Last update: 04-12-2018

250132 - ANALESTR - Structural Analysis

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: JOAN BAIGES AZNAR, GABRIEL BUGEDA CASTELLTORT

Others: JOAN BAIGES AZNAR, GABRIEL BUGEDA CASTELLTORT, MIGUEL ENRIQUE CERROLAZA RIVAS, POOYAN DADVAND

Opening hours

Timetable: Monday and Wednesday from 16 to 18 hours

Degree competences to which the subject contributes

Specific:

3026. Ability to analyse and understand how the characteristics of structures influence their behaviour. Ability to apply knowledge of the resistance dynamics of structures in order to dimension them in accordance with existing regulations using analytical and numerical calculation methods.

3027. Ability to calculate structures with interactive resistant mechanisms based on analytical and computational models approved by European Union regulations.

3037. Knowledge of the different types and basis for calculating prefabricated items and its application to the manufacturing processes.

3038. Knowledge of the design, calculation, construction and maintenance of building works in regard to their structure, finishes, installations and equipment.

Generical:

3104. Students will learn to identify, formulate and solve a range of engineering problems. They will be expected to show initiative in interpreting and solving specific civil engineering problems and to demonstrate creativity and decision-making skills. Finally, students will develop creative and systematic strategies for analysing and solving problems.

3106. Students will learn to assess the complexity of the problems examined in the different subject areas, identify the key elements of the problem statement, and select the appropriate strategy for solving it. Once they have chosen a strategy, they will apply it and, if the desired solution is not reached, determine whether modifications are required. Students will use a range of methods and tools to determine whether their solution is correct or, at the very least, appropriate to the problem in question. More generally, students will be encouraged to consider the importance of creativity in science and technology.

3107. Students will learn to identify, model and analyse problems from open situations, consider alternative strategies for solving them, select the most appropriate solution on the basis of reasoned criteria, and consider a range of methods for validating their results. More generally, students will learn to work confidently with complex systems and to identify the interactions between their components.

3110. Students will learn to plan, design, manage and maintain systems suitable for use in civil engineering. They will develop a systematic approach to the complete life-cycle of a civil engineering infrastructure, system or service, which includes drafting and finalising project plans, identifying the basic materials and technologies required, making decisions, managing the different project activities, performing measurements, calculations and assessments, ensuring compliance with specifications, regulations and compulsory standards, evaluating the social and environmental impact

250132 - ANALESTR - Structural Analysis

of the processes and techniques used, and conducting economic analyses of human and material resources.
3112. Students will develop an understanding of the different functions of engineering, the processes involved in the life-cycle of a construction project, process or service, and the importance of systematising the design process. They will learn to identify and interpret the stages in preparing a product design specification (PDS), draft and optimise specifications and planning documents, and apply a systematic design process to the implementation and operation phases. Students will learn to write progress reports for a design process, use a range of project management tools and prepare final reports, and will be expected to show an awareness of the basic economic concepts associated with the product, process or service in question.
3113. Students will learn to identify user requirements, to draft definitions and specifications of the product, process or service in question, including a product design specification (PDS) document, and to follow industry-standard design management models. Students will be expected to show advanced knowledge of the steps involved in the design, execution and operation phases and to use the knowledge and tools covered in each subject area to the design and execution of their own projects. Finally, students will assess the impact of national, European and international legislation applicable to engineering projects.

Transversal:

585. ENTREPRENEURSHIP AND INNOVATION - Level 1. Showing enterprise, acquiring basic knowledge about organizations and becoming familiar with the tools and techniques for generating ideas and managing organizations that make it possible to solve known problems and create opportunities.
586. ENTREPRENEURSHIP AND INNOVATION - Level 2. Taking initiatives that give rise to opportunities and to new products and solutions, doing so with a vision of process implementation and market understanding, and involving others in projects that have to be carried out.
589. SUSTAINABILITY AND SOCIAL COMMITMENT - Level 2. Applying sustainability criteria and professional codes of conduct in the design and assessment of technological solutions.
594. TEAMWORK - Level 3. Managing and making work groups effective. Resolving possible conflicts, valuing working with others, assessing the effectiveness of a team and presenting the final results.
584. THIRD LANGUAGE. Learning a third language, preferably English, to a degree of oral and written fluency that fits in with the future needs of the graduates of each course.

Teaching methodology

The course is run through a set of classes taught in the classroom with a large number of students (large group) and other practical classes with half of students (medium group) that are taught sequentially over 15 weeks one term.

Lectures are devoted to 32 hours during which the teacher explains the concepts and basic teaching materials matter, presents examples and exercises. 19 hours are devoted to practical sessions during which problems are solved in a more interactive process with students. These exercises are performed in order to strengthen knowledge and learning objectives specific and general.

The remaining hours are divided into classes weekly labs in 17 hours and 7 hours assessment processes. Laboratory practical classes are intended for the student to check with their own activities in the classroom or computer room, your progress in a concrete knowledge.

It uses material support in the form of detailed teaching plan using the virtual campus ATENEA: content, scheduling of activities and a learning assessment and bibliography.

Learning objectives of the subject

Students will learn to apply their knowledge of structural analysis to calculate operational strength as part of the design of structures that comply with current regulations, with the help of analytical and numerical calculation methods.

Upon completion of the course, students will have acquired the ability to: 1. Calculate/analyse structures using the matrix

250132 - ANALESTR - Structural Analysis

method, by developing a computer program or using/modifying an existing program. 2. Calculate/analyse structures with the finite element method, by using/modifying an existing computer program. 3. Determine the stability of a structure using second-order analysis.

Advanced structural calculation; Kinematic hypothesis, energy theorems and the relationship between motion and force; Operational strength of metal plates and their application to flat surface structures; Operational strength of sheet metal and its application to the structure of tanks; Matrix methods of calculating rod structures; Programming matrix methods for calculation; Basic concepts of the finite element method and its application to rod structures; Basic concepts of dynamic structural calculation; Definition of mass-matrix and damping concepts; Introductory concepts of structural stability and second-order analysis; Current regulations on actions, calculation and execution; Project conditions for designing and/or testing metal and concrete structures: limit state design; Ultimate limit states and serviceability limit states

Study load

Total learning time: 187h 30m	Theory classes:	32h	17.07%
	Practical classes:	19h	10.13%
	Laboratory classes:	24h	12.80%
	Guided activities:	7h 30m	4.00%
	Self study:	105h	56.00%

Last update: 04-12-2018

250132 - ANALESTR - Structural Analysis

Content

Introduction to Structural Analysis: Differential and Integral approach to the problem

Learning time: 24h

Theory classes: 5h
Practical classes: 2h
Laboratory classes: 3h
Self study : 14h

Description:
The problem of bending of beams: Differential and Integral Formulation. Exact solutions and boundary conditions. Approximate solutions: introduction to the method of finite differences and finite element method.
Problems
Laboratory

Matrix Methods in Structural Analysis Bar

Learning time: 52h 48m

Theory classes: 8h
Practical classes: 6h
Laboratory classes: 8h
Self study : 30h 48m

Description:
Matrix formulation for structural bars. Stiffness Matrices, Flexibility, Balance and Transfer. Stiffness matrix of a structure. Using a computer program for practical solutions
Problems
Laboratory

Resistant Behavior of Surface Structures: Plate and Sheet Bending

Learning time: 52h 48m

Theory classes: 8h
Practical classes: 6h
Laboratory classes: 8h
Self study : 30h 48m

Description:
Differential and integral formulation of the bending of plates. Exact solutions for rectangular and circular plates. Approximate solutions: emparillado plane, Finite Differences and Finite Elements. Plates on specific support: Virtual Portals. Introduction to the bending of plates: cylindrical shells
Problems
Laboratory

Last update: 04-12-2018

250132 - ANALESTR - Structural Analysis

Dynamic Calculation of Second Order Effects in Structures Bar	Learning time: 26h 24m Theory classes: 5h Practical classes: 5h Laboratory classes: 1h Self study : 15h 24m

Description:
Second Order Analysis of bar structures. Differential and Integral Formulation. Matrix Geometric Functions and Stability. Introduction to dynamic analysis of structures. Mass Matrices and Buffer. Introduction to seismic calculation.
Problems

Sizing, Testing and Safety of Structures	Learning time: 24h Theory classes: 6h Laboratory classes: 4h Self study : 14h

Description:
Bases for the design and testing of structures: Regulatory actions and calculation. Ultimate limit states and service. Introduction to strength design methods: the plastic hinge and break lines.
Laboratory

250132 - ANALESTR - Structural Analysis

Qualification system

La calificación final de la asignatura se obtiene a partir de las calificaciones parciales obtenidas en los actos de evaluación continuada de cada tema y del examen final

Para cada uno de los cinco temas de la asignatura se obtendrá una nota. Dicha nota será la media ponderada de las evaluaciones realizadas y de los trabajos entregados. De esta forma, se obtendrá una "nota media de curso (NMC)" igual a la media de las notas de cada una de los cinco temas.

La nota final (NF) será igual a la media de la NMC y de la nota del examen final (NEF). Es decir:

NF = (NMC + NEF)/2

No obstante, a aquellos alumnos cuya nota de todos y cada uno de los cinco temas sea igual o superior a 5 , y además hayan entregado todos los problemas y prácticas propuestos, se les exime de presentarse al examen final. En este caso, la nota final será igual a

NF = 1,15 * NMC

Para aquellos alumnos con nota final inferior a cinco, se realizará un examen de recuperación (cuya nota máxima será 5). Para poder presentarse al examen es preciso haber entregado correctamente todas las prácticas, trabajos y problemas propuestos a lo largo del curso.

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 any activity or evaluation laboratory continues under the programming period will be considered as zero rating.

Last update: 04-12-2018

250132 - ANALESTR - Structural Analysis

Bibliography

Basic:

Argüelles Álvarez, R. Cálculo de estructuras (Vol. 1, 2, 3). Madrid: Escuela Técnica Superior de Ingenieros de Montes, 1986. ISBN 8460024113 (V.1) 8460024121 (V.2) 8460041891 (V.3).

Corchero Rubio, J.A. Cálculo de estructuras: resolución práctica. 3a ed. Madrid: Colegio de Ingenieros de Caminos, Canales y Puertos, 1993. ISBN 84-7493-110-X.

Livesley, R. K. Métodos matriciales para cálculo de estructuras. Madrid: Blume, 1970.

Timoshenko, S.; Woinowsky-Krieger, S. Teoría de placas y láminas. Bilbao: Urmo, 1975. ISBN 978-8431401160.

Complementary:

Oñate Ibañez de Navarra, E. Cálculo de estructuras por el método de los elementos finitos. Artes Gráficas Torres. Barcelona: CIMNE, 1992. ISBN 8487867006.

Billington, D. Thin shell concrete structures. New York: McGraw-Hill, 1965. ISBN 9780070052710.

Timoshenko, S. P.; Gere, J. M. Theory of elastic stability. 2nd ed. Dover Publications Inc, 1961. ISBN 0070647496.

Canet, J. M; Barbat; A. H. Estructuras sometidas a acciones sísmicas. Artes Gráficas Torres. Barcelona: CIMNE, 1994. ISBN 8487867103.

Johansen, K. W. Yield-line theory. Londres: Cement and Concrete Association, 1962.