AEROSPACE ENGINEERING (LM52R)

(Brindisi - Università degli Studi)

Teaching COMPUTER AIDED DESIGN FOR AEROSPACE APPLICATIONS

GenCod A005152

Owner professor Anna MORABITO

Reference professors for teaching
Marta DE GIORGI, Anna MORABITO

Teaching in italian COMPUTER AIDED DESIGN FOR AEROSPACE

Teaching COMPUTER AIDED DESIGN FOR AEROSPACE APPLICATIONS
SSD code IIND-03/B

Reference course AEROSPACE ENGINEERING
Course type Laurea Magistrale

Credits 6.0

Teaching hours Front activity hours: 54.0

For enrolled in 2026/2027

Taught in 2026/2027

Course year 1

Language ENGLISH

Curriculum AERONAUTICS DESIGN

Location Brindisi

Semester First Semester

Exam type Oral

Assessment Final grade

Open **Course timetable**

BRIEF COURSE DESCRIPTION

This course is structured to provide students with advanced methodological and operational skills essential for the parametric and variational geometric modeling of complex mechanical systems. In a modern industrial environment, engineering design extends far beyond mere 3D representation; it demands the ability to structure digital models that natively incorporate functional constraints, corporate design rules, and expected product variability. To achieve this, the course focuses on the application of feature-based CAD systems, guiding students through the comprehension and formalization of **"design intent"**. Mastering this methodological approach is key to building flexible, robust, and easily modifiable models—a crucial competency in contemporary product development workflows, where engineering modifications must be managed rapidly and without rebuilding models from scratch.

To translate these methodological principles into solid professional expertise, lectures and laboratory activities entail an **in-depth, advanced study** and intensive use of **CATIA V5**, a software suite that represents the global benchmark in high-tech industries such as Automotive, Aerospace, and Advanced Surface Modeling. Rather than limiting the training to software commands, the course simulates the actual dynamics of industrial R&D departments through the integrated study of various workbenches:

- **Advanced Solid Modeling (*Part Design*):** For generating complex geometries optimized for downstream manufacturing processes.
- **Assembly Management (*Assembly Design*):** For developing intricate mechanical architectures, performing interference analyses, and managing kinematic and geometric relationships between components.
- **Knowledge Management (*Knowledge Advisor / KBE*):** For implementing formulas, global parameters, and configuration tables capable of automating design and creating standardized component families.
- **Technical Documentation (*Drafting*):** For the precise generation of 2D engineering and assembly drawings, complete with Geometric Dimensioning and Tolerancing (GD&T) compliant with international standards—serving as a vital bridge between design and manufacturing.

Ultimately, the course aims to train a specialized design engineer capable not only of proficiently using a market-leading software tool, but also of governing the entire product geometric definition cycle within a digital PLM (*Product Lifecycle Management*) framework. This combination of methodological rigor and operational excellence ensures immediate professional readiness, directly addressing the job market's demand for highly specialized technical profiles capable of seamlessly integrating into the design teams of structured and multinational corporations.

REQUIREMENTS

To effectively engage with the course content, students are required to possess the following core competencies:

- **Engineering Drawing:** Ability to interpret and prepare 2D technical documentation of mechanical components with elementary geometries.
- **Technical Standards:** Knowledge and correct application of the primary national and international standards (ISO/UNI) regarding representation methods (views, sections), functional dimensioning, as well as basic dimensional and geometric tolerancing (GD&T).

COURSE AIMS

The course aims to guide students toward achieving the following educational milestones:
1. Knowledge and Understanding

- **Fundamentals of Advanced Modeling:** Acquire a solid understanding of the mathematical and geometric principles underlying 3D modeling, as well as the operational mechanics of modern parametric and variational CAD systems.
- **Geometric Control Logic:** Deeply understand how to structure, constrain, and drive complex geometries through parameters, logical relationships, and formulas, ensuring digital model integrity and flexibility when facing design modifications.
- **Concurrent Engineering Methodologies:** Comprehend the principles of collaborative design and the centralization of geometric information using reference models (*skeletons).*

2. Applying Knowledge and Understanding

- **3D Geometric Modeling of Components:** Develop the operational skills to generate three-dimensional models of isolated mechanical parts, ranging from elementary prismatic geometries to free form shapes.
- **Advanced Assembly Management:** Master both *Bottom-Up* (assembling pre-existing components) and *Top-Down* (designing components directly within the context of the assembly) modeling strategies. Specifically, develop the capability to **create complex assemblies using the skeleton methodology**, defining a centralized reference model to parametrically drive the shape, position, and geometric relationships of all parts within the articulated system.
- **Product Engineering and Documentation:** Mature the ability to fully define an industrial product by translating 3D models into rigorous and standardized 2D technical documentation (part drawings, assembly drawings, and exploded views), integrating the geometric specifications and tolerances necessary for manufacturing.
- **Mastery of Industrial Tools:** Decline all the aforementioned competencies with autonomy and methodological rigor within the operative environments of the **CATIA V5** software suite, simulating standard workflows of industrial Research and Development (R&D) departments.

TEACHING METHODOLOGY

The course is developed through an integrated synergy between theoretical lectures and practical laboratory activities, structured as follows:

- **Lectures (Theoretical-Methodological Teaching):** Oriented toward acquiring the logical-mathematical principles underlying modern parametric-variational and feature-based CAD systems. Ample space is dedicated to studying advanced design methodologies necessary to formalize design intent and structure the architecture of complex industrial products, including through collaborative approaches.
- **Practical Exercises (Laboratory Activities):** Conducted entirely hands-on at the computer through the intensive use of the **CATIA V5** suite. This phase is aimed at consolidating the student's operational excellence via guided experiences that simulate real industrial workflows. Practical activities cover the entire digital product definition cycle: from part and surface modeling to advanced assembly management (including skeleton-based methodologies), up to the generation of technical documentation and engineering drawings (2D Drafting).

ASSESSMENT TYPE

The examination consists of an integrated theoretical-practical test with a total duration of **3 hours**, designed to evaluate both the student's methodological maturity and operational proficiency.

- **Theoretical Test (Duration: 1 hour):** Consists of a written response to two open-ended questions covering the methodological foundations addressed during the course. The objective is to assess the student's understanding of the logical-mathematical principles underlying parametric-variational modeling, the structuring logic of design intent, and the architecture of CAD software suites.
- **Practical Test (Duration: 2 hours):** Involves the computer-based development of an assigned design task using **CATIA V5**. Students must demonstrate autonomy and operational mastery in geometric modeling (of individual parts or assemblies) and in the correct generation of the associated 2D technical documentation (*Drafting*), complete with manufacturing tolerances and specifications.

OTHER USEFUL INFORMATION

- **Course Materials:** All lecture notes, slides, and reference materials are made available throughout the semester on the **Unisalento e-learning portal** under the specific course module page.
- **Office Hours (Student Support):** Information regarding office hours—including scheduled days, times, and meeting modalities (in-person or online)—is also managed, updated, and accessible through the same e-learning platform.

FULL SYLLABUS

- **CAD/CAM/CAE systems in the product lifecycle:** Framework of computer-aided design, simulation, and manufacturing technologies within modern Product Lifecycle Management (PLM) workflows.
- **Geometric and mathematical foundations:** 2D and 3D linear geometric transformations; solid geometry representation schemes (B-Rep, CSG) and operational logic of variational parametric engines.
- **Parametric part modeling (*Part Design*):** Use of the *Sketcher* workbench, definition of constrained profiles, and *sketching in context* techniques. Generation of base and engineering solid features (extrusion, revolution, ribs, holes, tappings, sweeps, lofts, shelling, etc.).
- **Advanced component modeling techniques:** Design via the **Multibody** approach (management of multiple solid bodies and boolean operations within the same part file) and introduction to free-form surface modeling within the *Generative Shape Design* environment.
- **Knowledge management and *Design Intent* implementation:** Use of formulas, global parameters, and logical rules to automate geometry and capture design intent.
- **Assembly architecture and management (*Assembly Design*):** Assembly strategies using the *Bottom-Up* approach (managing geometric and kinematic constraints between pre-existing parts) and the *Top-Down* approach (contextual modeling of components).
- **Advanced control structures:** Application of the **Skeleton** methodology (skeleton model) for the centralization of reference geometric information in complex assemblies.
- **Product engineering and technical documentation (*Drafting*):** Generation of 2D assembly and part engineering drawings from 3D models; functional dimensioning, application of tolerances, title blocks, and Bill of Materials (BOM).
- **Kinematic analysis (*DMU Kinematics*):** Introduction to motion simulation and verification of degrees of freedom in engineered mechanisms.

REFERENCE TEXT BOOKS	Lee Kunwoo, “Principles of CAD/CAM/CAE Systems”, Addison Wesley Longman Mortenson M.E.,“GeometricModelling”,John Wiley and Sons,1997. Ibrahim Zeid,“Mastering CAD/CAM”, McGrawHill Michel Michaud,CATIA-Core Tools, McGrawHill Lucidi delle lezioni