ISEL
INSTITUTO SUPERIOR DE ENGENHARIA DE LISBOA

DEC
ÁREA DEPARTAMENTAL DE ENGENHARIA CIVIL

Course file

Study cycle	BACHELOR IN CIVIL ENGINEERING		
Course	STRUCTURAL CONCRETE I	Mandatory	☒
		Optional	☐
Course scientific area	CIVIL ENGINEERING	Category	E

Course category: B - Basic; C - Core Engineering; E - Specialization; P - Complementary.

Year: 3rd	Semester: 5th		ECTS: 5,5		Total: 149
Contact time	T: 22,5	TP: 45	PL:	S:	OT:

T - Lectures; TP - Theory and practice; PL - Lab Work; S - Seminar; OT - Tutorial Guidance.

Course Director	**Title**	**Position**
Luciano Jacinto	Doutor	Professor Adjunto

Learning objectives (knowledge, skills and competences to be developed by students)

(max. 1000 characters)

O1.To define the limit states to be adopted in the design of commom reinforced concrete structures.
O2.To perform the design and safety checking of reinforced concrete sections regarding ultimate limit states (bending with or without axial force, shear and torsion).
O3.Analysis of second order effects in columns.
O4.To perform the design and safety checking of common reinforced concrete members, regarding the limit states of cracking and deformation limitation.
O5.To apply the code provisions concerning the indirect control of cracking and deformation in members of common reinforced concrete structures.
O6.Design of common columns and isostatic beams.

Syllabus

(max. 1000 characters)

S1.Historical notes on the use of reinforced concrete.
S2.Materials and their properties.
S3.Safety and actions.
S4.Design and safety checking regarding ultimate limit states involving bending with or without axial force.
S5.Design and safety checking regarding ultimate limit states involving shear.
S6 Design and safety checking regarding ultimate limit states involving torsion, with or without shear.
S7.Safety checking regarding the ultimate limit state involving buckling.
S8.General prescriptions about reinforcement.
S9.General prescriptions and detailing rules for beams.

S10.General prescriptions and detailing rules for columns.
S11.Cracking. Safety checking regarding the limit state of crack width limitation.
S12.Deformation. Safety checking regarding the limit state of deformation limitation.

Demonstration of the consistency between the syllabus and the course objectives

(max. 1000 characters)

Syllabus S1 makes an introduction to the course and defines its scope.
Syllabus S2 and S3 aim the achievement of objective O1.
Syllabus S2, S3,S4, S5 and S6 aim the achievement of objective O2.
Syllabus S2, S3 and S7 aim the achievement of objective O3.
Syllabus S11 and S12 aim the achievement of objectives O4 and O5.
Syllabus S2 to S12 aim the achievement of objective O6.

Teaching methodology (evaluation included)

(max. 1000 characters)

The course teaching is done through T and TP classes.
The course teaching staff provides every year texts in support to the T and TP classes. Adittionally, a workbook of practical problems is provided to the students.
In T classes the theories underlying the analysis of sections subjected to several conditions is presented.
The TP classes consist in solving problems with the accomplishment of the teachers. The practical application of theorectical principles is explained in detail, for the several steps involved in the computations.
The assessment may be continuous or through a final exam. Continuous assessment consists of two mid-term tests. The minimum grade in those tests is 8/20. The final grade is the arithmetic mean of the mid-term tests or the final exam grade. Final grades exceeding 15/20 must be defended in an oral exam.

Demonstration of the consistency between teaching methodology and the course learning objectives

(max. 3000 characters)

The learning objectives are achieved through careful planning how the knowledge delivered in the T lessons is conveyed to practical applications.
On one hand, the problems proposed in the workbook range from low to high difficulty, driving the most interested students towards some specialized study/research work.
Moreover, the sequence of problems proposed in the TP lessons is organized to allow, gradually and with increasing difficulty, the application of theoretical knowledge. This step-by-step approach is quite effective in what concerns the acquistion of the required skills.
The problems proposed in the TP lessons are the following type (+ = low difficulty; + + = moderate difficulty; + + + = high difficulty):
S3
A problem in which, given the actions, the design values must be obtained (+);

A problem to apply the combination rules, given the effects of individual actions (+);
S4
A problem about uniaxial bending in a rectangular section (+);
2 problems about uniaxial bending in T, U or I sections(+);
A problem about uniaxial bending in a variable width section (+ +);
A problem about uniaxial bending with compressive axial force (+);
A problem about biaxial bending with compressive axial force (+ +);
A problem about uniaxial bending in which reinforcement does not yield (+ + +). The use of compression reinforcement is explained.
Where applicable provisions on reinforcement and detailing rules are checked.
S5
A problem on a rectangular section (+);
A problem on a U, T, double T or hollowed section (+ +);
Code provisions on reinforcement and detailing rules are checked.
S6
A problem dealing with the shear-torsin interaction (+);
A problem involving the simultaneous existence of bending, shear and torsion, with the definition and detailing of all the reinforcement, taking into account code provisions and detailing rules (+ + +).
S7
A problem to check whether second order effects may be ignored (+);
A problem that explicitly accounts for 2nd order effects, using the prescribed methods in EC2 (nominal stiffness and nominal curvature) (+ + +).
S8, S9 and S10
These contents are applied at all problems related to S4, S5, S6 and S7.
S11 and S12
For each of these contents the following problems are proposed:
A problem concerning the application of the provisions that exempt the direct computation (+);
A problem in which the direct computation is carried out (+ +).

Main Bibliography

(max. 1000 characters)

1.Apontamentos da unidade curricular (baseados nos Eurocódigos) – Corpo docente (actualização contínua).
2.J. D' Arga e Lima, "Betão Armado - Armaduras (REBAP-83)", Edição do LNEC, Lisboa, 1988;
3.J. D' Arga e Lima, Vitor Monteiro, Mary Mun, "Betão Armado - Esforços Normais e de Flexão (REBAP-83)", Edição do LNEC, Lisboa, 1985;
4.P. Jimenez Montoya, A. G. Meseguer, F. Moran Cabré, "Hormigón Armado", Ed. G.Gili, Barcelona, 2000.
5.R. Park, T. Paulay, "Reinforced Concrete Structures", John Wiley and Sons, New York, 1975.
6.Leonhardt, F.; E. Monnig – "Construções de Concreto", Editora Interciência, Rio de Janeiro, 1980.
7.NP EN 1990: 2009 – "Eurocódigo – Bases para o projecto de estruturas", 2009.
8.NP EN 1992-1-1: 2010 – "Eurocódigo 2 – Projecto de estruturas de betão, Parte 1-1; regras gerais e para edifícios", 2010.

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