2025
Online Course Catalog

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All courses include comprehensive materials, opportunities for direct engagement, and a certificate of completion to showcase your achievement.

For group discounts, private training, or more information, contact Lisa Le, Education Specialist (lisal@aiaa.org).

Questions? Visit our FAQs at aiaa.org/course-faqs

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Fall 2025 Courses

COURSES LISTED IN CHRONOLOGICAL ORDER BY START DATE

2025 On-Demand Courses

Fall 2025 Courses

Orbital Mechanics and Mission Simulation

25 August–1 October | 2.4 CEU/PDH
$995 Member | $1,195 Non-Member

This course provides an overview of orbital and attitudinal dynamics. The intent is to provide a meaningful understanding of spacecraft flight dynamics with minimal mathematical emphasis. Thus, the student will gain sufficient knowledge that, when presented with a mission profile will have a conceptual understanding of the flight profiles and the sequence of events within the context of a mission simulation.

TOPIC AREAS: **Flight Dynamics | Attitudinal Dynamics | Mission Simulations**

Rotorcraft and Propeller Aerodynamics and Aeroacoustics: Numerical Approaches and Practical Applications

2 September–2 October | 2.0 CEU/PDH
$995 Member | $1,195 Non-Member

This course balances theory and hands-on application to help students master aerodynamics and aeroacoustics for advanced air mobility, enabling them to predict and analyze the complex aerodynamics and noise characteristics of rotorcraft and propeller blades. Through simulations and practical analyses of real-world rotorcraft and propeller applications, students will be well-prepared to apply these techniques to address challenges in real-world engineering scenarios.

TOPIC AREAS: **Momentum Theory | Blade Element Momentum Theory (BEMT) | Motor Dynamics | Propeller-wing Interactions | Aeroacoustics**

Fundamentals of Space Domain Awareness: An Introduction to Safe Operations, Security, and Defense

3–4 September | 1.0 CEU/PDH
$595 Member | $795 Non-Member

This course addresses the capabilities of space domain awareness (SDA) operations while giving students an overview of the challenges and problems in ensuring a safe and sustainable space environment. The course touches on key challenges with SDA as well as strategy and tactics, space object detection, tracking, characterization and identification, data and information flow, and decision making. Students will learn what government and industry stakeholders need from SDA and the frameworks for designing SDA strategies. They will also study how to characterize and identify space objects and use the space mission design process to develop on-orbit sensing systems.

TOPIC AREAS: **SDA | Space Sustainability | Object Characterization and Identification | Anti-Satellite (ASAT) | Conjunction Assessment | On-orbit Sensing | Object Motion**

Machine Learning for Aircraft Applications

8 September–13 October | 3.3 CEU/PDH
$1,295 Member | $1,495 Non-Member

This course teaches students how to apply reduced-order model (ROM) techniques in aerospace engineering, focusing on aircraft performance and aerodynamic load analysis. The course focuses on ROM techniques, which simplify complex aerodynamic and aeroelastic problems into manageable computational tasks. Students will learn about two primary types of ROMs: data-driven ROMs that leverage machine learning algorithms and equations-derived ROMs that rely on projection-based methods. They will explore steady-state and unsteady aerodynamic modeling approaches that can help accelerate the design process. They will gain a foundational understanding of machine learning and nonlinear projection concepts and how to implement them in aerospace applications.

TOPIC AREAS: **Data-driven ROM | Equation-derived ROM | Machine Learning | Nonlinear Projection | Aerodynamic Loads | System Coupling | Aerodynamic Modeling**

Spacecraft Design, Development, and Operations

15 September–22 October | 3.6 CEU/PDH
$1,395 Member | $1,595 Non-Member

This comprehensive course delves into the interdisciplinary design, development, and operations of spacecraft. Beginning with a summary of spacecraft, current and future launch vehicles and upcoming space missions, the course then addresses spacecraft orbits and trajectories, orbital rendezvous, and mission design and payload development. Students will learn about payloads, spacecraft buses, and subsystems from propulsion and attitude sensing and control to navigation. They will examine the environmental control and life support system (ECLSS) for a crewed spacecraft and learn about link equation and link budget calculation, antennas and ranging, and the role of NASA's Deep Space Network (DSN) to ensure continuous contact with spacecraft. The final session will examine spacecraft failures.

TOPIC AREAS: Launch Vehicles | Gravity-assist Maneuver | Payload Design | Spacecraft Design | ECLSS | Deep Space Network | Spacecraft Mission and Payload Development | Spacecraft Structures and Structural Analysis | Propulsion Systems | Attitude Sensing, Guidance, and Navigation | Spacecraft Dynamics and Control

Hypersonic Aerothermodynamics

16 September–9 October | 1.6 CEU/PDH
$895 Member | $1,095 Non-Member

This course gives students a sound understanding of the limitations and abilities of hypersonic systems, hypersonic aerothermodynamics, and the effects of the hypersonic flight environment on vehicle loads and performance. Students will learn the basic principles, technologies, and methodologies of hypersonic flight. Key technical topics covered include hypersonic aerodynamics, hypersonic flow physics, high-temperature gas dynamics, aerodynamic heating, plasma effects, boundary-layer transition, and flight vehicle force and moment characteristics. Course material will also touch on related topics such as hypersonic vehicle design, air-breathing propulsion systems, thermal protection systems, and flight trajectory challenges.

TOPIC AREAS: Hypersonic Aerodynamics | Hypersonic Flow Physics | High-temperature Gas Dynamics | Aerodynamic Heating | Plasma Effects | Boundary Layer Transition | Hypersonic Vehicle Design | Airbreathing Propulsion Systems

Design of Gas Turbine Engines: From Concept to Details

22 September–12 November | 3.2 CEU/PDH
$1,395 Member | $1,595 Non-Member

This course, updated to emphasize hands-on software demos using the AxSTREAM® platform, links the theory of gas turbine engines with real-world engine design. Students will discover the types of conventional gas turbine engines and the factors most affecting their performance. Exposed to the full spectrum of aero-propulsion system design, students will learn how thermodynamic, aerodynamic, and structural concepts are turned into hardware and how rotordynamics can prevent catastrophic failures of any rotating equipment. They will examine design techniques that have led to accelerated project schedules and software advances that have translated into more holistic system and component designs.

TOPIC AREAS: Gas Turbine Engine | Aero-Propulsion Systems and Components | AxSTREAM® Platform | Rotordynamics | Digital Engineering

Space Domain Awareness: A Comprehensive Guide to Safe Operations, Security, and Defense

22–25 September | 2.4 CEU/PDH
$995 Member | $1,195 Non-Member

As space becomes more congested and contested, space domain awareness (SDA), or tracking the number, direction, and capabilities of objects in space, has new urgency. In this course, students will apply SDA principles to real-world scenarios, learn how to characterize and identify space objects, and use a space mission design process to develop on-orbit sensing systems. Incidents like the Russian direct-ascent ASAT test, which made space debris a weapon, and close calls of maneuvering spacecraft highlight SDA's importance. Students also will learn about the conjunction assessment process and the technical, regulatory, political, and commercial challenges for SDA.

TOPIC AREAS: **SDA | Space Sustainability | Object Characterization and Identification | Anti-Satellite (ASAT) | Conjunction Assessment | On-orbit Sensing | Object Motion**

Fundamentals of Astrodynamics for Space Missile Defense

30 September – 23 October 2025 | 1.6 CEU/PDH
$895 Member | $1,095 Non-Member

This course introduces the fundamental principles of classical astrodynamics and various astrodynamical application examples including ballistic missile trajectories, hypersonic entry guidance and space-based intercept missile guidance. It is intended for aerospace GNC engineers, space mission designers, spacecraft systems engineers, technical managers, and graduate students, who are interested in a comprehensive overview of classical astrodynamics as applied to space missile defense.

TOPIC AREAS: **Orbital Dynamics | Modern Astrodynamics | Orbital Transfer | Missile Systems**

Space Domain Cybersecurity

6–9 October | 2.0 CEU/PDH
$1,495 Member | $1,995 Non-Member

This course examines the practical issues of developing and sustaining a secure cyber environment through all phases of the space mission lifecycle. The course is organized around the Space Domain Cybersecurity (SpaDoCs) Framework, a model for understanding and tackling all critical issues of cybersecurity in the space domain. Students will discuss threats and vulnerabilities in the space domain starting from the enterprise layer, then the mission, system, and DevSecOps layers. They will identify cyber threats to space missions and systems and will learn the first principles of cybersecurity, framing plans of action to address cybersecurity threats raised in the class.

TOPIC AREAS: **Space Domain Cybersecurity (SpaDoCs) Framework | DevSecOps | Cybersecurity Principles**

Aerodynamic Interactions in Multi-Propeller Aircraft Configurations

7–23 October | 1.5 CEU/PDH
$895 Member | $1,095 Non-Member

The course presents the basic principles, technologies, and methodologies of interactional aerodynamics mechanisms related to multi-propeller aircraft configurations. The class will define the principal interactional aerodynamics phenomena occurring on aircraft/rotorcraft configurations, along with their flight envelope (propeller-propeller, propeller-wing, blade-vortex-interactions, and the vortex ring state). They will assess the main effects on aerodynamic performance and the acoustic footprint. Course material also will address related state-of-the-art methodologies, from experimental techniques to numerical methods used for the investigation of these phenomena applied to innovative multi-rotor aircraft configurations. Students will complete a wing-propeller numerical test case using DUST®, a mid-fidelity, open-source aerodynamics software.

TOPIC AREAS: **Advanced Air Mobility | Acoustic Signature | DUST® | Interactional Aerodynamics | Wind Tunnel Models | Airfoil Systems | Loads Measurement Particle Image Velocimetry | Infrared Thermography**

Weapons Bay Cavity and Store Separation

14–23 October | 0.8 CEU/PDH
$595 Member | $795 Non-Member

This course delves into the physics of cavity flow and the challenges for modeling and simulation. Students gain a brief modern history of using weapons bays in military aircraft and the difficulties during a store separation event. Past, present, and future applications of modeling and simulation are drawn from the instructor's 40 years researching and modeling cavity flow. The course will cover current research on store separation from a weapons bay and techniques for prediction.

TOPIC AREAS: **Weapons Bay | Cavity Flow | Modeling and Simulation | Store Separation**

Space Architecture: Designing a Mars Habitation System: Challenges and Consequences

20 October–5 November | 0.9 CEU/PDH
$695 Member | $895 Non-Member

This course explores the design, planning, and operational challenges of establishing human habitation on Mars. Space architecture experts will discuss the unique constraints and opportunities of designing a Martian habitat, including mission planning, environmental hazards, and long-term sustainability strategies. Students will examine the impacts of Mars' environment on habitat design, transportation logistics, and mission architectures for crew arrival and settlement growth. Additional topics include the human factors of long-duration missions, habitability principles, and countermeasures and concepts for surface station layouts, modular approaches, and future expansion.

TOPIC AREAS: **Mars Habitats | Mars Transportation Logistics | ECLSS | Human Factors | Mission Planning**

Scramjet Propulsion: The Systems and Technologies to Enable Hypersonic Flight

21 October–18 November | 1.35 CEU/PDH
$895 Member | $1,095 Non-Member

This course provides insights into the challenges of hypersonic flight and the most important propulsion technologies being developed today. The course provides an overview of technologies required to develop and mature scramjet engines, including combined cycle propulsion systems to power hypersonic cruise aircraft and transatmospheric reusable spaceplanes. Students will gain insight into the performance metrics of high-speed air-breathing propulsion, the state of hypersonic transatmospheric flight (Mach > 5), and the critical technologies that must be matured to operate a scramjet in dual-mode.

TOPIC AREAS: **Ram/Scramjet Propulsion Design Requirements | Aerothermodynamics of Airframe Integrated Scramjet Propulsion | Ram/Scramjet Combustion and Endothermic Fuels | Materials, Structures, and Thermal Management**

Fundamentals of Python for Engineering Programming and Machine Learning

21 October–11 November | 3.2 CEU/PDH
$895 Member | $1,095 Non-Member

Also available as an On-Demand course.

This course, considered the essential overview of Python for engineering programming, has been expanded to include machine learning. Besides introducing the Python programming language to students, the course will focus on engineering applications with practical examples for implementing efficient algorithms. Students will use a computer during the class installed with Anaconda Python Distribution, where they will learn how to pose problems in ways to exploit the features and capabilities of the language.

TOPIC AREAS: **Python | Engineering Programming | Machine Learning | Anaconda Python Distribution**

V/STOL Aircraft Design Considerations, Case Studies, and Lessons Learned

28 October–20 November | 1.6 CEU/PDH
$895 Member | $1,095 Non-Member

This course, offered through the AIAA V/STOL Systems Technical Committee, features expert speakers who will provide firsthand experience in the development of V/STOL aircraft. Students will discover the design aspects of vertical and short takeoff and landing aircraft, the basic configurations available, and the design criteria driving particular configurations. The course also will highlight major design constraints, past and current types of these aircraft and their experimental and operational applications, and various approaches to V/STOL aircraft testing. Students also will learn the pros and cons of different V/STOL aircraft based on case studies.

TOPIC AREAS: **V/STOL Aircraft | V/STOL Jet Effects | V/TOL Propulsion Configuration**

Foundations of CFD with OpenFOAM®

3–6 November 2025 | 1.6 CEU/PDH
$895 Member | $1,095 Non-Member

This highly practical course introduces Computational Fluid Dynamics (CFD) in the context of the open source CFD toolbox, OpenFOAM®. It provides a foundation for all aspects of OpenFOAM®, from running cases to programming, so it is useful to both new users and existing users wishing to broaden their basic knowledge of OpenFOAM®.

TOPIC AREAS: **OpenFOAM® | Boundary Layer Controls | Aerospace Applications | RANS Model | ParaView | Coding Boundary Conditions**

Launch Vehicle Coupled Loads Analysis: Theory and Approaches

4–6 November | 1.2 CEU/PDH
$745 Member | $945 Non-Member

This course reviews the key basics of structural dynamics to create the building blocks of coupled loads analysis (CLA). Key to the launch vehicle and how it flies, CLA is a complex analysis to compute design loads on launch vehicles and spacecraft. Accurate CLA results ensure successful launch vehicle and spacecraft missions. The course, taught exclusively to NASA employees, is now available to the public. Students learn the building blocks of CLA, including time domain and frequency domain methods needed to build high-quality component models, including Craig-Bampton. All CLA flight events are covered: ground, liftoff, and ascent.

TOPIC AREAS: **Coupled Loads Analysis (CLA) | Craig-Bampton Models | Reduced Order Modeling | Time Domain Methods | Frequency Domain Methods | Numerical Integration | Launch Assessments | Ground Loads**

Technical Writing Essentials for Engineers

10–19 November | 0.8 CEU/PDH
$595 Member | $795 Non-Member

Also available as an On-Demand course.

This course reviews the essentials for writing technical reports, proposal technical volumes, and engineering process documents. Nearly half of the course focuses on a disciplined process for organizing and drafting documents and figures, while the remaining portion presents essential writing guidelines for efficient communication with a reader. Students will practice the techniques presented both during course time and in optional assigned exercises that simulate the process for organizing and drafting technical documents.

TOPIC AREAS: **Technical Writing | Technical Communication | Figure Creation**

Applied Model-Based Systems Engineering (MBSE)

17–20 November | 2.0 CEU/PDH
$995 Member | $1,195 Non-Member

This course introduces the processes, tools, and techniques for model-based systems engineering (MBSE). Emphasizing "learn by doing" through hands-on exercises, the class will focus on six central themes that comprise the unique advantages of MBSE and will participate in a simulated model-based design review to explore the application of MBSE to evaluate project technical maturity. Students will examine the current state of modeling languages, ontologies, architectural frameworks, and tools. They will follow systems engineering processes to build a system model from scratch, leveraging design patterns and other techniques, culminating in a final exercise to build their own model for a system.

TOPIC AREAS: **MBSE | Systems Modeling Language (SysML) | Design, Manage and Realize Lifecycle | System Structure and Behavior | System Models to Simulate System Behavior**

Space Systems Verification and Validation

2–5 December | 2.4 CEU/PDH
$995 Member | $1,195 Non-Member

In this course, students will follow the logical development of the assembly, integration and verification plan for a hypothetical mission designed to deliver large-scale meteorological imagery from LEO. Through this verification and validation (V&V) engineering case study, students will examine the complete traceability from design and verification requirements to event implementation and close out. Using MBSE tools and processes, they will develop V&V plans for a space system that includes hardware, software, and associated ground support equipment. They will implement those plans in a hands-on laboratory, leveraging NASA, ECSS, DOD, and industry standards and lessons learned to support V&V decisions.

TOPIC AREAS: **Verification and Validation | Space Systems Engineering | Product Verification | Software Verification | MBSE Tools | V&V of COTS | Flight Certification**

Aircraft and Rotorcraft System Identification Engineering Methods for Piloted and UAV Applications with Hands-On Training Using CIFER®

8–11 December | 2.0 CEU/PDH
$995 Member | $1,195 Non-Member

This course reviews the methods of piloted and UAV aircraft and rotorcraft system identification for determining flight dynamics and control models from test data. Students learn the benefits of the broad application of system identification throughout the flight vehicle development process. They also gain hands-on training in the CIFER® interactive system identification software suite using flight-test data and lab exercises. Using flight-test data from CIFER®, they will complete the entire identification process of extracting and verifying a flight dynamics model of a rotorcraft or fixed-wing aircraft. Students leave understanding how system identification results can validate and update physics-based flight simulation models.

TOPIC AREAS: **CIFER | eVTOL/UAM Configurations and Systems Identification | Flight Simulation Models | Model Stitching**

2025 On-Demand Courses

A Practical Approach to Flight Dynamics and Control of Aircraft, Missiles, and Hypersonic Vehicles

1.8 CEU/PDH | $895 Member | $1,095 Non-Member

This course employs a modern, practical approach to flight dynamics and control of aircraft and missiles, which utilizes MATLAB's computational tools of control systems analysis, design, and simulation. Recent advances in flight control systems (FCS) design for conventional aircraft/missiles as well as hypersonic vehicles will also be emphasized. Students will learn basic physics concepts and mathematical tools required for the flight dynamic modeling, analysis, design, and simulation of aircraft and missiles; fundamental principles of FCS design; MATLAB computational tools for control systems analysis; and examples of practical FCS designs.

TOPIC AREAS: **Flight Control Systems (FCS) | State-Space Control Design | Hypersonic Vehicle Control | High-AOA Flight Dynamics | Aircraft State-Space Models | MATLAB**

A Practical Approach to Gas Turbine Engine Performance and Design Using GasTurb14

3.2 CEU/PDH | $1,395 Member | $1,595 Non-Member

This course provides instruction on how to use GasTurb14 software to optimize design for gas turbine engines. Through examples that include creating engine models, running simulations, and conducting trade studies, students will learn the role of performance in a gas turbine engine project, the link between design and performance processes, the functions and interactions of primary engine components, and the effective use of GasTurb14 software. An introduction of the overall performance and operation of gas turbine engines is also covered.

TOPIC AREAS: **GasTurb14 | Gas Turbine Engine Performance | Gas Turbine Engine Design**

Advanced Flight Dynamics and Control of Aircraft, Missiles, and Hypersonic Vehicles

1.6 CEU/PDH | $945 Member | $1,145 Non-Member

This course provides a comprehensive overview of the advanced flight dynamic modeling, analysis and control design of aircraft, missiles, and hypersonic vehicles. Students will learn through a practical approach that utilizes MATLAB's computational tools of control systems analysis, design, and simulation. The course will focus on advanced topics such as control allocation of advanced tailless aircraft, high angle-of-attack velocity-vector roll maneuvers, flight control design of missiles/aircraft equipped with thrust vector control (TVC) systems, and hypersonic aircraft flight control.

TOPIC AREAS: **Guidance, Navigation, and Control (GNC) | Hypersonic Flight Control | Nonlinear Dynamic Inversion (NDI) Flight Control | Tailless Aircraft | MATLAB | Herbst/Cobra Velocity-Vector Roll Maneuvers**

Advanced Hydrogen Aerospace Technologies and Design

2.0 CEU/PDH | $945 Member | $1,145 Non-Member

This course gives an overview of the potential for hydrogen as an alternative fuel for aircraft applications. After showing successful examples of hydrogen's use in spacecraft, the course will illustrate how it can be used in various aircraft. Students will learn the fundamentals of hydrogen and cryogenics, design of hydrogen-powered fixed-wing craft, design of hydrogen fuel cell eVTOL craft, the infrastructure needed for hydrogen craft, and the challenges and benefits of using hydrogen as a fuel.

TOPIC AREAS: **Hydrogen Fuel | Hydrogen Fuel Cell | Electric Aircraft | Sustainability | Alternative Fuels | eVTOL Design | Policy and Regulation**

Advanced Solid Rockets

1.2 CEU/PDH | $845 Member | $1,045 Non-Member

In this course, students will learn both fundamental themes and advanced concepts related to solid rockets. The material presented will include basic principles of solid rocket motor (SRM) processes, broad description of rocket motor and system design principles, internal ballistics modeling, propellant fundamentals, component design (motor case, nozzle, and igniters), component and motor manufacturing, combustion instability, and motor failures. Students will leave with an understanding of solid rocket propulsion systems and their use in space, launch, tactical, and strategic vehicles.

TOPIC AREAS: **Solid Rocket Propulsion | Missiles | Launch Vehicles | Internal Ballistics Modeling**

Advanced Space Propulsion

1.0 CEU/PDH | $745 Member | $995 Non-Member

Taught by leading experts from the AIAA Nuclear and Future Flight Propulsion Technical Committee, this course introduces students to fundamentals and advanced concepts in advanced propulsion for spaceflight applications. After an overview of a wide breadth of advanced propulsion, students will learn the operational principles of metallized gel propellants, atomic (chemical) propellants for launch vehicles, nuclear thermal propulsion (NTP), fusion propulsion, and antimatter propulsion. The course focuses on hypothetical Mars missions as examples of applications for several of these concepts.

TOPIC AREAS: **Advanced Propulsion | Nuclear Thermal Propulsion (NTP) | Metallized Gel Propellant | Fusion Propulsion | Atmospheric Mining**

AI for Air Traffic Safety Enhancement

1.6 CEU/PDH | $895 Member | $1,095 Non-Member

This course teaches a framework for managing the health of the NextGen Air Transportation System using big data analytics with artificial intelligence (AI). Students will learn how to use simulation and machine learning tools with realistic operational data to enhance the safety and efficiency of national airspace system (NAS) operations. Topics include BEMT and dynamic inflow, CFD best practices, data post-processing for aerodynamic performance evaluation, noise prediction, and the role of human-in-the-loop simulation and data fusion. They will learn multiple risk-mitigation actions, planning, and control using reinforcement learning and optimization methods.

TOPIC AREAS: **Physics-based Simulation | Blade Element Momentum Theory (BEMT) | Computational Fluid Dynamics (CFD) | Ffowcs Williams and Hawkings (FW-H) Equation | Text Mining | Sensor Fusion | Human Reliability | Optimized Control and Planning**

Aircraft Handling Qualities

1.6 CEU/PDH | $895 Member | $1,095 Non-Member

Students will gain an understanding of the balance between workload and performance when the pilot is controlling an aircraft. The course covers the basics of flight dynamics, the effects of feedback control systems, human-in-the-loop modeling, the criteria for handling qualities, pilot-induced oscillations, and more. Many example aircraft are discussed to demonstrate lessons learned in designing for good handling qualities.

TOPIC AREAS: **Aircraft Handling | Piloted Aircraft | Flight Dynamics | Feedback Control Systems**

The Anatomy of Autonomy

1.5 CEU/PDH | $895 Member | $1,095 Non-Member

This course is structured to enable a fundamental understanding of autonomous capabilities, the foundations of their design, and their impact on current and future aviation and space systems. The course explores the differences between traditional automation and more advanced perception-based autonomy. Students will learn the role and complexity of task integration in developing increasingly autonomous systems, the potential roles and limitations of employing artificial intelligence (AI) technologies to enable autonomy, the impact of autonomy on traditional areas of contemporary engineering practice, the challenges to autonomous system design development and implementation beyond the technical arena, and more.

TOPIC AREAS: **Autonomous Operations | Systems Engineering | Artificial Intelligence (AI) | Mission Management**

Applications of Generative AI with Large Language Models in Aviation and Aerospace

0.8 CEU/PDH | $495 Member | $695 Non-Member

This course, tailored for beginners with no prior knowledge of computer programming, gives a comprehensive overview of the essentials of artificial intelligence (AI) and large language models (LLMs), emphasizing their applicability to the aviation and aerospace industries. Students will learn the fundamental concepts of AI, the key tools and libraries for LLM application development, implementation of applications using LLMs, and the ethical considerations of AI development. At the end of the course, students will apply what they learn to a real-world project.

TOPIC AREAS: **Artificial Intelligence (AI) | Large Language Models (LLMs) | Generative AI | AI Ethics**

Business Development for Aerospace Professionals

1.2 CEU/PDH | $795 Member | $995 Non-Member

This course teaches students how to effectively motivate a customer to buy by systematically identifying and then satisfying the customer's needs. Through a focus on real-world applications in aerospace and other high-tech industries, students will learn to determine which desired outcomes are the most important to the customer, combine importance and satisfaction to prioritize which desired outcomes to address, determine what services and support the customer will expect, and many more essential business skills that students can leverage immediately and consistently.

TOPIC AREAS: **Business Development | Customer Satisfaction | Aerospace R&D | Sales Funnel Management**

Cislunar Exploration: Challenges and Opportunities

1.0 CEU/PDH | $695 Member | $895 Non-Member

Students will learn to navigate both well-known and more obscure challenges of cislunar space exploration. The course begins with an overview of these challenges before diving deep into lunar navigation and mapping, space weather phenomena and their impacts, and the international laws that govern cislunar activities. Emphasis is placed on the historical development of the infrastructure that enables lunar navigation. After taking this course, students will be well prepared to face the challenges posed in this new era of returning to the moon.

TOPIC AREAS: **Lunar Exploration | Cislunar Space | Space Law | Geodesy | Geophysics | Lunar Navigation**

Computational Aeroelasticity

0.8 CEU/PDH | $595 Member | $795 Non-Member

This course covers concepts and terminology associated with aeroelasticity. Students will obtain an understanding of critical mathematical concepts, various unsteady aerodynamic theories, structural dynamic principles, aeroelastic principles, aeroservoelasticity, computational methods, and reduced-order models. Through this unified presentation of the various elements that are required for accurate aeroelastic and aeroservoelastic analyses, students will gain the tools they need to understand aeroelastic problems such as gust loads, flutter, and others.

TOPIC AREAS: **Aeroelasticity | Flutter | Computational Fluid Dynamics (CFD) | Modal Analysis | Finite Element Analysis (FEA) | Aeroservoelasticity**

Cryogenic Fluid Management for Storage and Transfer of Liquid Propellants in Space

0.8 CEU/PDH | $595 Member | $795 Non-Member

This course covers important issues and processes associated with the storage and transfer of cryogenic propellant in space that will all play a crucial role in building and maintaining a space-based fuel depot system for refueling spacecraft in future long-duration missions. The four main topics covered are cryogenic propellant tank self-pressurization and active pressure control in 1G and microgravity, propellant slosh dynamics, propellant management and liquid acquisition devices, and surface evolution for space CFM applications.

TOPIC AREAS: **Cryogenic Propellant | Propellant Slosh Dynamics | Propellant Pressure Control**

Design and Operation of Composite Overwrapped Pressure Vessels

1.6 CEU/PDH | $845 Member | $1,045 Non-Member

This course introduces the basic principles governing the design and operation of composite overwrapped pressure vessels (COPVs), with a focus on the requirements of COPVs developed for space applications. Students will gain familiarity with the consensus standards in the aerospace industry, the wide range of aramid and liner materials, the relevant analysis and test methods, and the computational design and analysis methods for COPVs. Students will leave this course with an understanding of how to design, test, and operate these incredibly important but sometimes dangerous pieces of technology.

TOPIC AREAS: **Composite Overwrapped Pressure Vessels (COPVs) | Finite Element Analysis (FEA) | Lifecycle Analysis | Non-Destructive Testing (NDT)**

Design of Electrified Propulsion Aircraft

1.6 CEU/PDH | $895 Member | $1,095 Non-Member

In this course, students will learn about current developments in electrified propulsion as well as how to design electrified propulsion aircraft starting from top-level aircraft requirements. The course examines example cases with a variety of powertrains including pure electric, parallel hybrid, serial hybrid, and combinations with both combustion engines and fuel cells. Students will learn the performance metrics needed to conduct trade studies on powertrain design variables to achieve predefined design goals. Historical and recent electric and hybrid aircraft system studies are also reviewed, as well as standard reporting parameters for future studies.

TOPIC AREAS: **Electric Aircraft | Hybrid-Electric Aircraft | Systems Engineering**

Design of Experiments: Improved Experimental Methods in Aerospace Testing

1.6 CEU/PDH | $895 Member | $1,095 Non-Member

This course teaches statistically based experiment design and its benefits over traditional experimental design methods. Students will learn how to specify the proper volume of data in their experiments to enhance the probability of success, understand the concepts of inferential risk, create full and fractional factorial designs to efficiently quantify main effects and interactions, minimize and quantify unexplained variance, and use response surface methods for higher order modeling. Students will also gain familiarity with Stat-Ease® 360 experimental design software.

TOPIC AREAS: **Design of Experiments (DOE) | Statistics | Factorial Designs | 2k Design | Response Surface Methods**

Design of Gas Turbine Engines: From Concept to Details

3.2 CEU/PDH | $1,395 Member | $1,595 Non-Member

Students will receive an overview of the complete spectrum of the design of gas turbine engines that puts each major segment of the process in perspective. The course will demonstrate how thermodynamic, aerodynamic, and structural concepts are modeled simply but with sufficient accuracy to enable engine geometry and weight to be defined and performance to be estimated. Students will have access to leading turbomachinery component and system modelling software to work through examples of engine design.

TOPIC AREAS: **Gas Turbine Engine Design | Compressor Design | Turbine Design | Thermodynamic Cycles**

Design of Modern Aircraft Structures

2.0 CEU/PDH | $995 Member | $1,195 Non-Member

Students will learn the most important fundamental and practical concepts of modern aircraft structures. After presenting a proposed set of desired competencies for both design and analysis, the course then covers evolution of design philosophy; airframe configurations and load paths; trade studies; margin of safety concept;

material selection, design values; failure theories; idealization, using structural elements; and selection of classical, empirical, and finite element analysis methods. The course also introduces design concepts for fail-safety, durability, and damage tolerance. Students will apply what they learn through practice problems and an optional design project.

TOPIC AREAS: **Structures | Finite Element Analysis (FEA) | Fatigue and Fracture | Materials and Material Selection**

Design of Space Launch Vehicles

3.6 CEU/PDH | $1,495 Member | $1,695 Non-Member

In this multidisciplinary course, students will learn basic physical concepts and mathematics utilized in the preliminary design and analysis of launch vehicles (LVs) including many practical aspects not found in any other course. The course covers LV basic anatomy, mission requirements and top-level performance analysis, engine characteristics, performance estimation, trajectory optimization, structures, ground transportation, manufacturing, testing, and more. Illustrative application examples of existing or heritage hardware are provided as well as solved practice problems to enhance the learning experience.

TOPIC AREAS: **Launch Vehicles (LVs) | Structural Analysis | Trajectory Optimization | Manufacturing | Launch Facilities | Financial Analysis**

Designing Better CubeSats Using System-Level Simulations

0.8 CEU/PDH | $595 Member | $795 Non-Member

This course teaches the workflows of modeling and analyzing a CubeSat mission using digital mission engineering (DME) best practices. Students will create a scenario for a CubeSat mission in Systems Tool Kit (STK), determine line-of-sight between assets, design an ideal orbit, conduct power generation/consumption studies, model an RF link, establish link and telemetry budget, model environmental losses, and more. After this hands-on experience with STK, students will be well prepared to design, model, and analyze CubeSat missions.

TOPIC AREAS: **Digital Mission Engineering (DME) | Systems Tool Kit (STK) | Orbital Mechanics | Satellite Communications | Solar Power Design | CubeSat Mission Design**

Digital Engineering Fundamentals

0.8 CEU/PDH | $595 Member | $795 Non-Member

This course gives an in-depth overview of digital engineering (DE) tools, principles, and practices. Students will learn to create, calibrate, and apply authoritative digital surrogate truth sources, implement quantified margins and uncertainties analyses to master risk at critical decision points, use better systems and test engineering performance metrics to support test and evaluation and critical decision making under risk, and translate the DoD Digital Engineering Strategy into practical actions to create lifecycle value. This course prepares students to be better decision makers, program managers, test engineers, and more by leveraging the powerful tools of DE.

TOPIC AREAS: **Digital Engineering | Uncertainty Quantification (UQ) | SmartUQ | Design of Experiments (DOE) | Systems Engineering**

The Digital Transformation of Test and Evaluation

0.8 CEU/PDH | $595 Member | $795 Non-Member

This course provides an in-depth understanding of a wide range of recent innovative applications of digital engineering tools, principles, and practices and how they have transformed testing and evaluation. Students will learn how a digital approach can drive model-based enterprise decision making to ensure seamless stakeholder collaboration across the acquisition lifecycle, deliver authoritative knowledge enabling faster and better decision making, and accelerate development, delivery, operations, and sustainment of new capabilities.

TOPIC AREAS: **Digital Engineering | Test and Evaluation | FAIR Knowledge Management Principles | Artificial Intelligence (AI)**

Electric VTOL Aircraft Design: Theory and Practice

2.0 CEU/PDH | $945 Member | $1,145 Non-Member

This course, taught by pioneering experts from industry and academia, provides an overview of the unique challenges and opportunities of passenger eVTOL aircraft. Students will learn the major constraints in eVTOL design, characteristics of leading batteries and motors, acoustics fundamentals, eVTOL sizing considerations, theory, and computational tools for eVTOL design, pros and cons of different eVTOL aircraft configurations, and cost estimation of eVTOL aircraft. Lessons are illustrated through a simplified multirotor VTOL aircraft progressively designed and analyzed in class.

TOPIC AREAS: Passenger eVTOL Aircraft | Electric Propulsion | Rotor Aeromechanics | Rotorcraft | Ffowcs Williams and Hawkings (FW-H) Equation

Electrified Aircraft Propulsion Technologies: Powering the Future of Air Transportation

1.8 CEU/PDH | $895 Member | $1,045 Non-Member

This course describes the benefits of electrifying the propulsion systems of large aircraft, identifies the technological advancements required to enable electrified aircraft propulsion, and details how the aerospace industry can transition to these advanced technologies. Students will learn to understand the benefits of electric propulsion, types of electric and hybrid-electric propulsion systems, fundamentals of electromechanical energy conversion and performance parameters, fundamentals of enabling power electronics, the key drivers of electrical machine and drive designs, the basics of electrical power distribution architecture, and the general considerations for the protection system design.

TOPIC AREAS: Electric Aircraft | Hybrid-Electric Propulsion Systems | Battery Design | Thermal Management | Cryogenic Power Electronics

eVTOL Infrastructure Considerations for Advanced Air Mobility

0.8 CEU/PDH | $595 Member | $795 Non-Member

Students will gain a basic understanding of what vertical lift infrastructure is and an overview of some of the more technical aspects that must be considered for advanced air mobility (AAM). The course covers commonly used terminology for defining and describing infrastructure, calculation of infrastructure dimensions necessary to support vertical lift operations, the latest developments in infrastructure standards, aircraft performance criteria to consider for infrastructure design, factors shown to perpetuate infrastructure accidents, and more. After taking this course, students will be familiar with the key building blocks of vertical lift infrastructure design, particularly in complex urban environments.

TOPIC AREAS: Advanced Air Mobility (AAM) | Infrastructure Design | eVTOL Craft | Urban Air Mobility (UAM) | Electric Aircraft | Airspace Design

Flight Test Techniques for UAS

1.6 CEU/PDH | $895 Member | $1,095 Non-Member

This course provides students with the theory, techniques, software, and analysis methods necessary for development, qualification, and acceptance tests of unpiloted aircraft systems (UAS). After an overview of the fundamentals of UAS flight test techniques, students will use open-source flight control software to design flight tests using manual and autonomous control, use MATLAB to reduce data generated from UAS flight tests, identify aircraft performance metrics from test data, and develop dynamic models to represent aircraft. This course gives students the tools to conduct tests faster, more efficiently, and with better results.

TOPIC AREAS: Unpiloted Aircraft Systems (UAS) | PX4 Flight Stack | Flight Data Analysis and Reporting

Flight Vehicle Guidance, Navigation, and Control Systems (GNC): Analysis and Design

1.6 CEU/PDH | $895 Member | $1,095 Non-Member

In this course, students will learn the basic physical concepts and mathematical tools required for the dynamical modeling, analysis, design, and simulation of GNC systems of aerospace flight vehicles. The course teaches these principles using illustrative examples of different flight vehicles including conventional missiles, launch vehicles, Mars EDL vehicles, and both hypersonic glide and cruise vehicles. Students will leave with an enhanced understanding of the fundamental principles of GNC design theory and practical applications.

TOPIC AREAS: Equations of Motion of Flight Vehicles | Strapdown Inertial Navigation | Hypersonic Vehicles | Orbital Intercept and Rendezvous Guidance

Fundamentals and Applications of Thermal Vacuum Testing Science

1.6 CEU/PDH | $895 Member | $1,095 Non-Member

This course provides an in-depth understanding of the fundamentals, goals, and requirements of thermal vacuum testing for launch vehicles, satellites, and satellite components and establishes an educational foundation of the science involved in conducting thermal vacuum testing. After a short refresher of the physics and fundamentals of thermo-vacuum testing and an overview of typical satellite test requirements, students will learn the physics behind vacuum bake-out, thermal vacuum cycling, and thermal vacuum balance testing. The course then reviews vacuum and analysis hardware with the goal of allowing course-takers to identify the test platform needed to achieve both specific program requirements and overall mission success. By making the underlying science understandable, students will leave this course well-prepared to understand test requirements and determine best methods for thermal vacuum testing.

TOPIC AREAS: Thermal Vacuum Testing | Thermodynamics and Heat Transfer | Thermal Testing | Electromagnetic/EMI Testing | Vibration/Shock Testing | Vacuum Chamber Hardware

Fundamentals and Applications of Pressure Gain Combustion

1.6 CEU/PDH | $895 Member | $1,095 Non-Member

This course gives an overview of the unique aspects of pressure gain combustion (PGC). After learning the historical context of PGC development, students will learn the thermodynamic theory and fundamental physics pertinent to PGC. The course presents the pros and cons of different PGC systems including pulse combustions, wave rotor combustion engines (WRCE), pulse detonation engines (PDE), and rotating detonation engines (RDE). The final lecture covers the challenges facing PGC development and gives a roadmap for the various programs that could help advance the technology.

TOPIC AREAS: Pressure Gain Combustion (PGC) | Deflagration and Detonation | Constant Volume Combustion (CVC) | Thermodynamic Cycle Analysis

Fundamentals of Aeroelasticity: From Basics to Application

1.6 CEU/PDH | $895 Member | $1,095 Non-Member

This course provides a condensed introduction to aircraft aeroelasticity. All relevant aspects of aeroelasticity are covered, ranging from fundamentals of aeroelastic modeling and phenomena to larger-scale aeroelastic modeling of aircraft. Students will come to understand aerodynamic and structural models tailored toward aeroelastic calculations, interpolation methods to couple aerodynamics with structures, and aeroelastic control and nonlinearities. The course does not go into advanced detail but instead provides an understanding of the most important aspects of the aeroelasticity field.

TOPIC AREAS: Aeroelasticity | Gust Response | Aeroelastic Nonlinearities | Aeroservoelasticity | Stability Analysis

Fundamentals of Classical Astrodynamics and Applications

1.6 CEU/PDH | $845 Member | $1,045 Non-Member

This course presents the fundamentals of classical orbital dynamics and modern computational astrodynamics. Students will receive a comprehensive introduction to classical astrodynamics problems including the two-body problem, Kepler's problem, Lambert's problem, angles-only initial orbit determination problem, circular restricted three-body problem (CR3BP), and orbit perturbations. Students will leave this course with the basic physical concepts and mathematical tools required for the analysis and design of advanced space missions and GNC systems of space vehicles.

TOPIC AREAS: Astrodynamics | Guidance, Navigation, and Control (GNC) | Initial Orbit Determination (IOD) | Clohessy-Wiltshire-Hill (CWH) Equations | Vinti's Method | Orbits Around Irregular-Shaped Bodies

Fundamentals of Data and Information Fusion for Aerospace Systems

0.8 CEU/PDH | $595 Member | $795 Non-Member

This course gives an overview of data and information fusion (DIF), an adaptive estimation process which spans sensing, tracking and identification, situation assessment, and resource management for decision making under uncertainty. Students will learn the multi-level reference model of DIF and receive a high-level introduction to systems engineering for design, development, implementation, integration, and validation of DIF technologies for real-world aerospace applications. They will learn the roles of DIF in various aerospace applications including missile defense, command-and-control, air-traffic control, remote-sensing, and autonomous vehicles.

TOPIC AREAS: **Data and Information Fusion (DIF) | Systems Engineering | Autonomous Operations**

Fundamentals of High-Speed Air-Breathing and Space Propulsion

1.6 CEU/PDH | $895 Member | $1,095 Non-Member

This course covers the fundamentals of five classes of engines: air-breathing rockets, ram/scramjets, detonation wave engines, arcjets, and ion thrusters. Students will examine and understand airbreathing, electrothermal, and electrostatic propulsion theories; contextualize advanced propulsion concepts in their design space; understand the limits and assumptions in calculating thrust; and grasp the propulsion requirements of in-orbit and launch missions. Students will leave with a comprehension of the equations used to calculate thrust for these advanced propulsion technologies.

TOPIC AREAS: **Advanced Propulsion | Ion Propulsion | Ramjets and Scramjets | Detonation Wave Engines | Arcjet Engines | Airbreathing Rockets | Orbital Mechanics**

Fundamentals of Airplane Performance, Stability, Dynamics, and Control

1.0 CEU/PDH | $595 Member | $795 Non-Member

This course gives an overview of several interrelated disciplines involving airplane performance, including aerodynamics, dynamics, and control systems. Students will learn the basic physics and mathematical tools required for preliminary estimation of airplane performance. The course covers static, longitudinal, and lateral/directional stability and control; aircraft equations of motion; estimation of stability and control derivatives; and closed-loop flight control. Students will leave this course with an enhanced understanding of the fundamental principles of airplane flight mechanics.

TOPIC AREAS: **Airplane Performance | Stability and Control**

Fundamentals of Space Systems

1.2 CEU/PDH | $595 Member | $795 Non-Member

This course provides a broad overview of the concepts and technologies of modern space systems with a concentration on scientific and engineering foundations of spacecraft systems and interactions among various satellite subsystems. The nomenclature, vocabulary, and concepts introduced will give students the ability to interact with and understand various subsystem specialists on their space system teams. All major satellite subsystems are reviewed as well as space mission geometry.

TOPIC AREAS: **Space Mission Design | Attitude Determination and Control (ADC) | Spacecraft Communications | Spacecraft Power and Thermal Control | Spacecraft Propulsion**

Fundamentals of Structural Dynamics

1.6 CEU/PDH | $895 Member | $1,095 Non-Member

This course introduces vibrations and structural dynamics. Through lectures, physical demonstrations, software tools, and optional assignments, students will gain an understanding of free and forced vibration of single and multi-degree-of-freedom systems, Fourier decomposition of excitation forces, modal testing, component loads analysis, and random vibration analysis. The main focus of the course is the essential concepts of these topics, but specific examples focused on turbomachinery and launch vehicles are also used to aid the learning process. Students will gain the knowledge necessary to work with dynamics experts and make basic calculations on their own.

TOPIC AREAS: **Vibration | Modal Analysis | Component Loads Analysis | Finite Element Analysis | Fourier Analysis**

Guidance and Control of Hypersonic Vehicles

1.6 CEU/PDH | $995 Member | $1,195 Non-Member

This course gives a comprehensive overview of the recent, emerging technological advances in hypersonic flight vehicles, with an emphasis on solving a variety of guidance and control problems of hypersonic vehicles. After an overview of guidance, navigation, and control (GNC) of hypersonic vehicles, students will learn the basic physical concepts and mathematical tools required for the dynamical modeling, analysis, design, and simulation of GNC systems of hypersonic aircraft. The course presents several numerical case studies, including Mars EDL missions and HGV/HCM guidance, using a MATLAB package that employs the numerical predictor-corrector guidance algorithm.

TOPIC AREAS: **Guidance, Navigation, and Control (GNC) | Hypersonic Glide Vehicles (HGV) | Hypersonic Cruise Missiles (HCM) | Hypersonic Interceptors**

Human Spaceflight Operations: Lessons Learned from 60 Years in Space

3.5 CEU/PDH | $1,195 Member | $1,495 Non-Member

Presented by a cadre of 15 experts in the field, this course shares the collective experience from over 60 years of human spaceflight operations. The aim of the course is to shine light on the subject of space operations, as distinct from engineering design. Students will learn how every aspect of spaceflight operations are performed, including mission engineering, space-based power systems, life support systems, communication, medical operations, mission planning, astronaut operations, and more. Speakers include flight directors, flight controllers, astronauts, and mission engineers.

TOPIC AREAS: **Human Spaceflight | Spaceflight Operations | Robotics | Guidance, Navigation, and Control (GNC) | Mission Engineering | Trajectory Design**

Hypersonic Flight Vehicle Design and Performance Analysis

2.0 CEU/PDH | $995 Member | $1,295 Non-Member

Students will learn principles and methods to address challenges in designing hypersonic flight vehicles of various propulsion types including ramjets, scramjets, turbine-based and rocket-based combined cycles, and pre-cooled engine cycles. Topics include an introduction to hypersonic flight from a historical perspective, design challenges, vehicle performance requirements, design methodology, aerodynamics, propulsion, structures, flight mechanics/stability and control, thermal management, design convergence, off-design performance analysis, the role of computational fluid dynamics (CFD), ground and flight testing, and ongoing international programs.

TOPIC AREAS: **Hypersonic Flight | Aerothermodynamic Cycle Analysis | Supersonic Mixing | Computational Fluid Dynamics (CFD)**

Hypersonic Propulsion Concepts: Design, Control, Operation, and Testing

1.6 CEU/PDH | $995 Member | $1,195 Non-Member

This course introduces students to the most important aspects of the technical discipline of high-speed air-breathing propulsion. After a presentation on the theoretical background of hypersonic flight, students will learn various practical applications and concepts, including aerothermodynamics cycle analysis, fundamentals of combustion for high-speed air-breathers, fundamentals of aerodynamics and boundary layers, and familiarization of engine ground testing and flight-testing techniques and considerations.

TOPIC AREAS: **Hypersonic Flight | Computational Fluid Dynamics (CFD) | Aerothermodynamic Cycle Analysis | High Temperature Materials**

Hypersonics: Test and Evaluation

0.8 CEU/PDH | $595 Member | $795 Non-Member

Students will learn the fundamentals and challenges of hypersonic testing. The course will cover the fundamentals of hypersonic flight, the various benefits of speed, the history of hypersonic testing, the differences between the disciplines and test capabilities used to evaluate high speed systems, the salient physics challenges for providing a relevant environment, and the benefits and drawbacks of various test techniques.

TOPIC AREAS: **Hypersonic Flight | Ground Testing | Flight Testing**

Introduction to Propellant Gauging

0.8 CEU/PDH | $595 Member | $795 Non-Member

This course covers the fundamentals of measuring total remaining propellant during space missions. All three propellant gauging methods are covered: the book-keeping (BK) method, based on calculation of used propellant; the pressure-volume-temperature (PVT) method, based on the ideal gas law; and the thermal propellant gauging method, based on the measurement of heat capacity of the remaining propellant. Students will also learn gauging methods for electric propellant.

TOPIC AREAS: **Propulsion | Propellant Gauging | Space Mission Planning**

Launch Vehicle Coupled Loads Analysis: Theory and Approaches

1.2 CEU/PDH | $745 Member | $945 Non-Member

This course gives students the foundation to understand and develop new coupled loads analysis (CLA) capabilities. Students will learn the key basics of structural dynamics, then use those fundamentals to create the building blocks of CLA and finally use those building blocks in CLA. Topics covered include modes and reduced-order modeling, Craig-Bampton models, damping, data recovery, numerical integration, time domain methods, frequency domain methods, preliminary loads, incorporation of systems engineering with CLA, and more. CLA flight events covered are ground loads, liftoff, aerodynamic flight, maneuvering, engine ignitions and shutdowns, staging, and engine oscillations.

TOPIC AREAS: **Coupled Loads Analysis (CLA) | Launch Vehicle Design | Vibration Analysis | Systems Engineering | Aeroelasticity**

Liquid Rocket Engines: Emerging Technologies in Liquid Propulsion

2.0 CEU/PDH | $995 Member | $1,195 Non-Member

This course covers emerging technologies in liquid propulsion and topics of interest in launch vehicle and spacecraft propulsion. After an introduction to rocket propulsion fundamentals, students will be familiarized with definitions and characterizations of rocket fuels and oxidizers, advances in additive manufacturing and their implications toward emerging liquid rocket engines, rocket engine testing, emerging technologies in cryogenic fuel storage, advances in turbomachinery, green propellants, CubeSat propulsion, and more.

TOPIC AREAS: **Liquid Fuel Rockets | Green Propellants | Finite Element Analysis (FEA) | Rocket Engine Manufacturing | Cryogenic Fluid Management**

Metal Additive Manufacturing for Aerospace Applications

1.2 CEU/PDH | $795 Member | $995 Non-Member

This course provides and overview of the concept-to-utilization life cycle in additive manufacturing (AM) for aerospace applications, guiding students through the intertwined basics of design and implementation using AM. Students will learn use cases for AM, the lifecycle for metal AM for aerospace components, the advantages and disadvantages of various metal AM processes, the different feedstocks for AM processes, the steps involved in post-build processing, and more. Case studies of both the successes and failures of AM are presented throughout.

TOPIC AREAS: **Additive Manufacturing (AM) | Direct Metal Printing (DMP) | Design for Additive Manufacturing (DfAM) | Machining**

Missile Aerodynamics, Propulsion, and Guidance

1.2 CEU/PDH | $745 Member | $995 Non-Member

This course covers the most important aspects of missile aerodynamics, propulsion, and guidance. Students will learn key drivers in the missile engineering process; critical tradeoffs, methods, and technologies in missile selection and sizing to meet flight performance and other requirements; conceptual design prediction methods; launch platform-missile configuration integration; aerodynamics, propulsion, and guidance development process; and targeting system, launch platform, and missile guidance integration. Multiple videos throughout the lectures illustrate missile system and subsystems development activities.

TOPIC AREAS: **Missile Engineering | Aerodynamics | Guidance, Navigation, and Control (GNC) | Systems Engineering**

Missile Design: A Comprehensive Guide

3.3 CEU/PDH | $1,395 Member | $1,695 Non-Member

This course covers the most important aspects of missile aerodynamics, propulsion, guidance, lethality, system engineering, and development. It will cover the same material as the AIAA course, Missile Aerodynamics, Propulsion, and Guidance, but with additional detail and additional material, including lectures on missile lethality, missile systems engineering, missile development, and more. Multiple videos throughout the lectures illustrate missile system and subsystems development activities.

TOPIC AREAS: **Missile Engineering | Aerodynamics | Guidance, Navigation, and Control (GNC) | Systems Engineering**

Optimal Control Techniques for Unpiloted Aerial Vehicles

1.4 CEU/PDH | $595 Member | $795 Non-Member

This course discusses the application of optimal control theory for unpiloted aerial vehicles. The theoretical topics covered are variational necessary conditions for optimal control and the Pontryagin minimum principle, the Legendre pseudospectral method for direct numerical trajectory optimization, the linear quadratic regulator, and optimal path search methods on graphs. The course focuses on applications, not intricate proofs, and uses many examples, including autopilot design, reference trajectory tracking, and optimal reference trajectory generation in drift (wind) fields and threat fields.

TOPIC AREAS: **Optimal Control Theory | Unpiloted Aerial Vehicles (UAV) | Linear Quadratic Regulator (LQR) | Numerical Trajectory Optimization | Reference Trajectory Tracking | Pontryagin Minimum Principle**

Practical Design Methods for Aircraft and Rotorcraft Flight Control for UAV, AAM, and Civil/Military Using CONDUIT®

2.0 CEU/PDH | $995 Member | $1,195 Non-Member

This course presents design methods for flight control using multi-objective parametric optimization. Students will learn best practices in the selection of handling qualities and flight control specifications, simulation modeling and fidelity assessment, and flight control design and analysis methods; multi-objective parametric optimization design using feasible sequential quadratic programming (FSQP); comparisons between a range of classical and modern control design methods; and more. Students will learn through a hands-on approach using provided CONDUIT® software to work through flight control examples for both aircraft and rotorcraft.

TOPIC AREAS: **Feasible Sequential Quadratic Programming (FSQP) | Multi-Objective Parametric Optimization | Flight Control | Unpiloted Aerial Vehicles (UAV) | Advanced Air Mobility (AAM) | eVTOL**

Rocket Testing

1.6 CEU/PDH | $645 Member | $845 Non-Member

This course teaches the fundamental and practical aspects of rocket testing activities. Students will learn the fundamentals of all main forms of rocket propulsion (liquid fuel, solid fuel, hybrid, and electric) and the state-of-the-art testing practices for each. The course will also cover uncertainty analysis and design of experiments (DOE), including heat transfer modeling and structures modeling to check the validity of experiments.

TOPIC AREAS: Rocket Propulsion | Design of Experiments (DOE) | Vacuum Chamber Testing | Altitude Chamber Testing | Thrust Measurement

Satellite and SmallSat Thermal Control Engineering

1.6 CEU/PDH | $845 Member | $1,045 Non-Member

This course presents satellite thermal control for small satellites as an organized engineering discipline. Students will learn how to design SmallSat thermal control systems based on best practices developed by the satellite industry. After an overview of the fundamentals of satellite thermal control systems, the course describes existing in industry methods of thermal control which are used for satellite thermal design, shows industry best practice for designing thermal control, gives hands-on experience in preliminary design and analysis of satellite thermal control system, and teaches how to use tools for CubeSat thermal management.

TOPIC AREAS: Satellite Thermal Management | CubeSat Design | Thermal Vacuum Testing

Space Architecture: Designing a Lunar Habitation System

0.9 CEU/PDH | $645 Member | $845 Non-Member

This course presents the development strategies and design challenges of locating and building lunar habitats. Students will learn how the transportation system, site selection, and environmental factors influence the shape, size, and growth of lunar bases. The course gives particular focus on the environmental control and life support systems (ECLSS), crew systems, and health maintenance systems and offers methods of integrating, maintaining, and upgrading these habitat subsystems.

TOPIC AREAS: Lunar Habitation | Human Spaceflight | ECLSS | Lunar Architecture | Systems Engineering

Space Architecture: Designing an Orbital Habitation System: Challenges and Consequences

0.9 CEU/PDH | $645 Member | $845 Non-Member

This course, presented by professional space architects, covers the development strategies and design challenges of locating and building orbital habitats. Students will learn how the transportation system, mission planning, and environmental factors influence the architecture of the orbital habitats in shape, size, and growth. The course offers methods of integrating, maintaining, and upgrading habitat subsystems, with particular focus on the environmental control and life support systems (ECLSS), crew systems, and health maintenance systems. Design concepts for accommodating human factors in microgravity and logistics for resupply and crew rotation are also presented.

TOPIC AREAS: Human Spaceflight | ECLSS | Space Architecture | Orbital Urban Planning

Spacecraft Avionics Systems Design and Applications

1.5 CEU/PDH | $895 Member | $1,095 Non-Member

This course gives a detailed look at basic spacecraft avionics systems engineering and design processes and principles. Topics covered include the up-front systems engineering process, requirement levels, trade studies, requirements allocation/linking requirements derivation, requirements verification, risk and risk assessment, safety, integration, testing, costing, and scheduling. Each avionics subsystem is explained in detail to gain insight into manpower and cost requirements, and the design, fabrication, and qualification of the electrical ground support equipment required to operate satellites are discussed in detail.

TOPIC AREAS: Spacecraft Avionics | Systems Engineering | Risk Assessment | Radiation Analysis

Spacecraft Design, Development, and Operations

3.6 CEU/PDH | $1,395 Member | $1,595 Non-Member

Perhaps the most comprehensive short course on spacecraft design available anywhere, this course presents an extensive and coherent treatment of the fundamental principles involved with the interdisciplinary design of spacecraft. Topics covered include the history of spacecraft, current launch vehicles (LVs), spacecraft design drivers, orbital mechanics, orbital maneuvering and rendezvous, thermal control, power systems, telecommunications, and much more. Students will leave this course with an enhanced understanding of the design and operation of spacecraft, particularly the basic physical concepts and mathematics utilized in the preliminary design and analysis.

TOPIC AREAS: Spacecraft Design | Spaceflight Operations | Space Mission Engineering | Orbital Mechanics

Spacecraft Lithium-Ion Battery Power Systems

1.8 CEU/PDH | $995 Member | $1,195 Non-Member

Using a systems engineering approach, this course provides a comprehensive treatment of the requirements, design, manufacturing, test, safety, deployment, and on-orbit operation of spacecraft lithium-ion battery (LIB) power system technologies for spacecraft electrical power systems (EPS). Students will learn the key electrical, thermal, mechanical, safety, and quality requirements for a compliant space LIB design, the natural and induced ground and on-orbit environments that impact space LIB design and test requirements, how to size a spacecraft LIB design for a given Earth-orbiting or planetary mission application, and more.

TOPIC AREAS: Systems Engineering | Spacecraft Electrical Power Systems (EPS) | Safety | Battery Life-Cycle Testing

Sustainable Aviation: Challenges, Design Implications, Recent Advancements, Noise, Emissions, Alternative Fuels, Electric Aircraft, and Emerging Technologies

1.0 CEU/PDH | $595 Member | $795 Non-Member

This course teaches the history and current developments in sustainable aviation. Students will learn about the various topics related to sustainable aviation that include noise, alternative fuels (biofuels, synthetic fuels, methane, alcohols, and hydrogen), and lifecycle environmental impact and analysis. The course will present the promises and challenges of different types of alternative fuels and electric aircraft. Students will also become well versed in recent developments in sustainable aviation.

TOPIC AREAS: Sustainable Aviation | Alternative Fuels | Electric Aircraft | Aircraft Noise | Aircraft Emissions

Test Foundations for Flight Test

1.6 CEU/PDH | $995 Member | $1,195 Non-Member

This course provides an understanding of the fundamental components involved with planning, executing, analyzing, and reporting on a flight test program. Students will learn the plan/execute/analyze/report (PEAR) cycle, the importance of requirement traceability, the elements of a test plan, the composition of a test team, safety planning, flight test data analysis, development of communication plans, risk identification, and more. These concepts will be demonstrated through real-world flight test vignettes presented throughout the course. Additionally, students will plan, execute, analyze, and report on a simple test project of their own.

TOPIC AREAS: Flight Testing | Safety | Systems Engineering | Technical Communication

Trusted Artificial Intelligence

0.8 CEU/PDH | $595 Member | $795 Non-Member

This course provides a foundation for building the trust in artificial intelligence (AI) systems necessary for them to be used robustly and correctly. Students will learn a framework for evaluating trust that highlights three perspectives: data, artificial intelligence algorithms, and cybersecurity. The course covers data management, interpretability and explainability, adversarial robustness, and monitoring and control for AI systems. After completing the course, students will understand which factors affect AI system behaviors, how those factors can be assessed and effectively applied for a given mission, and the risks assumed by trusting the system.

TOPIC AREAS: **Artificial Intelligence (AI) | Machine Learning (ML) | Data Management | AI Fairness and Bias | Cybersecurity**

Turbomachinery for Emerging Space Applications: Liquid Rocket Propulsion

2.4 CEU/PDH | $995 Member | $1,195 Non-Member

This course introduces the interdisciplinary design of turbomachinery components within their corresponding systems in the context of liquid rocket engines. The focus is on theory illustrated with practical examples throughout the course, including follow-along portions where students will be able to model cycles, perform turbine conceptual design, and more using the AxSTREAM® platform. Students will learn how mission requirements inform turbopump design, how turbopumps fit into a launch vehicle, how fluid properties are modeled, how subsonic and supersonic axial turbines are designed for space applications, and more.

TOPIC AREAS: **Turbopump Design | Cryogenic Pump Design | Liquid Rocket Engines | Secondary Flow Modeling | Rotor Dynamics**

Turbulence Modeling for Aerodynamic Flows

0.8 CEU/PDH | $595 Member | $795 Non-Member

This course covers turbulence modeling for aerodynamic flows. After an introduction to the challenges of turbulence simulation and the currently used modeling concepts, students will learn the main modeling concepts used in today's industrial/aeronautical CFD simulations, ranging from Reynolds averaged Navier-Stokes (RANS) to scale-resolving simulation (SRS) techniques (like large eddy simulation) and hybrid RANS-LES methods. Ansys CFD software will be used to illustrate example models, but the principles taught will be applicable to all CFD software tools.

TOPIC AREAS: **Computational Fluid Dynamics (CFD) | Turbulence Modeling | Eddy-Viscosity Models | Near Wall Modeling**

Understanding Aircraft Noise: From Fundamentals to Design Impacts and Simulations

1.2 CEU/PDH | $695 Member | $895 Non-Member

This course addresses aviation noise and its impacts, focusing on the engineering aspects of generation, propagation, and mitigation of noise from aircraft powered by gas turbine engines. Students will learn the role of international and local regulations in noise emissions and management, key metrics used for assessment of noise annoyance and certification, the different sources of noise from aircraft, the role of operational changes on noise emissions, noise measurement techniques, and basic noise simulation strategies. Examples will be demonstrated using FLIGHT-X environmental simulation program.

TOPIC AREAS: **Aviation Noise | Noise Modeling | Noise Mapping | Environmental Regulation**

Wind Tunnel Testing for Aircraft Development

1.8 CEU/PDH | $995 Member | $1,195 Non-Member

This course gives a broad overview of wind tunnel testing best practices used in support of aircraft design, development, and certification. Students will learn from two perspectives: the facility side in terms of furnishing high-quality and productive facilities with broad capabilities, and the client side who uses these facilities to gather crucial data to support aircraft development. The course will cover the history of wind tunnel testing, the cycle of aircraft development programs, types of wind tunnel tests, translation of wind tunnel data into parameters supporting aircraft design and development decisions, and more.

TOPIC AREAS: Testing and Evaluation | Wind Tunnel Testing | Aerodynamics | Computational Fluid Dynamics (CFD)

About AIAA

With nearly 30,000 individual members from 91 countries, and 95 corporate members, AIAA is the world's largest technical society dedicated to the global aerospace profession. Created in 1963 by the merger of the two great aerospace societies of the day, the American Rocket Society (founded in 1930 as the American Interplanetary Society), and the Institute of the Aerospace Sciences (established in 1933 as the Institute of the Aeronautical Sciences), AIAA carries forth a proud tradition of more than 90 years of aerospace leadership.

Our promise is to be your vital lifelong link to the aerospace community and a champion for its achievements.

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