Course guide
240151 - 240151 - Technology and Selection of Materials

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

<table>
<thead>
<tr>
<th>Type</th>
<th>Hours</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hours large group</td>
<td>40,5</td>
<td>36.00</td>
</tr>
<tr>
<td>Hours small group</td>
<td>4,5</td>
<td>4.00</td>
</tr>
<tr>
<td>Self study</td>
<td>67,5</td>
<td>60.00</td>
</tr>
</tbody>
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Total learning time: 112.5 h
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:
Reology
- 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 & 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**

**Basic:**

**Complementary:**

**RESOURCES**

**Audiovisual material:**
- Apuntes en PDF en Atenea elaborados por los profesores

**Hyperlink:**
- [http://www.steeluniversity.org/](http://www.steeluniversity.org/)