**MATERIALS ENGINEERING AND NANOTECHNOLOGY (LM56)**
(Lecce - Università degli Studi)

**Teaching NON-FERROUS METALLURGY**

GenCod A003984  
**Owner professor** PAOLA LEO

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<td><strong>SSD code</strong></td>
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<td><strong>Reference course</strong></td>
<td>MATERIALS ENGINEERING AND</td>
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<td><strong>Course type</strong></td>
<td>Laurea Magistrale</td>
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<td><strong>Credits</strong></td>
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<td><strong>Teaching hours</strong></td>
<td>Ore-Attivita-frontale: 54.0</td>
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<td><strong>For enrolled in</strong></td>
<td>2020/2021</td>
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<td>2021/2022</td>
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**Course year 2**  
**Curriculum** PERCORSO COMUNE  
**Location** Lecce  
**Semester** Primo-Semestre  
**Exam type** Orale  
**Assessment** Voto-Finale  
**Course timetable** https://easyroom.unisalento.it/Orario

**BRIEF COURSE DESCRIPTION**
The course clarifies the microstructure, mechanical properties, processing, physical metallurgy and engineering applications of non ferrous alloys. Particular attention is devoted to microstructure/property relationships and to the role of processing and heat treatments on the microstructure evolutions.

**REQUIREMENTS**
Metallurgy basics

**COURSE AIMS**
After the course the student should be able to:
1) Identify the microstructural features, properties and applications of the main non ferrous alloys;  
2) Recognize the main microstructural and mechanical features induced by casting, plastic deformation and joining methods;  
3) Identify the role of process parameters (welding, casting, plastic deformation) on microstrucural evolution and properties;  
4) Apply strengthening methods and heat treatments;  
5) Recognize the role of the processing thermal cycle on the microstructure evolution.

The development of individual projects helps each student to pursue the goals.

**TEACHING METHODOLOGY**
Lectures, laboratory practice, individual project

**ASSESSMENT TYPE**
The exam consists of two parts:
1. first written part: the student is asked to illustrate theoretical topics  
2. second part: the student is asked to discuss the laboratory topics and individual project with the lecturer.
Lectures:
1) A general introduction on the main alloys in terms of the main microstructural features, properties, applications, processing (1h)
2) Crystallography, defects, strengthening mechanism (3 hours)
3) Metallography and experimental techniques (3 hours):
   a) Specimen Preparation for Light Microscopy
   b) Optical microscope
   c) Hardness test
   d) EDS
4) Physical metallurgy of light alloys:
   a) Solidification principles: microstructure, heat treatments, defects (8 hours).
   b) Plastic deformation and solid-solid phase transformation induced by plastic deformation and heat treatments. Recovery and Recrystallization (3 hours).
   c) Principles of age hardening (6 hours).
   d) Microstructure and mechanical evolution by processing thermal cycle (3 hours)
Case studies on above topics.
5) Aluminum alloys (4 hours)
Wrought aluminum alloy: microstructures and heat treatments, designation of alloys and temper, work hardening, non heat treatable alloys, heat treatable alloys, joining, applications.
Case studies on above topics
Case studies on above topics.
6) Magnesium alloys (2 hours)
Microstructures and heat treatments, designation of alloys and temper, Zirconium free casting alloys, Zirconium containing casting alloys. Applications.
Case studies on above topics.
7) Titanium alloys (4 hours)
Alpha alloys: microstructure and properties
Alpha/Beta alloys: microstructure and properties
Heat treatments
Joining Applications.
Case studies on above topics.
8) Nickel alloys, shape memory and superplasticity
8) New processing for non ferrous alloys: microstructure evolution and properties (9 hours):
New joining techniques: microstructures and properties
New coatings techniques: microstructures and properties
Three dimensional (3D) building process: microstructures and properties
Case studies on above topics.

Laboratory (16h):
1) Grinding, polishing, chemical etching, electrolytic etching, optical microscopy analysis, hardness test and tensile test of light alloys: applied to microstructural and mechanical characterization
2) As cast and as welded microstructure characterization
4) Deformed microstructure and Recovery and Recrystallization
5) Ti-6Al-4V heat treatment (2 hours)
Microstructure evolution and hardness of Ti-6Al-4V due to annealing from Beta phase field.
Microstructure evolution and hardness of Ti-6Al-4V due to annealing from Alpha+Beta phase field.
Microstructure evolution and hardness of Ti-6Al-V due to air cooling from Beta phase field.
Microstructure evolution and hardness of Ti-6Al-V due to air cooling from Alpha+Beta phase field.
Microstructure evolution and hardness of Ti-6Al-V due to quenching from Beta phase field.

6) Microstructural and Mechanical Characterization of samples for the projects development.

**Individual project**
New joining/ coating/ 3D buildings techniques applied to non ferrous alloys: microstructural and mechanical characterization of samples (6-8 hours).

**REFERENCE TEXT BOOKS**