

30106 - Mathematics II

Syllabus Information

Academic Year: 2019/20

Subject: 30106 - Mathematics II

Faculty / School: 175 - Escuela Universitaria Politécnica de La Almunia
179 - Centro Universitario de la Defensa - Zaragoza

Degree: 425 - Bachelor's Degree in Industrial Organisational Engineering
457 - Bachelor's Degree in Industrial Organisational Engineering
563 - Bachelor's Degree in Industrial Organisational Engineering

ECTS: 6.0

Year: 1

Semester: Second semester

Subject Type: Basic Education

Module: ---

1.General information

1.1.Aims of the course

Mathematical methods are a basic tool in Engineering. The aims of the course are precisely the knowledge of these tools, in a way that is both theoretical and applied to real problems (using mathematical software). This knowledge and techniques will serve as the basis for other subjects.

1.2.Context and importance of this course in the degree

The subject is compulsory and forms part of the basic education of the students.

It is taught in the second semester of the first course and its content is part of the basis for other subjects. The practical approach of the subject helps to achieve this objective.

The unifying character of Mathematics simplifies problems dealt with in other subjects, and makes evident the similarities in apparently different problems.

1.3.Recommendations to take this course

Students should have the knowledge and skills achieved in Mathematics I and II through the final years of high school (preferably, with curriculum in science and technology). It is recommended that students have assimilated the concepts of the module Mathematics I (30100) taught during the first semester.

To follow this course appropriately, continuous study is required. Moreover, students' questions should be answered just as they arise, both in class or during office hours.

2.Learning goals

2.1.Competences

- 1: Ability to solve problems and take decisions with initiative, creativity and critical reasoning.
- 2: Ability to communicate knowledge and skills in Spanish.
- 3: Ability to continue learning and develop self-learning strategies.
- 4: Ability to apply Information and Communication Technologies (ICTs) within the field of engineering.
- 5: Ability to solve mathematical problems in Engineering. Ability to apply knowledge about Linear Algebra, Numerical Methods, Geometry and Differential Geometry.

2.2.Learning goals

At the end of this module, the student should be able to:

- 1: Apply the fundamental results of Linear Algebra, Analytic Geometry and Differential Geometry. Describe basic concepts such as: matrix, solution of a linear system, orthogonality, vector subspace, euclidean elements, curves and surfaces in 3-space.

- 2: Develop problem-solving strategies, distinguishing the most suitable method in each situation.
- 3: Explain the difficulties in attaining the exact solution of a problem and the necessity to apply numerical methods, determining their order of accuracy and error.
- 4: Use mathematical software to solve Linear Algebra problems as well as line and surface integrals.
- 5: Set and solve problems related to the areas above and applied to Industrial Organisational Engineering, selecting the most suitable methods and theoretical results. Moreover, students should be able to use the mathematical software proposed in no. 4 when these real problems are too complex for being solved by analytical methods.
- 6: Solve the problems described in no. 5 working as a team, expanding the information and methods proposed in class. Make oral presentations about the attained results, using an appropriate mathematical language and suitable computer programs.
- 7: Express, both orally and in writing, the basic concepts of the subject and the problem solving process, making use of scientific language.

2.3.Importance of learning goals

Students are provided with basic mathematical and procedural knowledge that will be useful for other modules in the degree such as: Physics, Computer Studies, Mechanics, Statistics, Operative Research, Economy, Electronics, Resistance of Materials... The ability to apply mathematical techniques to solve concrete problems in different fields related to Engineering constitutes a fundamental skill for an engineer/officer, as well as the use of the available sources and the appropriate interpretation of results.

3.Assessment (1st and 2nd call)

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

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There will be two types of assessments:

- *Theory and practice assessment.* Students are evaluated in the mathematical knowledge and the analytic and numeric skills required to solve problems, both theoretical and practical. During the semester, in a coordinated way with the other modules, different assessments will be proposed. They might cover up to 60% of the theoretical and practical content of the subject. The official assessment consists on a written exam.
- *Applied assessment.* Students are evaluated in mathematical reasoning and ability to use symbolic calculus tools in applied problems. During the semester, following the contents of the subject, there will be up to 4 computer practices. Each practice will be marked by means of an individual question paper and/or the files produced by the student during the class. Passing these computer practices during the semester will exempt the student from a final evaluation test on this part of the module.

Both the Theory and Practice and the Applied assessments will be marked from 0 to 10 points. To pass the module, a minimal mark will be required in each kind of assessment. Moreover, the weighted average between the two types of assessments must be equal to or bigger than 5 points. This weighted average will give the final mark of the module and will be calculated according to the following criteria: Theory and Practice assessments will constitute at least 85% of the final mark, whereas Applied assessments will constitute up to 15% of the final mark.

If a student does not succeed in passing one of the two assessments above (Theory and Practice or Applied), he/she will be able to keep the mark of the assessment that he/she passed until the end of the course.

Assessment criteria

In the evaluation of each assessment the following criteria will be followed:

- Understanding of the mathematical concepts needed to solve the problems.
- Usage of efficient strategies and procedures in their resolution.
- Absence of mathematical errors in procedures and solutions.
- Correct usage of terminology and notations.
- Organized and clear exposition of ideas.
- Correct resolution of problems. Correct usage of mathematical strategies and methods.
- Knowledge and correct usage of mathematical software in the tests concerning Applied Assessment.
- Correct interpretation of results.
- Ability to select the most suitable method.
- Clear and detailed explanations, reasoning the answers to the posed questions.
- Results and final quality of the tests concerning Applied Assessments.
- Quality and coordination in the exposition of results.
- Usage of mathematical language.

4.Methodology, learning tasks, syllabus and resources

4.1.Methodological overview

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The learning process designed for this subject is based on the following:

Strong interaction between the teacher/student. 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.

Matemáticas II 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.

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The learning process designed for this subject is based on the following activities:

Classroom learning:

- Activities Type I. Theory and problems lectures. Both the theoretical contents, with illustrative examples, and representative problems will be presented in plenary lectures.
- Activities Type II. Computer-lab lectures. Computer-lab classes will be conducted in computer-lab facilities of the centre. Students will become familiar with symbolic, numerical and graphic calculus using suitable mathematical software.
- Activities Type III. Evaluation tests. During the course, the student will carry out several evaluation tests of the following types:
 - Theoretical and practical tests.
 - Computer-lab tests.

Non-classroom learning:

- Activities Type IV. Autonomous study.
In order to successfully overcome this subject, it is estimated that students shall expend a minimum of 65 hours of autonomous study.

4.2.Learning tasks

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The programme offered to the student to help them achieve their target results is made up of the following activities...

Involves the active participation of the student, in a way that the results achieved in the learning process are developed, not taking away from those already set out, the activities are the following:

- **Face-to-face generic activities:**
 - **Lectures:** The theoretical concepts of the subject are explained and illustrative examples are developed as support to the theory when necessary.
 - **Practice Sessions:** Problems and practical cases are carried out, complementary to the theoretical concepts studied.
 - **Individual Tutorials:** Those carried out giving individual, personalized attention with a teacher from the department. Said tutorials may be in person or online.
- **Generic non-class activities:**
 - 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 summaries and reports.
 - Preparation of the written tests for continuous assessment and final exams.

The subject has 6 ECTS credits, which represents 150 hours of student work in the subject during the semester, in other words, 10 hours (Lectures: 4 h.; Other Activities: 6 h.) per week for 15 weeks of class.

The overall distribution is:

- 52 hours of lectures, with 50% theoretical demonstration and 50% solving type problems.
- 8 hours of written assessment tests.
- 90 hours of personal study, divided up over the 15 weeks of the semester.

There is a tutorial calendar timetable set by the teacher that can be requested by the students who want a tutorial.

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The subject consists of different types of activities:

1. Theory sessions.
2. Problem-solving sessions.
3. Computer-lab classes.
4. Personalized tutoring.
5. Autonomous study.
6. Realization of self-evaluation activities.

4.3.Syllabus

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- 1.- Introduction to Octave.
- 2.- Systems of Linear Equations.
- 3.- Determinants.
- 4.- Numerical linear algebra.
- 5.- Vector Spaces.
- 6.- Orthogonality and Least Squares
- 7.- The Geometry of Vector Spaces.
- 8.- Diagonalization.
- 9.- Singular value decomposition.
- 10.- Multiple integrals: double integrals.
- 11.- Multiple integrals: change of variables; triple integrals.
- 12.- Plane and space curves: curvature and torsion.
- 13.- Line Integrals: the fundamental theorem for line integrals; Green's theorem.
- 14.- Surfaces: normal vector.
- 15.- Surface Integrals: Stokes' theorem, Gauss' theorem.

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The contents of the subject are the following:

- Matrices, linear systems and determinants.
- Vector spaces.
- Euclidean spaces.
- Linear maps.
- Eigenvalues and eigenvectors: Diagonal form.
- Bilinear and quadratic forms.
- Affine space.

4.4.Course planning and calendar

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A detailed schedule will be published on the Moodle page of the subject.

The dates of the final exams will be those that are officially published on the School website.

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The specific dates for the scheduled activities are made public on the Moodle platform, <http://moodle.unizar.es>, in which students are enrolled at the beginning of the course.

Besides, the course schedule can be found on the website of the Centro Universitario de la Defensa: <http://cud.unizar.es>

4.5.Bibliography and recommended resources

Bibliography available in <http://psfunizar7.unizar.es/br13/egAsignaturas.php?codigo=30106>