Universitat de Lleida

DEGREE CURRICULUM

MATERIALS 2

Coordination: Jose Ramon Castro Chicot

Academic year 2014-15

Subject's general information

Subject name	MATERIALS 2
Code	101412
Semester	1r Q Continuous evaluation
Typology	Obligatory
ECTS credits	9
Theoretical credits	0
Practical credits	0
Coordination	Jose Ramon Castro Chicot
Department	Enginyeria Agroforestal
Modality	Presencial
Important information on data processing	Consult this link for more information.
Language	Catalan
Degree	Degree in Architectural Technology
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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 propierties of building materials and building systems in order to realize the building with technical criteria.

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: CERAMICS**

1.-CERAMIC MATERIALS. HISTORICAL NOTES

2.-RAW MATERIALS

3.-CERAMIC FABRICATION PRODUCTS

4.-CLASSIFICATION AND TYPES OF CERAMIC PRODUCTS

5.-PHYSICAL PROPERTIES OF CERAMIC PRODUCTS

BLOCK V: GLASS

1.-GLASS: GENERALITIES AND HISTORICAL NOTES

2.-COMPOSITION OF GLASS

3.- FABRICATION OF GLASS

4.- CLASSIFICATION OF GLASS

5.-PROPERTIES OF GLASS

Methodology

See "Development plan"

Development plan

September.

Theory. Blok 1: Concrete

Presentation of the subject (Class 1)

- Concrete: basic concepts. Classification.
- Components of the concrete. Properties of the fresh and hardened concrete.
- Aggregates.

Theory. (Class 2)

- Aggregates. Concrete dosage.

Laboratory 1.Concrete I. (Class 3)

- Preparation of concrete, settlement using Abrams cone and molding of tubes.

Theory.(Class 4)

- Concrete dosage. Methods: Fuller, Bollomey, Carlos de la Peña, ACI...

October.

Theory. (Class 5)

- Production and transport of concrete. Concrete installation, compacting and curing.
- Special concretes: self-compacting, recycled, printed.

Theory.(Class 6)

- Concrete reinforced with steel fibers.

(Class 7)

- Factory visit: Prefabricats Pujol. Miralcamp.
- Concrete production, rebar production, prestressed concrete, terrazzo floor...

Theory.(Class 8)

- The reinforced concrete: stone material (compression) + ductile material (traction)

Theory. Block 2: Metallic Materials (Class 9)

- Extraction processes.
- Networks crystallographic metals.

Theory. (Class 10)

- Fe-C Alloys. The characteristics of the steel through of diagrams the phase change

Laboratory 2. Concrete II. (Class 11)

- Density of hardened concrete, broken test tubes: compressive strength, indirect tensile strength and resistance to bending.

Theory (Class 12)

- Steels in construction. Steels arm. Steels prestressed.

Theory.(Class 13)

- Non-ferrous metals. Aluminum, copper, lead and zinc.

Theory. (Class 14)

- Non-ferrous metals. Aluminum, copper, lead and zinc.

November.

Theory.(Class 15))

- The protection of metals. The galvanizing

Theory.Block 3: Polymers.(Class 18)

- Nature of polymeric materials.The chemistry of carbon.

WEEK 9: PROGRAMMED EVALUATION 1

Laboratory 3. Steels.(Class 19)

- Visual identification of corrugated steel, measuring geometric characteristics, tensile strength.

Theory. (Class 20)

- The physics of polymers. Polymers in construction. Thermoplastic and thermostables polymers.

Theory.Block 4: Ceramics. (Class 21)

- Historical notes.
- Raw materials
- Manufacturing (up traditional preparation)
- Ceramic products manufacturing Preparation mechanics
- Ceramic products manufacturing: Modeling
- Ceramic products manufacturing: Drying

Theory.(Class 22)

- Ceramic products manufacturing: Cooking

- General classification of ceramic products
- Ceramic structural. Rules
- Videos ceramics manufacturing

December. (Class 23)

- Visit Ceramics La Coma-Balaguer.
- Production thermoclay, bricks, etc.

Theory. (Class 23)

- Structural Ceramics: classification
- Ceramic Tiles: Manufacturing

Laboratory 4. Mortar and Ceramics. (Class 25)

- Granulometry of sand, mortar resistance to bending and compression, identification of bricks, ceramic bricks in compressive strength.

Theory. (Class 26)

- Tiles ceramics: Regulations
- Ceramics sanitary
- Refractory ceramic

Theory.Block 5: Glass.(Class 27)

- Historical notes
- Raw materials
- Glass manufacture
- Defects
- Video glass manufacturing

Theory. (Class 28)

- Glass Properties
- Types of glass

January.

- Visit Ceramics Exhibition La Coma-Balaguer. (Class 29)
- Tutoria.

WEEKS 16-17: PROGRAMMED EVALUATION 2

WEEK 19: RECOVERY EXAM

Evaluation

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

Guidelines for the evaluation of the subject.

- The subject is passed from 5.

Exams:

- 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 weekk 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?

- Three laboratory activitis as well as two 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.

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