Universidad Zaragoza

Year : 2019/20

28600 - Mathematics applied to building I

Syllabus Information

Academic Year: 2019/20
Subject: 28600 - Mathematics applied to building I
Faculty / School: 175 - Escuela Universitaria Politécnica de La Almunia
Degree: 422 - Bachelor's Degree in Building Engineering
ECTS: 6.0
Year: 1
Semester: First semester
Subject Type: Basic Education
Module: ---

1.General information

1.1.Aims of the course

The foreseen outcomes of this signature are based on the following approaches and objectives:
The basic mathematical tools and their methods are part of the different tools that professional engineers need to face and solve the different sort of problems they are going to find in the real life, therefore, among the learning outcomes, students are expected to get a good knowledge and capability for implementing numerical and analytical solutions using real calculus based on high quality softwares and computer programs. Taking this into account, this is the main reason why Engineering and Architectural students need to get the learning outcomes of this subject.
Successful students must be able to gather and implement the basic tools of this subject in any aspect related to the Engineering or Architectural area, making it into the basic tool for any other subject in their chosen degree and at the same time acquiring techniques that will improve and give them a successful professional development.

1.2.Context and importance of this course in the degree

This subject is part of the basic structure of academic knowledges required for the students to overcome with success this academic degree. It is being taught in the first semester in the first course with the main purpose of providing students new mathematical tools and skills that are going to be essentials in the good learning and successful study of the different subjects they are going to face with in higher years, such as Physics, Economy, Statistics, among others.
The main focus of this subject is to provide students high capability and skill in the comprehension, implementation and right use of the mathematical tools in any engineering problem, giving the best solution and being able to explain with it the different observed phenomena.

1.3.Recommendations to take this course

It is advisable for the students to have a good knowledge of basic integral and differential calculus along with a reasonable capability and skill using symbolic and numerical softwares.

2.Learning goals

2.1.Competences

2.2.Learning goals

2.3.Importance of learning goals

3.Assessment (1st and 2nd call)

3.1.Assessment tasks (description of tasks, marking system and assessment criteria)

4.Methodology, learning tasks, syllabus and resources

4.1.Methodological overview

The methodology followed in this course is oriented towards the achievement of the learning objectives. A wide range of teaching and learning tasks are implemented, such as theory sessions, practice sessions, tutorials, and autonomous work

and study.

A strong interaction between the teacher and the student is promoted. This interaction is brought into being through a division of work and responsibilities between the students and the teacher. Nevertheless, it must be taken into account that, to a certain degree, students can set their learning pace based on their own needs and availability, following the guidelines set by the teacher.

The current course "Matemática Aplicada a la Edificación I" is conceived as a stand-alone combination of contents, yet organized into two fundamental and complementary forms, which are: the theoretical concepts of each teaching unit and the solving of problems or resolution of questions, at the same time supported by other activities.

Here, the practical and theoretical classes are combined with the continuous use of high quality free and open-source software, which allows a deeper comprehension and quick visualization of new mathematical tools and concepts.

Regarding to the slides, proposed exercise photocopies, laboratory session guides and other materials used in class, all of them are going to be available on the Moodle platform of this course.

Material	Format
Topic theory notes Topic problems	Paper/repository
Topic theory notes Topic presentations Topic problems Related links	Digital/Moodle, E-mail
Educational software	Open source wxMaxima and Octave

4.2.Learning tasks

This 6 ECTS (150 hours) course is organized as follows:

Face-to-face generic activities:

- **Theory sessions** (2 ECTS: 20 hours). Theoretical activities carried out mainly through exposition by the teacher, where the theoretical supports of the course are displayed, highlighting the fundamental, structuring them in topics and or sections, interrelating them.
- **Practice sessions** (1.77 ECTS: 17.7 hours). Problems and practical cases are carried out complementary to the theoretical concepts studied.
- **Exams** (8 hours). 1 hour per test.

Generic non-class activities: (1.5 ECTS: 15 h)

- Study and understanding of the theory taught in the lectures.
- Understanding and assimilation of the problems and practical cases solved in the practical classes.
- Preparation of seminars, solutions to proposed problems, etc.
- Preparation of the written tests for continuous assessment and final exams.
- **Individual Tutorials**: Those carried out giving individual, personalized attention with a teacher from the department. These tutorials may be in person or online.
- **Autonomous work and study** (90 hours).

4.3.Syllabus

This course will address the following topics:

Topic 0. Introduction to the open-source software Maxima and revision of real functions of real variables

Topic 1. Limits and Continuity of functions

- Limits, indeterminate forms, equivalence functions
- Continuity and discontinuity of functions
- Classical theorems
- Bisection method

Topic 2. The derivative

- The derivative, the tangent (straight) line, properties and rules
- The chain rule
- Implicit differentiation, inverse function and parametric functions
- Newton's Method
- Classical theorems: Rolle, Mean value and L'Hôpital
- Taylor polynomials and approximations
- Interpolation and numerical differentiation
- Monotonic function, increasing and decreasing functions, concavity and convexity of functions

Topic 3. Integration

- Riemmann Integral and its basic properties
- Antiderivatives and indefinite integration
- Fundamental theorems of Calculus
- Improper integrals
- Geometric applications
- Numerical integration

Topic 4. System of linear equations

- Groups, rings and fields
- System of linear equations: elementary operations
- Gaussian elimination and rank of a matrix
- Theorems of characterization (Rouché-Frobenius)
- Determinants
- Numerical Gaussian elimination, condition number
- Decompositions: LU, QR and Cholesky
- Iterative methods

Topic 5. Vector spaces with inner products

- Linearly independent sets, dimension and basis
- Subspaces of vector spaces
- Inner product
- Length, angles and orhtogonality
- Orthogonal subspaces and sets
- Orthogonal projection and optimal approximation

Topic 6. Diagonalization

- Eigenvalues and eigenvectors
- Spectral decomposition and polynomials of matrices
- Normal matrices
- Numerical methods for approximating eigenvalues
- Compatible matrices
- Singular value decomposition (SVD)

4.4.Course planning and calendar

This course has 6 ECTS credits, which represents 150 hours of student work in the subject during the semester, in other words, 10 hours per week for 15 weeks of class.

A summary of a weekly timetable guide can be seen in the following table. These figures are obtained from the subject file in the Accreditation Report of the degree, taking into account the level of experimentation considered for the said subject is moderate.

Activity	Weekly school hour
Lectures	6
Other activities	3

Week	Topic	Contents	Test	Weight	Them
1	1	Maxima - functions	First test	5%	Limits - C
2	2	Limits - Continuity			
3	3	The derivative	Second test	5%	The der
4		Taylor			
5		Interpolation			
6	4	Integration	First written exam	40%	Infinitesima
7		Applications			
8		Numerical integration			
9	5	System of linear equations	Third test	5%	Linear s
10		Determinants			
11		Numerical Linear Algebra			
12	6	Vector spaces	Fourth test	5%	Vector s
13		Optimal approximation			
14	7	Diagonalization	Second written exam	40%	Linear A
15		Singular value decomposition			

The dates of the final exams will be those that are officially published at Distribución de Exámenes (https://eupla.unizar.es/asuntos-academicos/examenes). Further information concerning the timetable, classroom, office hours, assessment dates and other details regarding this course will be provided on the first day of class or please refer to the Faculty of EUPLA website and Moodle.

4.5.Bibliography and recommended resources

http://biblos.unizar.es/br/br_citas.php?codigo=28600&year=2019