

FACULTY OF **ENGINEERING**

DEGREE COURSE: **INDUSTRIAL ENGINEERING**

MASTER DEGREE: **INDUSTRIAL ENGINEERING / DESIGN**

**SUBJECT:** METALLIC MATERIALS

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### **OBJECTIVES**

The student will improve his knowledge about the properties, heat treatments and applications of the most important classes of ferrous and non-ferrous materials used in mechanics and design.

### **CONTENTS**

Principles of physical metallurgy. Deformation of metals and strengthening methods in metals. Phase diagrams. Steels: primary steel production (blast furnace, converter), scrap and recycling (electrical furnaces). Heat treatments of steels. Designation and properties. Steels for general use, alloy steels, tool steels, stainless steels. Cast Irons. Production of the Aluminum alloys: Bayer and Hall-Heroult. Classification of the aluminum alloys. Extrusion, forging, drawing, casting of the alloys. Powder metallurgy. Thermal treatments. Major field of use. Recycling processes. Magnesium alloys: production and classification. Mechanical and metallurgical properties of the Magnesium alloys. Industry and application field of the Magnesium alloys. Production of Titanium alloys. Classification of the Titanium alloys. Major application fields of the Titanium alloys. Production of Copper alloys. European norms for the Copper alloys. Technological processes for the production of the copper alloys. Copper alloys: brass, bronzes, cupraluminum, cupronickel. Major applications of the copper alloys. Production of the nickel-based, cobalt-based

and ODS superalloys. Creep of metallic materials. High temperature properties of the superalloys and comparison to the other metallic materials. Heat treatments of the superalloys. Production of Uranium and its alloys. Physical and Mechanical properties. Main application fields. Hints on nuclear radiation processes. Precious metals (silver, gold, platinum, Rhodium and palladium).

## **LEARNING OUTCOMES**

At the end of the course the student will be able to understand the mechanical and metallurgical properties of the following materials and alloys: ferrous alloys (steel, stainless steel and iron), copper, aluminum, magnesium, titanium, nickel-based superalloys, cobalt, ODS, cobalt alloys, nickel, uranium, alloys of precious metals (Ag, Au, Pt, Rh, Pd).

## **ASSESSMENT**

Written exam: multiple choice and open questions

## **RECOMMENDED TEXTBOOKS**

The student should know some fundamentals of Chemistry (atomic bonds) and the nature of mechanical properties.

Metallic Materials: Physical, Mechanical, and Corrosion Properties  
Philip A. Schweitzer, P.E.