



# Course guide

## 240151 - 240151 - Technology and Selection of Materials

Last modified: 16/05/2023

**Unit in charge:** Barcelona School of Industrial Engineering  
**Teaching unit:** 702 - CEM - Department of Materials Science and Engineering.

**Degree:** BACHELOR'S DEGREE IN INDUSTRIAL TECHNOLOGY ENGINEERING (Syllabus 2010). (Compulsory subject).

**Academic year:** 2023    **ECTS Credits:** 4.5    **Languages:** Catalan, Spanish

### LECTURER

**Coordinating lecturer:** ANTONIO MANUEL MATEO GARCIA (Q1)  
ELISA RUPÉREZ (Q2)

**Others:**

### DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

#### Specific:

1. Knowledge of science, technology and materials' chemistry fundamentals. Understanding the relation between microstructure, synthesis or processing and materials' properties.

### TEACHING METHODOLOGY

During the course there are classroom and laboratory practices, together with independent learning, relating the theoretical and practical knowledges.

There are two exams

Hours:

Theory: 45 h (3h/week = 2 sessions of 1.5 hour)

Laboratories: 8 h (4 sessions of 2 hours, 1 session per week. Groups of up to 15 students)

### LEARNING OBJECTIVES OF THE SUBJECT

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

- Implement methodologies to select materials and forming processes for industrial applications.
- Knowing the basics of the most common processing techniques (forming, heat treatment and welding) for the different families of materials and assess their suitability depending on application.
- Knowing how processing affects the structure and properties of materials.

### STUDY LOAD

Type	Hours	Percentage
Hours large group	39,2	34.81
Hours small group	5,9	5.24
Self study	67,5	59.95

**Total learning time:** 112.6 h

## CONTENTS

### 1. MATERIALS SELECTION

#### Description:

- Presentation of the topic, evaluation information and schedule.
- Design process
- Design methods
- Design tools
- Interactions between function, material, shape and process
- Materials properties plots
- Materials properties
- Representation of materials in Ashby plots
- Materials selection
- Strategies for selection
- Performances index
- Influence of shape on the selection

**Full-or-part-time:** 23h

Theory classes: 5h

Laboratory classes: 6h

Self study : 12h

### 2. RAW MATERIALS

#### Description:

- Steel processing:
  - Blast furnace
  - Oxygen steelmaking
  - Electric arc furnace
  - Secondary steelmaking
  - Continuous casting
  - Cupola
- Aluminium production:
  - Bayer process
  - Electrolysis
- Metallic powder production
  - Powder characteristics
  - Atomization
- Ceramic raw materials
- Polymer raw materials
  - Synthesis of polymers: polymerization
- Additives

**Full-or-part-time:** 7h

Theory classes: 2h

Self study : 5h

### 3. METAL CASTING

**Description:**

- Solidification
- Defects
- Moulding technology
- Types of moulds
- Filling systems and risers
- Other technologies
- Shell moulding
- Lost-wax casting
- Injection moulding
- Advantages and limitations of metal casting

**Full-or-part-time:** 6h

Theory classes: 2h

Self study : 4h

### 4. PLASTIC FORMING OF METALS

**Description:**

- Softening mechanisms
- Static recovery and recrystallization
- Dynamic recovery and recrystallization
- Cold working versus hot working
- General classification of plastic forming processes
- Rolling
- Mills
- Problems and defects
- Forging
- Open-die versus closed-die
- Defects
- Extrusion
- Drawing
- Sheet forming
- Shearing
- Bending
- Deep drawing

**Full-or-part-time:** 25h 30m

Theory classes: 7h 30m

Laboratory classes: 1h 30m

Self study : 16h 30m

### 5. POWDER METALLURGY

**Description:**

- Pressing
- Sintering
- Advantages and limitations of powder metallurgy

**Full-or-part-time:** 1h 30m

Theory classes: 0h 30m

Self study : 1h

## 6. POLYMER FORMING

### Description:

Rheology

- Injection
- Injection machine, process variables, molds
- Defects in molded parts
- Morphologies induced by processing
- Advanced processing based on injection
- Extrusion
- Extruder, process parameters, nozzles
- Defects in extruded parts and morphology induced by processing
- Processing techniques based on extrusion
- Other processing techniques
- Thermoforming
- Rotational Molding
- Processes for cellular plastics (foam)
- Processing of thermosets and composites

**Full-or-part-time:** 16h 30m

Theory classes: 5h

Laboratory classes: 1h 30m

Self study : 10h

## 7. CERAMIC FORMING

### Description:

- Glass forming
- Viscosity  $\eta$  temperature curve
- Pressing
- Blowing
- Drawing
- Glass-ceramics
- Forming of clay products
- Pressing
- Hydroplastic forming
- Barbotine casting
- Firing
- Cement
- Tape casting

**Full-or-part-time:** 6h

Theory classes: 2h

Self study : 4h



## 8. HEAT TREATMENTS

### Description:

- Metallurgical theory for heat treatments of steels
- General classification of heat treatments
- Isothermal transformations: TTT diagrams
- Continuous cooling transformations: CCT diagrams
- Bulk heat treatments
- Annealings: normalized, total and isothermal
- Sub-critical treatments: spheroidizing, recrystallization and stress relieve
- Austempering and martempering
- Quench and temper: quenchability concept and cooling media
- Surface heat treatments
- Induction
- Flame
- Cementation
- Carbonitriding
- Nitriding
- Heat treatments of cast irons: austempering
- Heat treatments of non iron-based alloys: aging

**Full-or-part-time:** 20h

Theory classes: 4h

Laboratory classes: 6h

Self study : 10h

## ACTIVITIES

### (ENG) LABORATORI DE SELECCIÓ DE MATERIALS

**Full-or-part-time:** 14h

Laboratory classes: 6h

Self study: 8h

### (ENG) PRÁCTICAS DE LABORATORIO DE TECNOLOGÍA DE MATERIALES

**Full-or-part-time:** 12h

Laboratory classes: 9h

Self study: 3h

### (ENG) CUESTIONARIOS

**Full-or-part-time:** 3h

Self study: 3h

## GRADING SYSTEM



## BIBLIOGRAPHY

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### Basic:

- Groover, Mikell P. Fundamentos de manufactura moderna : materiales, procesos y sistemas [on line]. 3a ed. México: Prentice-Hall Hispanoamericana, 2007 [Consultation: 22/04/2020]. Available on: <https://ebookcentral.proquest.com/lib/upcatalunya-ebooks/detail.action?docID=4585363>. ISBN 9789701062401.
- Ashby, MF ; D.R.H. Jones. Engineering materials.Vol. 1 : An introduction to their properties and applications. 3rd ed. Oxford: Elsevier Butterworth-Heinemann, 2005-2006. ISBN 9780750663809.

### Complementary:

- Dieter, George Ellwood. Mechanical Metallurgy. London: McGraw-Hill, 1988. ISBN 007084187X.
- Osswald, Tim A. Procesado de polímeros: Fundamentos. Cúcuta, Colombia: Guaduales, 2008. ISBN 9789584432025.

## RESOURCES

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### Audiovisual material:

- Apuntes en PDF en Atenea elaborados por los profesores

### Hyperlink:

- <http://science.discovery.com/tv/how-its-made/>- <http://www.steeluniversity.org/>