

Academic Year: ( 2022 / 2023 )

Review date: 11-06-2021

Department assigned to the subject: Aerospace Engineering Department

Coordinating teacher: CINI , ANDREA

Type: Compulsory ECTS Credits : 6.0

Year : 1 Semester : 1

**REQUIREMENTS (SUBJECTS THAT ARE ASSUMED TO BE KNOWN)**

Student must own basic knowledge relative to the following fields:

**MATERIALS:**

- + Properties and common uses in aerospace applications of polymeric, ceramic and composite materials.
- + Properties and common uses in aerospace application of metallic materials.

**ENGINEERING GRAPHICS:**

- + Descriptive geometry.
- + Standard specification for the representation of basic industrial and aerospace elements.
- + Geometric dimensioning and tolerancing.
- + Computer aided design.

**MANUFACTURING PROCESSES:**

- + Manufacturing in the aerospace industry:
  - Manufacturing processes.
  - Geometric and functional specifications.
  - Tooling and assembly processes.

**OBJECTIVES**

At the end of the course the student should be able to:

- Identify manufacturing process capabilities.
- Select properly the technology or group of technologies to product a piece, component or mechanism attending to its application.
- Select the type of material to manufacture a piece, component or mechanism considering different aspects as service life, machinability and maintenance.
- Recognize and predict a potential failure in aerospace structures and propulsion systems with analytical and numerical techniques.

**DESCRIPTION OF CONTENTS: PROGRAMME****REQUIREMENTS TO MANUFACTURING PROCESSES: PROCESS CERTIFICATION, DESIGN**

Engineering requirements: data for manufacturing  
Quality requirements.  
Cost requirements  
Environmental requirements  
Lead time  
Plant lay-up  
Stability of the process: development vs production.  
Certification of manufacturing processes.

**MANUFACTURING PROCESS CAPABILITIES.**

- Why we need to fix these capabilities
- How to define process capabilities
- Repeatability of the process
- Statistical analysis of manufacturing capabilities
- Tolerances
- Defects (composite materials)

#### CONCURRENT ENGINEERING: MATERIALS, DESIGN AND PRODUCTION INTEGRATION

- Why concurrent engineering
- Product view from different company areas: local target vs global target
- Thinking out of the box. Mutual challenge and collaboration
- Concurrent engineering vs technologies
- Advanced Composite Materials

#### MANUFACTURING PROCESSES FOR ADVANCED COMPOSITE MATERIALS: AUTOCLAVE PROCESS, RTM, FILAMENT WINDING.

- Processes
- Tooling (thermal effects)
- Vacuum bag
- Sandwich
- Defects
- Drilling
- Bonded
- Final trimming
- Joning
- FEM (Machining process simulation)

#### MANUFACTURING PROCESS FOR POLYMERIC MATERIALS

#### MANUFACTURING PROCESSES FOR SUPERALLOYS.

- FEM (Machining process simulation)

#### INFLUENCE OF MACHINING AND ASSEMBLY PROCESSES ON SERVICE INSPECTION.

- Maintenance and inspection activities for in Service aircrafts
- Accessibility
- Design/production for maintenance
- In service damage. Allowable damage definition.
- In Service inspection
- Temporary/permanent repairs
- Non conformance material. Repairs in the production site.

#### ASSEMBLY PROCESSES

- Definition of assembly process based on design requirements
- Consideration of small tooling on the assembly process. Back to the design phase.
- Ergonomic considerations
- Torsion boxes and fuselage examples on assembly

#### INSPECTION METHODS

- Visual inspection and Tap coin
- Ultrasonic inspection: factory and in Service inspection.
- Defects vs inspection methods
- . ¿Uninspectable¿ details
- Thermography

#### TOTAL QUALITY: KEY CHARACTERISTICS, PFMEA, FEEDBACK LOOPS.

- From quality control to total quality
- Impact of different Company areas on the final quality of the product
- Quality plans
- Key characteristics
- PFMEA-DFMEA
- Management of non conformance material.
- Feedback loop. Learning from the non quality.

#### MAINTENANCE.

#### FAILURE MECHANISM COMPOSITES

FAILURE MECHANISM SUPERALLOYS

LEAN MANUFACTURING

#### LEARNING ACTIVITIES AND METHODOLOGY

Theoretical lessons.

Practical lessons

Lab sessions

#### ASSESSMENT SYSTEM

The following requirements have to be met in order to pass the subject:

- 1) to have a MINIMUM mark of 4.0/10 in the end-of-term exam;
- 2) to have a minimum overall mark of 5.0/10 (weighing 60% the end-of-term exam mark and 40% the mark of the continuous evaluation).

Continuous evaluation 40%

<b>% end-of-term-examination:</b>	60
<b>% of continuous assessment (assignments, laboratory, practicals...):</b>	40

#### BASIC BIBLIOGRAPHY

- Jamal Y. Sheikh-Ahmad Machining of Polymer Composites, Springer, 2009
- Michael C.Y.Niu Composite Airframe structures, Hong Kong Conmilit Press Ltd., 1992