ISEL
INSTITUTO SUPERIOR DE ENGENHARIA DE LISBOA

ADEC
ÁREA DEPARTAMENTAL DE ENGENHARIA CIVIL

Course file

Study cycle	BACHELOR IN CIVIL ENGINEERING		
Course	Calculus II	Mandatory	☒
		Optional	☐
Course scientific area	CIVIL ENGINEERING	Category	B

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

Year: 1st	Semester: 2nd		ECTS: 5,5		Total: 148
Contact time	T:	TP: 67,5	PL:	S:	OT:

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

Course Director	Title	Position
Cristina Januário	Doutor	Professor Adjunto

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

(max. 1000 characters)

After the student's approval, he should

1. Master the concepts of limit, continuity and differentiability of real-valued and vector functions of several variables.

2. Master the calculation of multiple integrals, identifying the geometric representation of the domain and recognizing the appropriate coordinate system.

3. Parameterize curves and surfaces and to apply it in the calculation of line and surface integrals.

4. Develop spacial visualization and deductive reasoning skills in the analysis and solution of applied problems.

5. Be able to formulate a mathematical problem and to identify and implement the appropriate strategies and tools to its analytical and/or computational solution.

6. Be able to apply the key concepts and techniques of differential and integral calculus in IRn in the context of the various engineering-related courses of the program.

7. Have analysis, algebra and deductive reasoning skills.

8. Have reflection and criticism capabilities.

Syllabus

(max. 1000 characters)

1. Topological notions in IRn; Scalar and vector fields; Domain, contour diagram, and graph; Limits and continuity.

2. Differential Calculus in IRN: diretional derivative; partial derivative; Schwarz theorem, differentiability of scalar fields; tangent plane; the derivative as a linear map (gradient vector/Jacobian matrix); chain rule. Differential operators: gradient, divergence, and curl. Taylor's formula for scalar fields. Local constraint-free extrema. Applications.

3. Integral Calculus in IRn: double and triple integrals, Fubini's theorem; substitution of variables. Line integrals: length-of-arc; line integral of scalar and vector fields. Work, conservative fields, and potential. Green's theorem. Surface integrals: parametrization of a surface, integral surface scalar and vector fields. Flow, the divergence theorem, Stokes' theorem. Applications.

Demonstration of the consistency between the syllabus and the course objectives

(max. 1000 characters)

Goals 1-4 are met within contents of Chapters 1-5 of the syllabus, in which analysis, algebra and deductive reasoning skills are widely developed (goal 7). In addition to the applications studied in each Chapter, the systematic use of applied and/or computational and contextual problems yields increase of motivation, efficiency and spectrum of learning, since they enable:

- to convey the fact that the differential and integral calculus in IR is an indispensable tool in the study of engineering;
- to practice the mathematical formulation of problems, their solution and criticism (goals 5 and 8);
- to enable computational experiences in direct mathematical formalization of problems and their solution, to formulate conjectures and to construct, evaluate, modify, and interpret algorithms (goals 5, 7 and 8);
- to help students to recognize the concepts and techniques studied when they are met in the study of other courses (goal 6).

Teaching methodology (evaluation included)

(max. 1000 characters)

Theoretical lectures where the fundamental concepts and definitions are presented in a clear way using the teaching supporting materials available. Theoretical-practical and/or pratical classes where the exercises illustrating the theoretical concepts are solved. Special emphasis is given to problems connecting the tools developed with concepts which are important in engineering-related courses. Exercises sheets are available for an effective monitoring and strengthen of the knowledge presented.

The assessment comprises two alternative components, continuous assessment (two partial tests) and exam assessment.

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

(max. 3000 characters)

Lectures are essential to a correct and comprehensive coverage of all topcis of the syllabus, while in-class solution of exercices allows for a successful application of the theorectical knowledge to practical problems.

By their organization, contents and diversity in the degree of difficulty, the exercises sheets allow students to closely monitor all topics of the syllabus and are the main tool regarding individual study. The exercises that constitute them are suited for the development of algebra skills and deductive reasoning allowing the student to acquire work and independence skills

Since the success in mathematics is not compatible with pre-assessment study on its own, it is essential to implement processes to avoid this inclination. The student is encouraged to solve the proposed exercises and to clarify his doubts throughout the semester.

Main Bibliography

(max. 1000 characters)

1. H. Anton, “Calculus: A New Horizon”, 6ª Edição, John Wiley & Sons Inc., 1998.

2. H. Anton, I. Bivens, S. Davis, “Calculus Multivariable”, Wiley-Blackwell, 2008.

3. A. Azenha, M. A. Jeronimo, “Elementos de Cálculo Diferencial e Integral em IR e IRn”, McGraw-Hill, 1995.

4. R. Larson, R. P. Hostetler, B. H. Edwards, “Cálculo”, Volume 2, 8ª Edição, McGrawHill, 2006.

5. J. Marsden, A. Tromba, “Vector Calculus”, 4th Edition, W.H. Freeman and Company, 1996.

6. W. McCallum, D. Hughes-Hallet, et al., “Multivariable Calculus”, 5th Edition, International Student Version, John Wiley & Sons, 2010.

7. James Stewart, Calculus: early transcendentals, Brooks Cole, 6ª Edição, 2007.