Universitat de Lleida

DEGREE CURRICULUM

MATERIALS 2

Coordination: CASTRO CHICOT, JOSE RAMON

Academic year 2017-18

Subject's general information

Subject name	MATERIALS 2
Code	101412
Semester	1st Q(SEMESTER) CONTINUED EVALUATION
Typology	

Degree	Course	Typology	Modality
Bachelor's Degree in Architectural Technology	2	COMPULSORY	Attendance-based
Bachelor's Degree in Building Engineering	2	COMPULSORY	Attendance-based

ECTS credits	9
Groups	1GG
Theoretical credits	6.75
Practical credits	2.25
Coordination	CASTRO CHICOT, JOSE RAMON
Department	ENGINYERIA AGROFORESTAL
Teaching load distribution between lectures and independent student work	90 class hours and 135 hours of autonomous work
Important information on data processing	Consult this link for more information.
Language	Catalan

Teaching staff	E-mail addresses	Credits taught by teacher	Office and hour of attention
CASTRO CHICOT, JOSE RAMON	jrcastro@eagrof.udl.cat	5,5	Thursday from 12-13 hours. Office 1.09. CREA Building
GASIA GABERNET, JOSE	jgasia@eagrof.udl.cat	3,5	To be specified by email. Office 1.11. Associate Teachers, 1st floor. CREA Building.

Subject's extra information

Subject is developed in the 1st semester of the 2nd year of teaching. It belongs to the module "Specific training", specifically in the field "Techniques and technologies of building".

It is compulsory class attendance and organized visits. The organized visits to production plants or industrial, are part of the syllabus.

Learning objectives

- To introduce the student in the main composite materials that characterize the current building.
- To provide a detailed view of the transformation processes that take place in the industry to convert a material into a component with specific characteristics.
- To establish the basis that relate the properties of building materials and building systems in order to realize the building with technical criteria.
- Visiting companies from building materials to know first hand the manufacturing processes.
- Perform laboratory practice to evaluate the mechanical behavior of building materials.

Competences

University of Lleida strategic competences

- **UdL3** Mastering ICT's.

Cross-disciplinary competences

- **EPS2**. Capacity to gather and interpret relevant data, within the area of study, to judge and think about relevant subjects of social, scientific and ethical nature.
- **EPS7**. Capacity to work in situations with a lack of information and/or under pressure.
- **EPS8**. Capacity of planning and organizing the personal work.
- **EPS13**. Capacity to consider the socioeconomic context as well as the sustainability criteria in engineering solutions.

Degree-specific competences

- **GEE12**. Manufactured or traditional constructive systems and materials knowledge, its varieties and physics and mechanical characteristics that define them.
- **GEE13**. Capacity to adapt the materials of construction to the typology and use of buildings; manage the reception and the quality control of the materials, its use in the building works, the execution control of the units of work and the performance of tests and final proofs.
- **GEE14**. Knowledge of the historical evolution of the techniques and constructive elements and the structural systems that have given origin to the stylistic forms.

- **GEE15**. Aptitude to identify the elements and constructive systems, define their function and compatibility, and his use in the building process. Pose and solve constructive details.
- **GEE16**. Knowledge of the specific control procedures for the building works.
- **GEE17**. Capacity to give advice on the causes and evidences of the building injuries, to be able to offer solutions to avoid or amend their pathologies, and analyse the life cycle of the elements and constructive systems.
- **GEE18**. Aptitude to take part in the rehabilitation, restoration and conservation of the built heritage.
- **GEE19**. Capacity to develop maintenance plans and handbooks and manage its implementation in the building.
- **GEE20**. Knowledge of the environmental impact evaluation for building and demolition process, of sustainability in buildings, and of the procedures and techniques to determine the energy efficiency in buildings.

Subject contents

The course Materials II consists of five areas:

· **BLOCK I: CONCRETE**

1.-CONCRETE

- 1.1.-Historical. Definition
- 1.2.-Components of concrete
- 1.3.-Bàsics concepts
- 1.4.-Classification

2.-PROPERTIES OF FRESH CONCRETE. TESTS

- 2.1.-States of concrete
- 2.2.-Requirements of fresh concrete
- 2.3.-Physical properties
- 2.4.-Rheological properties
- 2.5.-UNE. Fresh concrete tests.

3.-PROPERTIES OF HARDENED CONCRETE. TESTS

- 3.1.-Phisycal properties
- 3.2.-Durability of concrete: mechanical actions, physical actions, chemical actions and biological actions.
- 3.3.-Mechanical properties
- 3.4.-Rheological properties
- 3.5.-UNE. Hardened concrete. Tests.

4.-GRANULOMETRY OF AGGREGATES

- 4.1.-General concepts
- 4.2.-Series of sieves
- 4.3.-Graphical representation of granulometry analysis
- 4.4.-Fineness modulus, grading module. Minimum and maximum size. Particle size fraction.
- 4.5.-Curves theoretical: Fuller parabola and Bolomey parabola
- 4.6.-Type granulometries: continuous and discontinuous.
- 4.7.-Filler size in the concrete.
- 4.8.-Composition of aggregates.

5.-PROPORTIONING OF CONCRETE. PRINCIPLES AND METHODS

- 5.1.-The dosification in the concrete

5.2.-Characteristic resistance

5.3.-Consistency of concrete

5.4.-Maximum size of aggregate

5.5.-Proportions Water / cement

5.6.-Characteristics of components

5.7.-Conditions of durability

5.8.-Dosage concrete weight

5.9.-Dosage concrete volume

5.10.-Methods dosage: method Fuller, method Bolomey, method Carlos de la Peña and ACI method

6.-FABRICATION, TRANSPORT AND PUTTING IN WORK

6.1.-Manufacture of concrete

6.2.-Transport concrete

6.3-Dumping and compaction

6.4.-Compaction methods

6.5.-Precautions in vibrated

6.6.-Type vibrators: needles and vibrating tables

6.7.-Concreting in cold weather

6.8.-Concreting in hot weather

6.9.-Cured concrete

7.-QUALITY CONTROL OF CONCRETE

7.1.-Production control

7.2.-Reception control

7.3.-Consistency control

7.4.-Previous tests

7.5.-Tests control

7.6.-Statistical control

7.7.-Decisions derived from control

8.-SPECIAL CONCRETE

8.1.-High-strength concrete. Components and dosage

8.2.-Concrete autocompactan. Composition. Classification. Tests.Condicions general of execution.

8.3.-Recycled aggregate concrete. Precautions in the use of recycled aggregates.Granulometry control.Chemical control. Durability control.

8.4.-Lightweight aggregate concrete. Docility. Durability. Execution.

8.5.-Concrete fibers. Fiber type steel, polymer and inorganic. Characterization of concrete with fibers. Dosage.

8.6.-Shotconcrete. Components.

8.7.-Stamped concrete. Materials. Moulds. Resin finish. Putting in work.

· **BLOCK II: METAL MATERIALS**

1.-EXTRACTION PROCESS AND TREATMENTS

2.-METALS. GENERALITIES

2.1.-Unions atoms. Covalent bond. Ionic bond. Metallic bond. Van der Waals forces.

2.2.-Crystalline solids. Networks of crystalline metallic materials.

3.-METAL ALLOYS

3.1.-Solidification of metals and alloys. Curves solidification. Speed solidification.

3.2.-Size of grain.

3.3.-Phase diagrams or balance.

4.-PHASE DIAGRAMS: IRON - CARBON (STEEL)

4.1.-Heat treatment of steel: annealed, normalized, tempering, annealing

4.2.-Carbon steels and alloy steels. Iron foundries.

4.3.-Methods of forming metallic materials. Merger and molding processes, forming, rolling, forging, extrusion, drawing, bending.

5.-WELDING ALLOYS. WELDING TECHNIQUES

6.-STEEL CONSTRUCTION. PRODUCTS FINISHED. PRODUCTS PROCESSED.

6.1.-Processed products. Passive reinforcement. Active reinforcement. Rolled steel.

6.2.-Passive reinforcement. Corrugated bars. Welded.

6.3.-Active reinforcement. Steels alleged. Wires. Chord. Bars.

6.4.-Diagrams stress - deformation reinforcement passive and active.

6.5.-Corrosion of steel reinforcement in concrete.

7.-NON-FERROUS METALS. ALUMINUM. COPPER. LEAD. ZINC

7.1.-Aluminum. Aluminium alloys. Heat treatment of aluminum.

7.2.-Copper, lead, zinc. Architectural applications.

7.3.-Corrosion.Corrosion gases. Electrochemical corrosion.

7.4.-Protection. Methods change process: Structural design and cathodic protection. Protection through non-metallic coatings. Metallic coatings.

· **BLOCK III: POLYMERS**

1.-POLYMERS

1.1.-Components of plastics. Thermoplastic polymers. Thermostable polymers

1.2.-Additives. Reinforcements. Charges

2.-PROPERTIES

2.1.-Physical properties. Optical properties. Mechanical properties. Chemical properties. Behavior against fire.

3.-MANUFACTURING PROCESSES

3.1.-Machining processes: extrusion and injection

4.-APPLICATIONS IN THE CONSTRUCTION ARCHITECTURAL

4.1.-Polyvinyl chloride -PVC

4.2.-Polyethylene -PE

4.3.-Polypropylene -PP

4.4.-Polystyrene -PS

4.5.-Polyurethane -PU

· **BLOCK IV: PREFABRICATED**

1. MATERIALS OF CEMENT.

2. PREFABRICATED LARGE AND SMALL.

3. PREFABRICATED STRUCTURAL FOR CONSTRUCTION AND CIVIL WORKS

BLOCK V: CERAMIC

1. TERRA COTTA CERAMIC MATERIALS: HOLLOW BRICKS, PERFORATED BRICKS, TILES

2. POTTERY AND MORTAR TO SET THE FACTORY WORK.

3. CERAMICS "FINE": TILES, FACADES, FLOORS

Methodology

- **Master class**. Explanations and Power Point presentations, made in the classroom.
- **Visits to companies** manufacturing construction materials sector. The tours are guided by company staff explaining to students the different processes by which they pass materials into a finished and ready to work suministarse product.
- **Team work**. Made a visit to the factory, students have to make an exercice in groups of 2 or 3 people.
- **Laboratory practice**. Students do laboratory practices in groups of 2 or 3 people.

Development plan

Week	Methodology	Temary	Teaching hours	Hours of personal work
1	Master class	**Block 1. Concrete** Properties of fresh concrete	6	9
2	Master class	Aggregates. Granulometric curves Aggregates and concrete dosing.	4 2	9
3	Laboratory practice Master class	Practice 1.Concrete I. Preparation of concrete, seat cone Abrams and manufacture of test specimens. The dosage concrete. Fuller method, Bolomey, Carlos de la Peña, ACI ...	4 2	9
4	Master class	Manufacturing and transportation of concrete. Puting, compaction and curing of concrete. Special concretes: self-compacting, recycled, printed. Concrete reinforced with steel fibers.	6	9
5	Visit production plant Master class	Visit Prefabricados Pujol. Miralcamp. Production of concrete, scrap metal processing assembly, prestressed concrete, terrazzo floor. Reinforced concrete: stony material (compression) + ductile material (traction)	4 2	9

6	Master class	**Block 2. Metallic materials** Extraction processes. Crystallographic networks metals. Metal alloys Fe-C. The characteristics of the steel through the phase change diagrams.	6	10
7	Laboratory practice Master class	Practice 2. Concrete II. Density of hardened concrete, broken specimens: compressive strength, indirect tensile strength and flexural strength. Steels in the building. Steel arm. Prestressing steels.	4 2	10
8	Master class	Non-ferrous metals. Aluminum, copper, lead and zinc. Protection of metals. Galvanization.	2 4	10
9	PA1. Written exam			
10	Laboratory practice Master class	Visual identification of the corrugated steel, measurement of geometric characteristics, tensile strength. **Block 3. Polymeric materials** Nature of the polymeric materials. Carbon chemistry. The physics of polymers. Polymers in construction. Thermoplastic and thermostable polymers.	2 4	10
11	Master class	**Block 4. Prefabricated materials** Materials of cement. Precast concrete small and large format. Prefabricated structural: construction and civil engineering.	6	10
12	Visit production plant Master class	Visit precast small format. **Block 5. Ceramic** Terra cotta ceramic materials: facing, perforated bricks, hollow bricks... tiles	4 2	10

13	Laboratory practice:Morter and ceramic Visit production plant	Granulometry of sand, mortar strength flexural and compressive, identification bricks ceramic, compressive strength of bricks. Visit Ceràmica La Coma-Balaguer. Production of Termoarcilla, hollow and perforated bricks.	2 4	10
14	Master class Practice. Team work.	"Fine" ceramics, tiles, floors, facades. Inventory of building materials of a building.	4 2	10
15	Master class	Bituminous materials, adhesives, insulation and paints	6	10

Evaluation

Evaluation activities	%	Dates
PA 1. Written exam.	40	Week 9
PA 2. Written exam.	35	Weeks 16 or 17
Laboratory and visits to production and industrial centers	25	Along the course
Recovery exam.	75	Week 19

Exams:

- The subject is passed from 5.
- Two tests (PA1 and PA2) are scheduled in weeks 9 and 16/17. The test PA1 has a weight of 40% and PA2 has a test weight of 35% over the final mark.
- Tests (PA1 i PA2) with a mark lower than 3 are not considered in the calculation of the final mark (test with mark equal to 3 is considered).
- Following the guidelines of the Academic Framework of Degrees in EPS, a recovery examn will take place in the week 19. It will be possible to recover / improve one test (PA1 and PA2) or the complete subject. The recovery will be done through a written exam. The mark of the recorvery exam should be equal or greater than 3 in order to be considered in the final mark.

Laboratory and visits to production and industrial centers?

- Five laboratory practices as well as three visits to production and industrial centers will be carried out during the course. Each of these activities will imply the delivery of the reports. The mark corresponding to lab and visits represent the 25% of the final mark.
- Attendance to the laboratory and visits as well as delivery of reports is mandatory.
- Laboratory and visits cannot be recoverd by performing any other activity.

- Not presenting an exercise or later delivery behaves mark 0 in the corresponding exercise.

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Block II: Metal materials

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Block III: Polymers

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