Last update: 03-07-2019

330511 - MATER - Materials

Coordinating unit: 330 - EPSEM - Manresa School of Engineering
Teaching unit: 750 - EMIT - Department of Mining, Industrial and ICT Engineering
Academic year: 2019
Degree: BACHELOR'S DEGREE IN AUTOMOTIVE ENGINEERING (Syllabus 2017). (Teaching unit Compulsory)
ECTS credits: 6 Teaching languages: English

Teaching staff

Coordinator: Casellas Padro, Daniel

Others: Soler Conde, Marc Antoni

Degree competences to which the subject contributes

Basic:

CB3. That students have the ability to gather and interpret relevant data (usually within their area of study) to make judgments that include a reflection on relevant social, scientific or ethical issues.

Specific:

CE8. Knowledge of the fundamentals of science, technology and materials chemistry. Understand the relationship between microstructure, synthesis or processing and properties of materials.
CE13. Knowledge and application of production and manufacturing systems.

Generical:

CG3. Knowledge in basic and technological subjects that will enable them to learn new methods and theories and give them the versatility to adapt to new situations.
CG4. Ability to solve problems with initiative, decision-making, creativity, critical reasoning and to communicate and transmit knowledge, skills and skills in the field of automotive engineering.
CG7. Ability to analyze and assess the social and environmental impact of technical solutions.

Transversal:

1. EFFICIENT ORAL AND WRITTEN COMMUNICATION - Level 1. Planning oral communication, answering questions properly and writing straightforward texts that are spelt correctly and are grammatically coherent.
2. SELF-DIRECTED LEARNING - Level 1. Completing set tasks within established deadlines. Working with recommended information sources according to the guidelines set by lecturers.

Teaching methodology

MD1 Master class or lecture (EXP)
MD2 Problem solving and case study (RP)
MD3 Practical work in laboratory or workshop (TP)
MD5 Small-scale project, activity or assignment (PR)
MD7 Assessment activities (EV)

Learning objectives of the subject

On completing the subject, students will have knowledge and understanding of the following:
-Materials classification and behaviour.
-Influence factors on materials.
-Selection criteria.

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Study load

Total learning time: 150h	Hours large group:	45h	30.00%
	Hours medium group:	0h	0.00%
	Hours small group:	15h	10.00%
	Guided activities:	0h	0.00%
	Self study:	90h	60.00%

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Content

Topic 1: Structure of materials

Learning time: 10h

Theory classes: 3h
Laboratory classes: 1h
Self study : 6h

Description:
Atoms, bonds and materials.
Structure of materials.

Related activities:
Activity 3

Specific objectives:
On completing the subject, students will have knowledge and understanding of the following:

Crystalline and amorphous materials.
Polymorphism and isomorphism.
Crystalline defects.
Grain index and size.
The relationship between crystalline defects and properties.
The relationship between crystalline defects and alloys.

Topic 2: Heat treatments

Learning time: 18h

Theory classes: 6h
Laboratory classes: 2h
Self study : 10h

Description:
Diffusion.
Phase diagrams.
Heat treatments.

Related activities:
Activities 3 and 5.

Specific objectives:
On completing the subject, students will have knowledge and understanding of the following:

Diffusion mechanisms.
Flick diffusion laws.
Applied diffusion processes.
Phase diagrams.
Annealing, quenching, tempering and precipitation hardening treatments.
CCT and TTT diagrams.

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Topic 3: Mechanical properties	Learning time: 23h Theory classes: 6h Laboratory classes: 3h Self study : 14h

Description:
Properties obtained from the following:

Tensile tests.
Fatigue tests.
Hardness tests.
Creep and relaxation tests.
Wear tests.

Related activities:
Activity 4

Specific objectives:
On completing the subject, students will have knowledge and understanding of the following:

Tensile tests: stress-strain curves, elastic modulus, yield strength, Poisson ratio, elongation, area reduction, Hollomon model of strain-hardening, anisotropy coefficient.
Hardness: Brinell, Vickers and Rockwell scales.
Fracture toughness, critical stress, and critical cracking.
Fatigue: stress amplitude, mean stress, endurance limit.
Creep, evolution of curves.

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Topic 4: Electrical and chemical properties of materials

Learning time: 17h

Theory classes: 5h
Laboratory classes: 2h
Self study : 10h

Description:
Dielectric, semiconductor and conductor materials.
Other electrical properties: piezoelectricity, thermocouples, etc.
Corrosion and corrosion protection.

Related activities:
Activity 6.

Specific objectives:
On completing the subject, students will have knowledge and understanding of the following:

Electrical conductivity, electrical behaviour of materials.
Electrochemical corrosion cells.
Cathode and anode corrosion reactions.
Corrosion protection strategies.

Topic 5: Metals

Learning time: 13h

Theory classes: 4h
Laboratory classes: 1h
Self study : 8h

Description:
Ferrous metals: steels and cast iron.
Non-ferrous metals: aluminium, copper, titanium and alloys.

Related activities:
Activity 4.
Activity 3.

Specific objectives:
On completing the subject, students will have knowledge and understanding of the following:

Metal classification by microstructure, composition and behaviour.
Relationship between properties, structure and treatments of alloys.

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Topic 6: Non-metallic materials

Learning time: 14h

Theory classes: 6h
Laboratory classes: 2h
Self study : 6h

Description:
Polymers: thermoplastics, thermosets and elastomers.
Ceramic materials.
Particles, fibre and ?sandwich? composites.

Related activities:
Activity 4.

Specific objectives:
On completing the subject, students will have knowledge and understanding of the following:

Applications, advantages and disadvantages of polymeric, ceramic and composite materials.
Amorphous and crystalline structure of ceramic and polymeric materials
Design of simple fibre-reinforced composites.

Topic 7: Selection of materials

Learning time: 10h

Laboratory classes: 4h
Self study : 6h

Description:
Selection of materials.

Related activities:
Activity 2.

Specific objectives:
On completing the subject, students will have knowledge and understanding of the following:

Resolution of simple material selection problems using property maps.

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Planning of activities

Activity 1: Finite element simulation

Hours: 7h
Laboratory classes: 2h
Self study: 5h

Description:
Lab

Descriptions of the assignments due and their relation to the assessment:
Report.

Specific objectives:
On completing the activity students will have knowledge and understanding of the following:

-Use finite elements software.
-Results interpretation of F.E.M. software.

Activity 2: Metallography

Hours: 8h
Laboratory classes: 2h
Self study: 6h

Description:
Lab

Descriptions of the assignments due and their relation to the assessment:
Report.

Specific objectives:
On completing the activity students will have knowledge and understanding of the following:

-Use the metallograpic microscope.
-Microstructures identification.
-Grain size determination.

Activity 3: Mechanical tests

Hours: 8h
Laboratory classes: 2h
Self study: 6h

Description:
Lab

Descriptions of the assignments due and their relation to the assessment:
Report.

Specific objectives:
On completing the activity students will have knowledge and understanding of the following:

- Tensile test results determination.
- Hardness test.
- Impact test.

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Activity 4: Heat treatments	Hours: 8h Laboratory classes: 2h Self study: 6h

Description:
Lab

Descriptions of the assignments due and their relation to the assessment:
Report.

Specific objectives:
On completing the activity students will have knowledge and understanding of the following:

- Sample preparation for microstructural study.
- Heat treatment process.
- Microstructure and properties obtained from a heat treatment.

Activity 5: Corrosion	Hours: 5h Laboratory classes: 2h Self study: 3h

Description:
Lab

Descriptions of the assignments due and their relation to the assessment:
Report.

Specific objectives:
On completing the activity students will have knowledge and understanding of the following:
- Galvanic series determination.
- Electrolytic coating elaboration and performance calculation.
- Cathodic protections systems.

Activity 6: Materials selection tecniques	Hours: 5h Laboratory classes: 2h Self study: 3h

Description:
Lab

Descriptions of the assignments due and their relation to the assessment:
Report.

Specific objectives:
On completing the activity students will have knowledge and understanding of the following:

- Materials selection tecniques

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Qualification system

Exams 80%
Activities 20%

Regulations for carrying out activities

The activities are individual except those that are clearly specified as a group activity.
All reports must be delivered in the ISO 9000 format.
All reports must be original, and external information must be correctly cited.

Bibliography

Basic:

Callister, William D.; Rethwisch, David G. Ciencia e ingeniería de los materiales. 2ª ed. Barcelona: Reverté, 2016. ISBN 9788429172515.

Complementary:

Askeland, Donald R. Ciencia e ingeniería de los materiales. México: International Thomson Editores, 2001. ISBN 8497320166.

Smith, William F.; Hashemi, Javad. Fundamentos de la ciencia e ingeniería de materiales. 5ª ed. México: McGraw-Hill, 2014. ISBN 9786071511522.

Shackelford, James F. Introducción a la ciencia de materiales para ingenieros. 7ª ed. Madrid: Pearson Educación, 2010. ISBN 9788483226599.

Others resources: