Moscow Aviation Institute | National Research University

MOSCOW AVIATION INSTITUTE

PROFESSIONAL TRAINING

2025

Moscow Aviation Institute | National Research University

Unmanned Aerial Vehicles

UAS Designs and Application Models

Type: Advanced training
Hours of instruction: 72
Format: Online / In person
Description: The program comprises a range of topics introducing with the basics of UAV structure.

Contents:

- Tasks and components of onboard UAV equipment; UAV classification
- Onboard measuring systems
- Fundamentals of inertial navigation and satellite navigation
- Data blending. Integration and filtering
- Basics of control theory
- UAV control loops and algorithms
- Architecture of onboard software for UAV autopilots
- Firmware and tuning for various types of UAVs
- UAS application in environmental protection, archeology, aerial photography and 3D mapping
- Specifics of UAS use for civilian purposes

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Aerodynamics of Unmanned Aerial Vehicles

Type: Advanced training
Hours of instruction: 72
Format: Online / In person
Description: The program covers key aspects of the design and operation of unmanned aerial vehicles (UAVs) and their systems. The course will provide students with extensive knowledge about the structure and functionality of unmanned aerial systems (UASs), as well as the concepts of UAV application that determine their design features.

Contents:

- General information about unmanned aerial vehicles. Structure of an unmanned aerial system (UAS)
- UAV operational concepts dictating their appearance
- Aerodynamic characteristics of the aircraft body. Aerodynamic efficiency of a UAV.
- Aerodynamics of the aircraft configuration. Criteria for the selection of the UAV configuration and aerodynamic design
- Aerodynamics of aircraft controls. UAV stability and controllability.
- Aerodynamic characteristics of the wing.
- Hazardous flight modes and methods of dealing with them.
- Methods of aerodynamic design of the fuselage, lifting surfaces, rotors.
- Overall aerodynamic design of an airplane.
- Aerodynamic design of a helicopter.

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Manufacturing Technology for Modern UAV Systems

Type: Advanced training
Hours of instruction: 108
Format: Online / In person
Description: The program is aimed at studying polymer composite materials, their properties, treatment, and application in the design of unmanned aerial vehicles. Students will gain in-depth knowledge about the structure of polymer composites, their physical and mechanical properties, as well as modern processing and quality control technologies.

Contents:

- Polymer composite structure and factors affecting the physical and mechanical properties of the material
- Main technological processes of manufacturing UAV parts made of polymer composites
- Standardized polymer composite designs and their manufacturing
- Technologies for joining polymer composite-based parts
- Assembly of components and units made of polymer composites
- Basics of developing a quality control system for polymer composite products
- Materials used in UAV construction and their basic properties

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Composite Materials

Fracture Mechanics and Strength of Composite Structures

Type: Advanced training
Hours of instruction: 72
Format: Online / In person
Description: The program is aimed at the continuing training of specialists in the field of fracture mechanics and strength of composite structures. During the course, students will learn modern methods for analyzing the strength, durability, and fracture of structures made of polymer composite materials, taking into account their specific anisotropy and complex structure. Special emphasis is placed on the practical application of fracture mechanics theory, methods of determining critical parameters, and modeling the processes of damage and crack development.

Contents:

1. Fundamentals of fracture mechanics in composite materials
2. Fracture models and strength criteria for polymer composites
3. Anisotropy and its effects on strength characteristics
4. Methods of determining critical stresses and the stress-strain state
5. Crack analysis and the development of defects in composite structures
6. Non-destructive testing and damage diagnostics methods
7. Increasing structural durability and stability
8. Effects of cyclic loads and fatigue strength of polymer composites
9. Computer simulation of fracture
10. Application of finite element analysis methods for strength forecasting
11. Practical cases: aviation and automotive structures
12. Methods of experimental strength assessment and quality control

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Composite Structure Modeling

Type: Advanced training
Hours of instruction: 144
Format: Online / In person
Description: The program focuses on advanced skills in the field of computer simulation of engineering problems using modern methods of finite element analysis and polymer composite modeling. Students will master the Abaqus software package for creating, analyzing, and optimizing structures made of composite materials, including dynamic strength and topological optimization methods. Special attention is paid to the practical skills necessary for building models, the use of various types of contacts and solvers, as well as the analysis of calculation data and parametric optimization.

Contents:

1. Fundamentals of composite material modeling
2. Creation and processing of finite element models
3. Geometry construction and component organization
4. Assignment of boundary conditions and loads
5. Simulation of element interaction: contact and friction
6. Types of finite element model analysis: static, frequency, stability
7. Interpreting the results and post processing
8. Parametric and topological optimization of structures
9. Application of dynamic strength in aviation tasks
10. Configuring dynamic solvers
11. Mathematical models of polymer composites
12. Features of quasistatic problem formulation
13. Simulation methods and fracture criteria for polymer composites
14. Impact simulation (bird strike resistance)
15. Solving airframe hard landing problems

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Polymer Composite Structure Design

Type: Advanced training
Hours of instruction: 108
Format: Online / In person
Description: The program offers a deep dive into the theoretical foundations and modern methods of optimizing the strength and structural characteristics of polymer composite products. As part of the training, the key criteria for design optimality, modern mathematical programming methods, and analysis of complex aircraft unit layouts are considered. Special focus is placed on effective reinforcement models and structural safety, including thin-walled bars, plates, beams, and complex holed assemblies. Practical cases – such as the design of torsion-box wings and joints – demonstrate the integration of theory and engineering practice to create reliable and lightweight next-generation aircraft structures.

Contents:

1. Design optimality criteria
2. Mathematical programming methods
3. Analysis of the structural layout of a craft being designed
4. Design optimization models
5. Safety factor in the design of polymer composite structures
6. Optimal reinforcement at a point and under plane stress conditions
7. Design of thin-walled bars
8. Optimal plate reinforcement against bending and compression
9. Optimal reinforcement of beam structures
10. Designing a torsion-box wing using penalty methods
11. Optimal hole reinforcement
12. Joint design in composite structures

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Small Satellites and Launch Vehicles

Design and Application of CubeSat Spacecraft

Type: Advanced training
Hours of instruction: 72
Format: Online / In person
Description: The purpose of the program is to provide students with knowledge and practical skills in the design, assembly, testing, and use of CubeSat spacecraft.

Contents:

- Introduction to CubeSats and small spacecraft, their history, global market, development trends, and standards.
- CubeSat structure and systems architecture, systemic approach, main subsystems and their interconnection.
- Design and modeling, design environments, basic calculations, and mission simulation.
- Buses and payloads, interfaces and integration.
- Power supply system, energy balance, solar panels and batteries.
- Radio communication systems (VHF, UHF, S-band), work with SDR and ground stations.
- Testing and preparation for launch.
- Orbital parameters and flight control.

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Orbital Satellite Constellations

Type: Advanced training
Hours of instruction: 72
Format: Online / In person
Description: The purpose of the program is to develop competencies in the field of ballistic design, developing reliable satellite constellations, and evaluating their commercial viability.

Contents:

- Introduction to satellite constellations, classification, history, and purpose..
- Ballistics and trajectory design, fundamentals of celestial mechanics for constellations, types of orbits, coverage area.
- Constellations deployment, launch vehicles, and orbital maneuvers.
- Reliability and survivability, methods of increasing reliability, calculation methods.
- Communications and control, channels, protocols, automation.
- Commercial applications and economics, payback and life cycle assessment.

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Advanced Launch Vehicles

Type: Advanced training
Hours of instruction: 72
Format: Online / In person
Description: The goal of the program is to develop systemic knowledge in the design and application of advanced launch vehicles, with an emphasis on small-lift vehicles, reusable elements and technological solutions for delivering payloads to medium-altitude orbits.

Contents:

- Classification and trends in the development of launch vehicles, main tendencies.
- Design of small- and ultrasmall-lift launch vehicles, their features, architecture, standard layouts.
- Reusable technologies in rocket engineering, options for rocket stage recovery, design solutions.
- Launch of payloads into medium orbits, trajectories, and features of upper stages.
- Structural design of multi-purpose upper stages and space tugs.
- Electric vehicles in orbit, types of electric propulsion systems, use as part of orbital tugs, long-term acceleration.
- Ground infrastructure for small-lift launch vehicles, assembly, launch, and impact areas.
- Systems integration and commercial scenarios, economic efficiency, competitive analysis.

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Artificial Intelligence

Neural Network AI Technologies

Type: Advanced training
Hours of instruction: 16
Format: Online / In person
Description: The program forms an idea of artificial intelligence and the place of neural network technologies in this field, offering an overview of modern neural network architectures and considering their functional capabilities. Also presented is a list of typical applied tasks and solutions based on modern neural network AI technologies for solving applied problems. Students are introduced to computer vision and data processing technologies.

Contents:

- Neural networks and artificial intelligence: modern development approaches
- Classification of tasks solved using modern neural network AI technologies
- Libraries of modern neural network AI technologies
- Neural network text processing and generative artificial intelligence
- Neural network image processing and generative artificial intelligence

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MOSCOW AVIATION INSTITUTE

LEADING HIGH-TECH UNIVERSITY

2025

Moscow Aviation Institute is the one of the most sought-after universities by industry in the field of comprehensive works on breakthrough technologies and engineering personnel training

1930
established

185 000+
graduates

13
schools

20 000+
students

5
branches

1 800+
international students

2 500+
faculty members

Programs

- AIRCRAFT ENGINEERING
- SPACECRAFT ENGINEERING
- PROPULSION ENGINEERING
- CONTROL SYSTEMS AND COMPUTER SCIENCE IN ENGINEERING
- INFORMATICS, CYBERNETICS AND ELECTRIC POWER ENGINEERING
- RADIOELECTRONICS AND COMMUNICATION SYSTEMS
- MANAGEMENT, ECONOMICS AND LINGUISTICS
- ROBOTICS
- MATERIALS AND STATE-OF-THE ART TECHNOLOGIES

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