

# MATERIALS ENGINEERING AND NANOTECHNOLOGY (LM76)

(Lecce - Università degli Studi)

## Teaching COMPOSITE AND NANOCOMPOSITE MATERIALS

GenCod A003713

Owner professor Antonio GRECO

**Teaching in italian** COMPOSITE AND NANOCOMPOSITE MATERIALS

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**SSD code** ING-IND/22

**Reference course** MATERIALS ENGINEERING AND

**Course type** Laurea Magistrale

**Credits** 6.0

**Teaching hours** Front activity hours: 54.0

**For enrolled in** 2022/2023

**Taught in** 2023/2024

**Course year** 2

**Language** ENGLISH

**Curriculum** PERCORSO COMUNE

**Location** Lecce

**Semester** First Semester

**Exam type** Oral

**Assessment** Final grade

### BRIEF COURSE DESCRIPTION

This course is aimed at providing the basics of composites and nanocomposites materials in view of their application in different engineering fields, using a strong interdisciplinary approach. Competences on polymer matrices and reinforcements, mechanics of anisotropic materials, fabrication technologies of thermoplastic and thermosetting matrix composites are provided.

### REQUIREMENTS

knowledge of solid mechanics and materials science and technology

### COURSE AIMS

#### **Knowledge and understanding:**

The course provides the basis of knowledge to understand and solve complex new problems in design and processing of composite materials accounting for anisotropy and reactive processing

#### **Applying knowledge and understanding**

The student will be able to apply the basic knowledge on mechanics of anisotropic materials to the design of simple structural elements. A multidisciplinary approach is presented accounting for chemical, materials and mechanical engineering aspects.

#### **Making judgements**

Simplification and synthesis of complex problems is presented in order to promote the judgement and evaluation capabilities of the students

#### **Communication**

The course promotes the development of the following skills of the student: ability to expose in precise and formal terms an abstract model of concrete problems, identifying the salient characteristics of them and discarding the inessential characteristics; ability to describe and analyze an efficient solution for the problem under consideration. A seminar on composite properties is assigned to students

#### **Learning skills**

Autonomous learning is promoted thanks to the use of: different books and slides, numerical methods, homework exercise to be solved in groups of two.

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TEACHING METHODOLOGY      The course is made up of frontal lessons for about 45 hours, and about 10 hours practice with a software implementing micro and macromechanics of composite materials. 10 more hours of laboratory are foreseen, in order to highlight the relevance of anisotropy in mechanical testing, and provide a practical demonstration of the main technologies for composite processing

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ASSESSMENT TYPE              Oral exam after a seminar on composite properties and a homework .

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FULL SYLLABUS

**Introduction:**  
matrix and reinforcements. Reinforcement materials: Physical, chemical, mechanical properties of carbon, glass, aramide, basalt, polymeric and natural fibers. Surface treatment of fibers for improved adhesion

**Sandwich structures:**  
Core materials: foams and honeycombs. Mechanical properties of sandwich structures.

**Micromechanics**  
Fiber-matrix interface. Characterization of fiber-matrix adhesion. Calculation of the elastic and ultimate properties of unidirectional laminae from the properties of matrix and fibers

**Macromechanics**  
Elastic properties of a lamina of arbitrary orientation. Failure criteria

**Macromechanical behavior of a laminate**  
Lamination theory. Special cases of laminate stiffness. Mechanical behaviour of anisotropic laminates (Helius Composite Design)

**Nanocomposites**  
Nanofillers, geometries and materials. Preparation of nanocomposites. Characterization of nanocomposites: improvement of properties and analytical prediction of properties.

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REFERENCE TEXT BOOKS

- P.K. Mallick, "**Fiber reinforced composites**", Marcel Dekker
- R.M. Jones, "**Mechanics of composite materials**", McGraw Hill
- Didactic aids (lecture slides) provided by the teacher