Learning Module Outline

Short Description	
Description of the module	**3D Printing Processes in Aerospace Components and Maintenance** This module explores specific 3D printing processes, challenges, and opportunities in aerospace component production and maintenance. It introduces the fundamentals of 3D printing technologies and their applications in aerospace. It will explain the types of technologies and materials used, discuss the limitations and typical defects in 3D-printed parts, present experimental research methodologies, and highlight key performance characteristics such as mechanical resistance and aerodynamic behavior in boundary layers. The module is divided into six units: **1. Technologies** 1.1. Overview of additive manufacturing technologies used for aerospace applications 1.2. Comparison of FDM, SLA, SLS, and other relevant methods 1.3. Integration of 3D printing into composite structure manufacturing **2. Materials** 2.1. Mechanical and thermal properties of Light Weight materials used in 3D printing for aerospace applications, LW-PLA, LW-ASA 2.2. Parameter selection based on weight, strength, and printability criteria **3. Limitations of Technologies and Common Defects in Products** 3.1. Technological constraints of 3D printing in composite applications 3.2. Common defects: layer adhesion failure, warping, porosity, dimensional inaccuracy 3.3. Strategies for defect prevention and quality control in UAV part production, unavoidable defects **4. Research Methodology** 4.1. Methods of experimental analysis and testing of 3D-printed structures 4.2. Use of standard testing procedures (e.g., tensile, flexural, impact tests) 4.3. Analysis of printed parts under simulated aerodynamic and mechanical loads **5. Mechanical Strength and Performance Characteristics** 5.1. Evaluation of static and dynamic mechanical strength of printed components 5.2. Impact resistance and toughness of materials used in UAV applications 5.3. Influence of printing parameters on strength and structural integrity **6. Boundary Layer and Specific Aerodynamics** 6.1. Influence of surface texture and print layer patterns on aerodynamic flow. Interaction of printed part geometry with boundary layer behavior 6.2. Design considerations for aerodynamic efficiency in 3D-printed UAV parts

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Target Groups	
Targets	• Engineering students (Aerospace, Aeronautical, Materials and Mechanical Engineering) • Engineers and technical staff in Aerospace and Aeronautical Industries

Learning Objectives	
Learning Objectives for this module	Upon completion of this module, attendants will be able to: • Identify and describe the main 3D printing technologies applicable to UAV composite structure manufacturing. • Select appropriate materials for 3D printing based on mechanical, thermal, and weight requirements. • Recognize the limitations of different additive manufacturing methods and identify typical defects in 3D-printed parts. • Apply fundamental research methodologies to evaluate the performance and quality of 3D-printed UAV components. • Assess the mechanical strength, impact resistance, and structural integrity of 3D-printed UAV components. • Understand how surface texture, material structure, and print quality affect boundary layer behavior and aerodynamic performance. • Integrate knowledge of materials, printing methods, and design constraints to develop optimized UAV components for real-world applications.

Learning Resources	
Resources	• UAV Laboratory; • Construction laboratory; • University Airfield Kyviškės; • Scientific articles.

Self-assessment and Learning Activities	
Self-assessment and Learning Activities to be created	• Textbook • Lesson presentations • Lesson reviews • Quizzes • Printing parameter selection for material • G-code preparation (and print evaluation)

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