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250109 - QUIMATER - Materials Chemistry

Coordinating unit: 250 - ETSECCPB - Barcelona School of Civil Engineering

Teaching unit: 751 - DECA - Department of Civil and Environmental Engineering

Academic year: 2018

Degree: BACHELOR'S DEGREE IN CIVIL ENGINEERING (Syllabus 2010). (Teaching unit Compulsory)
BACHELOR'S DEGREE IN CIVIL ENGINEERING (Syllabus 2017). (Teaching unit Compulsory)

ECTS credits: 7,5 Teaching languages: Catalan, Spanish

Teaching staff

Coordinator: LUCIA FERNANDEZ CARRASCO, SUSANA VALLS DEL BARRIO

Others: DIEGO FERNANDO APONTE HERNÁNDEZ, ANDREU CODINA MENDOZA, LUCIA FERNANDEZ CARRASCO, PATRICIA ROVIRA BASTUS, ISAAC TAN BACHS, SUSANA VALLS DEL BARRIO

Opening hours

Timetable: By appointment with the teachers responsible for each topic.
Coordinating Professor: Susanna Valls del Barrio.
Office: 111 module B1.

By appointment with the professors responsible for each topic
Responsible English group: Prof. Ignasi Casanova.
B-1 109 - office

Degree competences to which the subject contributes

Specific:

3023. Theoretical and practical knowledge of the chemical, physical, mechanical and technological properties of the materials most commonly used in construction.

Transversal:

591. 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.

597. EFFECTIVE USE OF INFORMATION RESOURCES - Level 1. Identifying information needs. Using collections, premises and services that are available for designing and executing simple searches that are suited to the topic.

600. SELF-DIRECTED LEARNING - Level 1. Completing set tasks within established deadlines. Working with recommended information sources according to the guidelines set by lecturers.

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Teaching methodology

The course consists of 2.3 hours per week of classroom activity (large size group) and 2.3 hours weekly with half the students (medium size group).

The 2.3 hours in the large size groups are devoted to theoretical lectures, in which the teacher presents the basic concepts and topics of the subject, shows examples and solves exercises.

The 2.3 hours in the medium size groups is devoted to solving practical problems with greater interaction with the students. The objective of these practical exercises is to consolidate the general and specific learning objectives.

The rest of weekly hours devoted to laboratory practice.

Support material in the form of a detailed teaching plan is provided using the virtual campus ATENEA: content, program of learning and assessment activities conducted and literature.

Learning objectives of the subject

Students will acquire a theoretical and practical understanding of the chemical, physical, mechanical and technological properties of the most common construction materials.

On completion of the course, students will have acquired the ability to:
1. Identify and determine the composition and structure of construction materials using a variety of experimental techniques;
2. Design programs for analysing the materials of a specific structure or infrastructure;
3. Conduct critical appraisals of the results.

Basic scientific principles of materials chemistry (heat, equilibrium, atomic structure, crystals, polymers and gels); Structure, types and properties of construction materials (conglomerates, phase diagrams, corrosion); Experimental methods for determining the composition and structure of construction materials. Capacity of enforcement and quality control of construction materials, and understanding of its foundations.

Theoretical and practical knowledge of chemical, physical, mechanical and technological qualities of materials used in construction. 4.1 Identify, obtain the composition and structure of building materials, using different experimental techniques. 2.4. Design a program of analysis of materials of a structure or infrastructure. 4.3. Perform a critical assessment of the results of a materials testing program conducted in a structure. Basic scientific knowledge of chemistry of materials (heat, balance, spatial atomic crystals, polymers and gels). Knowledge of structure, type and properties of building materials (binders, phase diagrams, corrosion). Knowledge of experimental methods for determining the composition and structure of building materials.
Establish and consolidate basic chemistry concepts studied in the secondary school. If necessary,
adequate tools will be provided to students so that they can follow the subject properly. Provide basic knowledge of the structure of matter and the interpretation of the chemical, physical and mechanical properties of materials from the atomic interactions to the establishment of relations between the microscopic structure and macroscopic properties. To study the main types of chemical processes, the factors that influence the performance of materials under service conditions. To provide basic knowledge and understand the chemistry of the most common building materials and processes of degradation they may suffer. To introduce students to the study of building materials used by the public works engineer in their professional practice, from the study of cementitious materials.

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Study load

Total learning time: 187h 30m	Hours large group:	40h	21.33%
	Hours medium group:	22h	11.73%
	Hours small group:	13h	6.93%
	Guided activities:	7h 30m	4.00%
	Self study:	105h	56.00%

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Content

Fundamentals of Chemistry

Learning time: 12h
Theory classes: 5h
Self study : 7h

Description:
Atomic structure. Periodic table. Solids

Phase diagrams

Learning time: 9h 36m
Theory classes: 2h
Practical classes: 2h
Self study : 5h 36m

Description:
The Phase Rule. Binary diagrams. The Lever Rule. Systems CaO-SiO2 and CaO-Al2O3
Quantification of phases and compositions

Metallic materials and their durability

Learning time: 31h 12m
Theory classes: 7h
Practical classes: 6h
Self study : 18h 12m

Description:
Fe-C system. Ferrous metals. Non-ferrous metals.
Intrepretació Fe-C diagram, description of the different phases and microstructure as cooling temperature, percentage of phases formed, carbon content in the alloy and formed at each stage.
Oxidation-reduction. Corrosion
Electrochemical processes. Redox

Binders (I)

Learning time: 14h 23m
Theory classes: 4h
Practical classes: 2h
Self study : 8h 23m

Description:
Clays: mineralogy, chemistry and applications in construction
Plaster: mineralogy, chemistry and applications in construction. Standard
Lime: mineralogy, chemistry and applications in construction
Exercises

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Binders (II). Portland cement

Learning time: 33h 36m

Theory classes: 9h
Practical classes: 5h
Self study : 19h 36m

Description:
Raw materials. Stages of the manufacture process. Process control methods. Dosage of mixes.
Phase diagrams. Components and structure of clinker. Formation reactions.
Phase diagrams. Bogue calculations
Hydration reactions. Determination of the heat of hydration. Stages in the development of the microstructure. Components and structure phases of hydrated cement paste. Techniques for monitoring hydration. Microstructure characterization techniques. Determination of Ca / Si.
Enthalpies. Calculation of reaction enthalpies. Energy efficiency in the production of clinker. Alternative fuels and raw materials. Capture and storage of CO2

Binders (III). Other cements and regulations

Learning time: 14h 23m

Theory classes: 6h
Self study : 8h 23m

Description:
Cement with special characteristics. Cements with additions. Calcium aluminate cement.
RC-16 cement regulations. Regulatory tests of cement.

durability

Learning time: 26h 24m

Theory classes: 6h
Practical classes: 5h
Self study : 15h 24m

Description:
Processes attack in the cement paste and its consequences: Attack of sulfates, chlorides, carbonation, dissolution / leaching, cation exchange reaction and alkali-granulate
The concept of chemical equilibrium and reactions
Concept solubility
Exercises solubility
The concept of acid-base reactions
Ionization
pH-meter
Salts
acid-base exercises

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Introduction to the study of the properties of building materials	Learning time: 14h 23m Theory classes: 4h Practical classes: 2h Self study : 8h 23m

Description:
Physical properties of materials
Problems general properties: Physical

Laboratory Practices	Learning time: 9h 36m Laboratory classes: 4h Self study : 5h 36m

Description:
Practice in the computer lab:
- instrumental technical to the identification of materials -Interpretation of various structures by XRD
A session in the laboratory to perform two practices:
- consistency of cement, Vicat needle
- manufacturing mortars
- and calculating the resistant class

Exams	Learning time: 14h 23m Laboratory classes: 6h Self study : 8h 23m

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Qualification system

Exercises to take (bi-weekly periodicity; 30% of the final grade)
• Partial exams (3; no eliminatory of
subject matter; Each 20% of the final grade)
• Laboratory (10% of the total)
• Bonus (up to 10%)

Criteria for re-evaluation qualification and eligibility: Students that failed the ordinary evaluation and have regularly attended all evaluation tests will have the opportunity of carrying out a re-evaluation test during the period specified in the academic calendar. Students who have already passed the test or were qualified as non-attending will not be admitted to the re-evaluation test. The maximum mark for the re-evaluation exam will be five over ten (5.0). The non-attendance of a student to the re-evaluation test, in the date specified will not grant access to further re-evaluation tests. Students unable to attend any of the continuous assessment tests due to certifiable force majeure will be ensured extraordinary evaluation periods.

These tests must be authorized by the corresponding Head of Studies, at the request of the professor responsible for the course, and will be carried out within the corresponding academic period.

Regulations for carrying out activities

Failure to perform a laboratory or continuous assessment activity in the scheduled period will result in a mark of zero in that activity.
It is an indispensable requirement to approve of the subject to have carried out the practices of laboratori(presencial session and non presencial session) and to have given the corresponding report and to have carried out activity 0 that will be proposed in the classroom.

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Bibliography

Basic:

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Whitten, K.W.; Davis, R.E.; Peck M.L. Química general. 5a ed. Madrid: Mc-Graw Hill, 1999. ISBN 8448113861.

Butler, I.S.; Grosser, A.E. Problemas de química: adaptados al curso de principios de química. Barcelona: Reverté, 1976. ISBN 8429170847.

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Complementary:

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Masterton, W. L., Hurley, C. N. Química: principios y reacciones. madrid: Thomson, 2003. ISBN 8497321006.

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