

Course guide

2500011 - GECMATCONS - Construction Materials

Last modified: 01/10/2023

Unit in charge: Barcelona School of Civil Engineering
Teaching unit: 751 - DECA - Department of Civil and Environmental Engineering.

Degree: BACHELOR'S DEGREE IN CIVIL ENGINEERING (Syllabus 2020). (Compulsory subject).

Academic year: 2023 **ECTS Credits:** 6.0 **Languages:** Spanish, English

LECTURER

Coordinating lecturer: MARILDA BARRA BIZINOTTO, MIREN ETXEBERRIA LARRAÑAGA

Others: DIEGO FERNANDO APONTE HERNÁNDEZ, MARILDA BARRA BIZINOTTO, MIREN ETXEBERRIA LARRAÑAGA, SUSANA VALLS DEL BARRIO

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:

14400. Ability to apply knowledge of building materials in structural systems. Knowledge of the relationship between the structure of the materials and the mechanical properties that derive from it. (Common module to the Civil branch)

14401. Ability to analyze and understand how the characteristics of structures influence their behavior. Ability to apply knowledge about the resistant operation of structures to size them according to existing regulations and using analytical and numerical calculation methods. (Common module to the Civil branch)

Generical:

14380. Scientific-technical training for the exercise of the profession of Technical Engineer of Public Works and knowledge of the functions of advice, analysis, design, calculation, project, construction, maintenance, conservation and exploitation.

TEACHING METHODOLOGY

The course consists of 2 hours per week of classroom activity (large size group) and 2 hours weekly with half the students (medium size group).

The 3 hours in the large and medium 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 0,5 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 (0,5) is laboratory practice.

Although most of the sessions will be given in the language indicated, sessions supported by other occasional guest experts may be held in other languages.

To do the laboratory practices you need the following personal protective equipment (PPE):

- * Protection gloves - Chemical
- * Protection gloves - Mechanical

LEARNING OBJECTIVES OF THE SUBJECT

Knowledge of the mechanical and technological properties of the most used materials in construction; Construction materials and structural systems. Relationship between the structure of the materials and the mechanical properties derived from them. Relationship between the mechanical properties of the materials and the most adequate structural systems for each of them. Obtaining, manufacturing and placing of the main building materials (concrete, steel, bituminous and ceramic materials). Physical, chemical and mechanical properties of concrete, steel and other metals, bituminous materials, ceramic materials, polymers and composite materials. Regulations for quality control of construction materials. Environmental impact and management of building materials. Study of the energy consumption and of the life cycle of the building materials.

- 1 Ability to relate the materials used in construction with their mechanical and physical properties and the structural needs existing in each case.
- 2 Ability to organize and plan analysis of properties of materials involved in a civil work, both through on-site and laboratory tests.
- 3 Ability to carry out an energy and life cycle study of construction materials.

Knowledge of the physical and mechanical properties, process of obtaining, manufacturing and putting into work of the materials of building. Knowledge of rocks including properties and tests, pathologies and repair. Knowledge of foundries and steels. Knowledge of concrete including fabrication, commissioning, curing, durability, mechanical and chemical properties. Knowledge of properties and uses in construction of metals. Knowledge of ceramic materials, as well as their mechanical, thermal, electrical and acoustic properties. Knowledge of the properties of bituminous materials including their rheological properties, mixing with aggregates, as well as dosing and manufacturing. Knowledge of other materials. Knowledge of the impact and environmental management of construction materials.

Knowledge of the mechanical and technological properties of the materials most used in construction; building materials and structural systems. Relationship between the structure of materials and the mechanical properties derived from them. Relationship between the mechanical properties of the materials and the most suitable structural systems for each of them. Obtaining, manufacturing and implementing the main building materials (concrete, steel, bituminous materials and ceramics). Physical, chemical and mechanical properties of concrete, steel and other metals, bituminous materials, ceramic materials, polymers and composite materials. Quality control regulations for construction materials. Environmental impact and management of construction materials.

STUDY LOAD

Type	Hours	Percentage
Self study	84,0	56.00
Hours medium group	24,0	16.00
Hours small group	6,0	4.00
Guided activities	6,0	4.00
Hours large group	30,0	20.00

Total learning time: 150 h

CONTENTS

T1: Mechanical and technological properties of construction materials

Description:

Mechanical properties of solids. Basic concepts of stress, strain, fracture mechanics and toughness. Thermal and electrical properties. Liquids, viscoelasticity and gels. Surface phenomena

T1 - Application problems

Full-or-part-time: 12h

Theory classes: 2h

Practical classes: 3h

Self study : 7h

T2: Building materials, structural systems

Description:

T1 - Mechanical and technological properties of construction materials

Full-or-part-time: 3h 35m

Theory classes: 1h 30m

Self study : 2h 05m

T3: Aggregates

Description:

T3: Aggregates

T3: Exercises

Practice 1 (P1): Aggregates

Full-or-part-time: 14h 23m

Theory classes: 1h

Practical classes: 3h

Laboratory classes: 2h

Self study : 8h 23m

T4: Concrete

Description:

Components, structure and microstructure. Properties of hardened concrete. Fresh concrete. Production, transport, placement, compaction and curing. Mix design. Admixtures and additions. Durability. Chemical and physical causes of concrete deterioration.

Interpretation and application of EHE for structural concrete

Laboratory practice 1 (P1): Properties of fresh concrete

T4: Mix design

Laboratory practice 3 (P3): Properties of hardened concrete

Full-or-part-time: 33h 36m

Theory classes: 7h

Practical classes: 4h

Laboratory classes: 3h

Self study : 19h 36m

T5: Steel and other metals

Description:

Steels and cast iron. Steel industry. Formation processes. Thermal and mechanical treatments. Steels reinforcement and prestressed concrete. Structural steels. Stainless steels and other alloy steels. Corrosion of steel. Non-ferrous metals. Copper and copper alloys. Nickel and nickel alloys. Aluminum.

T5: Application problems

Full-or-part-time: 19h 12m

Theory classes: 5h

Practical classes: 3h

Self study : 11h 12m

T6: Polymers

Description:

Polymers of general interest in construction. Properties, tests and specific regulations.

Full-or-part-time: 8h 24m

Theory classes: 3h 30m

Self study : 4h 54m

T7: Fibre composites

Description:

Fibers. Matrix. Interfaces. Mechanical behavior of reinforced fibre materials. Application of composites in construction. Durability
T7: Exercises

Full-or-part-time: 13h 12m

Theory classes: 3h 30m

Practical classes: 2h

Self study : 7h 42m

T8: Bituminous materials

Description:

Bitumen. Mix design of bituminous mixtures. Properties and tests of bituminous mixtures. Production and control of bituminous mixtures.

T8: Exercises

Laboratory practice 4 (P4): Properties of bituminous mixtures

Full-or-part-time: 15h 36m

Theory classes: 3h 30m

Practical classes: 2h

Laboratory classes: 1h

Self study : 9h 06m

T9: Ceramic materials

Description:

T9: Ceramic materials

Full-or-part-time: 7h 11m

Theory classes: 3h

Self study : 4h 11m

T10: Criteria for the selection and sustainable use of construction materials

Description:

Life cycle and parameters to assess the environmental impact. Environmental protection of soils and water: leaching. Recycling.

Full-or-part-time: 9h 36m

Theory classes: 4h

Self study : 5h 36m

Assesment

Full-or-part-time: 7h 11m

Laboratory classes: 3h

Self study : 4h 11m

GRADING SYSTEM

The mark of the course is obtained from the ratings of continuous assessment and their corresponding laboratories and/or classroom computers.

Continuous assessment consist in several activities, both individually and in group, of additive and training characteristics, carried out during the year (both in and out of the classroom).

The teachings of the laboratory grade is the average in such activities.

The evaluation tests consist of a part with questions about concepts associated with the learning objectives of the course with regard to knowledge or understanding, and a part with a set of application exercises.

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.

EXAMINATION RULES.

The final grade of the course will be the weighted average of the directed studies (*ED), the laboratory practices (P) and the exams (E), $N = 0.75E + 0.20P + 0.05ED$

Attendance at the laboratory sessions is mandatory to pass the course

BIBLIOGRAPHY

Basic:

- Domone, P.; Illston, J. Construction materials : their nature and behaviour. 4th ed. London ; New York: Spon Press, 2010. ISBN 9780415465151.

Complementary:

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- Mehta, P.K.; Monteiro, P.J.M. Concrete: microstructure, properties, and materials. 3rd ed. New York: McGraw-Hill, 2006. ISBN 0071462899.

- Neville, Adam M. Properties of concrete. 5th ed. Pearson, 2011. ISBN 9780273755807.

- Fernández Cánovas, M. Hormigón. 9a ed. Madrid: Colegio de Ingenieros Caminos Canales y Puertos. Servicio de Publicaciones, 2011. ISBN 9788438003640.

- Kraemer, C. Ingeniería de carreteras: v. II. Madrid: Mc Graw Hill, 2003. ISBN 84-481-3998-4.

- Smith, M.R.; Collis, L. ; editado en versión española por: Suárez,L.; Regueiro, M. Áridos : áridos naturales y de machaqueo para la construcción. 2ª ed. Madrid: Colegio Oficial de Geólogos de España, 1994. ISBN 8492009705.

- Joana Roncero. Manual de tecnología de aditivos para hormigón. Madrid: ACHE, 2010. ISBN 9788489670709.