3 Credits**

Provides an industry-focused introduction to autonomous vehicles and the guidance, navigation, and control (GN&C) engineering challenges they pose. Students will engage with theoretical and real-world examples for developing vehicles at varying levels of autonomy. Classical control theory will be complemented with approaches from the data-driven world of machine learning and artificial intelligence.

### **AESE 405 Launch Vehicle Engineering 3 Credits**

A comprehensive course in the integrated design and engineering of today's launch vehicles, including structures, propulsion, materials, thermal and fluids management, and Guidance, Navigation, and Control. Multiple examples of current designs will be analyzed and a collaborate class project will focus on the design and analysis of a new launch vehicle.

### **AESE 406 Data Fusion and State Estimation 3 Credits**

A comprehensive course in data fusion and Kalman Filtering for optimal state estimation of dynamic systems. Includes coverage of basic probability, dynamic system modeling, state space representation of dynamic systems, state estimation theory, least squares estimation, and discrete Kalman filter estimation. This course implements the theory through extensive modeling and simulation using Python and C++. A design project provides experience with practical design issues and tradeoffs.

### **AESE 407 Hypersonic Flows 3 Credits**

An introduction to hypersonic aerodynamics, covering advanced concepts pertinent to highly compressible, reacting flows. Topics to include boundary layer and shockwave phenomena, viscous heat transfer, radiative heating, surface effects such as ablation and catalysis, and basics of rarefied flow. The course will focus on developing applied skills needed to solve real-world design problems for hypersonic flight, concluding with a final project.

### **AESE 408 Advanced Aerospace Vehicle Design 3 Credits**

An overview of design methodology for next-generation aerospace vehicles such as satellites, reentry vehicles, hypersonic systems, and/or hybrid-electric aircraft concepts, focusing on the interdisciplinary analysis of structures, fluid mechanics, propulsion, and Guidance, Navigation, and Control. Case studies will be used to explore real-world vehicles and students will complete a systems-level design of a flight vehicle concept of their own choosing based on specified mission requirements.

### **AESE 460 Aerospace and Space Systems Engineering Project 1-6 Credits**

Project work on some aspect of aerospace or space systems engineering in an area of student and faculty interest. Selection and direction of the project could involve interaction with local communities or industries. Consent of department required.

**Repeat Status:** Course may be repeated.

### **AESE 490 Thesis 1-6 Credits**

Directed study leading to a thesis.

**Repeat Status:** Course may be repeated.