AEROSPACE ENGINEERING (LM52)

(Brindisi - Università degli Studi)

Teaching ADVANCED TECHNOLOGIES AND ADDITIVE MANUFACTURING FOR AEROSPACE

GenCod A006162

Owner professor RODOLFO FRANCHI

Reference professors for teaching MAURIZIO CALABRESE, RODOLFO FRANCHI

Teaching in italian ADVANCED TECHNOLOGIES AND ADDITIVE

Teaching ADVANCED TECHNOLOGIES AND ADDITIVE MANUFACTURING FOR

SSD code ING-IND/16

Reference course AEROSPACE ENGINEERING

Course type Laurea Magistrale

Credits 9.0

Teaching hours Ore-Attivita-frontale: 81.0

For enrolled in 2021/2022

Taught in 2022/2023

Course year 2

Language INGLESE

Curriculum CURRICULUM AEROSPACE TECHNOLOGY

Location Brindisi

Semester Secondo-Semestre

Exam type Orale

Assessment Voto-Finale

Course timetable https://easyroom.unisalento.it/Orario

BRIEF COURSE DESCRIPTION

The course aims to deepen the aspects related to manufacturing technologies applied in aeronautical constructions, with particular reference to the materials selection and application and the related transformation technologies. Materials/technologies solutions will mainly be used for the construction of airframe and motor structures. The aspects of the "Machinability of materials for aeronautical application" in terms of cutting processes will be discussed. The aspects related to the optimization theory applied to the aerospace manufacturing will be presented. The study and the classification of light alloys for aeronautical application, as well as superframes for airframe and motor application, will be addressed. In particular, the main aspects related to the metallurgy and workability of Alluminum alloys and Nickel and Titanium superalloys will be studied taking into account the comparison with real applications. In the field of plastic deformation technologies, the basic principles of Super Plastic Forming and its applicability to the aeronautics industry will be illustrated. On some aspects discussed in the theory section, numerical examples will be carried out to familiarize with the physical quantities that characterize them and laboratory exercises will be focused on Finite Element simulation tools for the machining and forging processes. Moreover, the course aims to provide an overview of Additive Manufacturing processes, explain their underlying physical principles, discuss current research and an appreciation for why AM is so important to many branches of industry. In order to take maximum advantage from the capabilities of additive metal technology in the most economical way, will be studied how to design for this technology by following its principles. At the same time, the aspects relating to the design for additive metal manufacturing (DFAM) concept and, the act of integrating product design and additive manufacturing principles into one activity, will be illustrated. Laboratory exercises will be carried out by 3D printer with FFF (Fused Filament Fabrication) and Wax Jet Printing technology, in addition to laboratory exercises that will be focused on tools for the finite element simulation of additive processes.

REQUIREMENTS

You must have passed the Examination of Mechanical Technology. The contents of the Industrial Design Drawing and knowledge of Technical Industrial Design are also useful.

COURSE AIMS	During and a the end of the course, the student should be able to acquire: - An in-depth knowledge of materials for aeronautical application and processes for their transformation; - A basic knowledge of the Alluminum alloys, Nickel and Titanium superalloys characterization; - A basic knowledge of the Additive Manufacturing Technologies in terms of characterization and use; - A basic knowledge of approximantion and optimization with specific focus on the aerospace manufacturing; - A basic knowledge of the Finite Element manufacturing processes simulation with specific focus on machining and forging. - Knowledge for characterization and use of Additive Manufacturing technologies. - Basic knowledge of Design for Additive Manufacturing.
TEACHING METHODOLOGY	Attività frontale di 81 ore.
ASSESSMENT TYPE	Written, oral, written and/or oral. The exam consists of two consecutive parts: - A first written part (its duration is about 1 hour) in which the student have to solve a task related to the topics discussed in the course; the test aims to determine the student's ability to carry out calculations related to the physical quantities that characterize the processes discussed during the course; - The second oral part (which begins immediately after the written part) in which the student discusses both the written part and other contents of the course, in order to illustrate their understanding and knowledge level of the topics discussed and the ability to deliver it to perform relevant kinematic and dynamic analyzes.

FULL SYLLABUS	- Critical analysis of aeronautical materials/processes for comparison with the reference context. Tutorials on the discussed topics.(9 hours) - Machining of materials for aeronautical applications (9 hours). Exercises on the discussed topics (6 hours). - Design of Experiments, Approximation and Optimization (6 hours). - Further research on the metallurgy of light alloys, Nickel superalloys and Titanium alloys (9 hours). - Super Plastic Forming technology (3 hours). - Finite Elements simulation applied to the machining and forging (6 hours) and their application to some cases of study (6 hours). - Classification of additive manufacturing processes (3 hours). - Overview of existing manufacturers and their specific equipment (3 hours). - Additive manufacturing technologies for metallic materials: METAL POWDER, METAL WIRE, METAL SHEETS (3 hours). - Powder Fusion Mechanisms (solid-state sintering, chemically-induced binding, liquid-phase sintering, full melting) (3 hours). - AM technologies for plastic component production (powder, solid and liquid material) (3 hours). - Design for Additive Manufacturing, Additive Manufacturing Process Steps (3 hours). - Additive manufacturing technologies and applications in the aerospace industry (3 hours). - Finite element simulation techniques for additive manufacturing and its application to case studies (3 hours). Small time remodeling is possible between the subjects treated according to the course progress.
REFERENCE TEXT BOOKS	[1] F.C. Campbell, Manufacturing Technology for Aerospace Structural materials, First Edition, Elsevier, 2006 [2] M. Donachie, S. Donachie, SuperAlloys a Technical Guide, UniSalento, Second Edition, ASM International, 2002. [3] Additive Manufacturing - Innovations, Advances, and Applications, T.S. Srivatsan, T.S. Sudarshan. [4] Dispense del Corso.