Course guide
2500201 - FONAMATEMA - Fundamentals of Mathematics

Unit in charge: Barcelona School of Civil Engineering
Teaching unit: 751 - DECA - Department of Civil and Environmental Engineering.
Degree: BACHELOR'S DEGREE IN ENVIRONMENTAL ENGINEERING (Syllabus 2020). (Compulsory subject).
Academic year: 2022 ECTS Credits: 6.0 Languages: Catalan

LECTURER

Coordinating lecturer: FRANCISCO JAVIER MARCOTE ORDAX
Others: FRANCISCO JAVIER MARCOTE ORDAX

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
14445. Recognize the biological bases and foundations of the plant and animal field in engineering: notions of genetics, biochemistry and metabolism, physiology, organisms and environment, population dynamics, flows of matter and energy and changes in ecosystems, biodiversity, principles of the kinetics of microbial growth and reactor theory.
14446. Solve mathematical problems that may arise in engineering by applying knowledge about: linear algebra, geometry, differential geometry, differential and integral calculus, optimization, ordinary differential equations.
14447. Obtain basic knowledge about the use and programming of computers, operating systems, databases and basic numerical calculation and applied to engineering.
14448. Manage the basic concepts about the general laws of mechanics and thermodynamics, concept of field and heat transfer, and apply them to solve engineering problems.
14449. Apply the basic principles of general chemistry, organic and inorganic chemistry and their applications in engineering.
14450. Describe the global functioning of the planet: atmosphere, hydrosphere, lithosphere, biosphere, anthroposphere, biogeochemical cycles (C, N, P, S), soil morphology and apply it to problems related to geology, geotechnics, edaphology and climatology.

General:
14440. Identify, formulate and solve problems related to environmental engineering.
14441. Apply the functions of consulting, analysis, design, calculation, project, construction, maintenance, conservation and exploitation of any action in the territory in the field of environmental engineering.

TEACHING METHODOLOGY

Theoretical, problem-solving and practical classes will be given. The subject is face-to-face and the class work will be evaluated, in addition to the exams proposed for the course. Class participation will be valued very positively. Class attendance will not be enough to pass the course, which means that the student must spend an average of 4 hours a week studying outside the classroom. Support material is used in the format of a detailed teaching plan through the ATENEA virtual campus: contents, programming of assessment and guided learning activities and bibliography.

Although most of the sessions will be given in the language indicated, sessions supported by other occasional guest experts may be held in other languages.
LEARNING OBJECTIVES OF THE SUBJECT

Mathematical concepts are discussed to understand relationships between different environmental variables. Emphasis is placed on a block of basic mathematical tools: matrix operations, solving linear systems of equations, derivation and integration of one-variable functions, plane and space geometry.

1. Manage trigonometric functions including their derivation and integration. Ability to analyze sequences and series in the context of engineering.
2. Solve maximum and minimum problems using differential calculus related to simple engineering problems.
3. Solve integrals of one variable, looking for a relationship with simple engineering problems.


At the end of the course, the student will have had to: a) achieve knowledge and computational fluency on matrices and systems of linear equations, basic linear transformations in plane and space, differential and integral calculus of real functions of real variable; b) to acquire basic knowledge about the use of Matlab, having had to practice with problems posed in some of the subjects that configure the syllabus of the subject; c) get started in the numerical resolution of some problems.

STUDY LOAD

<table>
<thead>
<tr>
<th>Type</th>
<th>Hours</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hours medium group</td>
<td>15,0</td>
<td>10.00</td>
</tr>
<tr>
<td>Self study</td>
<td>84,0</td>
<td>56.00</td>
</tr>
<tr>
<td>Hours small group</td>
<td>15,0</td>
<td>10.00</td>
</tr>
<tr>
<td>Hours large group</td>
<td>30,0</td>
<td>20.00</td>
</tr>
<tr>
<td>Guided activities</td>
<td>6,0</td>
<td>4.00</td>
</tr>
</tbody>
</table>

Total learning time: 150 h

CONTENTS

Topic 1: Matrices (I): Systems of linear equations

Description:
Solve in class some problems from a list provided to students.
Problem solving in class by students, under the supervision of the teacher.

Specific objectives:
Learn to use matrices to solve certain types of problems. In particular, how to solve systems of linear equations. Show examples of poorly conditioned systems of equations
Learn to manipulate matrices fluently, and to solve problems for which they are especially useful.
Assist students individually in any difficulties they may encounter in trying to solve a problem.

Full-or-part-time: 24h
Theory classes: 5h
Practical classes: 3h
Laboratory classes: 2h
Self study: 14h
Topic 2: Introduction to Matlab

Description:
Introduction to Matlab. Basic instructions. Solving systems of linear equations: large systems that come from real cases; poorly conditioned systems

Specific objectives:
Get started in using Matlab. Practice matrix manipulation and solving systems of linear equations

Full-or-part-time: 4h 48m
Laboratory classes: 2h
Self study : 2h 48m

Topic 3: Matrices (II): Product of matrices

Description:

Problem solving in class by students, under the supervision of the teacher
Problem-solving in class of Topic 3, from a list provided to students

Specific objectives:
Learn the relationship between matrix product and elementary operations. Know how to calculate the inverse of an array. Know how to find the matrix associated with a linear application; particular case; rotations and symmetries in plane and space. Assist students individually in any difficulties they may encounter in trying to solve a problem. Learn to manipulate matrices fluently, and to solve problems for which they are especially useful

Full-or-part-time: 24h
Theory classes: 5h
Practical classes: 3h
Laboratory classes: 2h
Self study : 14h

Topic 4: Real functions of real variable: differential calculus

Description:

Problem solving in class of Topic 4, from a list provided to students

Class resolution of a problem by students, under the supervision of the teacher

Specific objectives:
Remember the basic concepts of the differential calculus of a variable. Function treatment with Matlab. Know how to identify when a function is or is not differentiable at a point. Solve endpoint and optimization problems. Assist students individually in any difficulties they may encounter in trying to solve a problem

Full-or-part-time: 24h
Theory classes: 5h
Practical classes: 3h
Laboratory classes: 2h
Self study : 14h
**Topic 5: Real functions of real variable: integral calculus**

**Description:**
The integral defined as the area under a curve. Primitives and Barrow's rule. Variable change. Calculation of areas and volumes of revolution. Numerical calculation of integrals (trapezoids, Simpson). Treatment with Matlab.

Problem solving in class of Topic 5, from a list provided to students
Problem solving in class by students, under the supervision of the teacher

**Specific objectives:**
Learn to interpret the integral defined as an area under a curve, and the relationship between integrals and primitives. See how the value of an integral can be approximated numerically. Calculate integrals with Matlab. See applications of the integral to the calculation of areas, volumes of revolution, etc.

Learn the utilities of integral calculus. Know how to calculate definite integrals both analytically and numerically.

Assist students individually in any difficulties they may encounter in trying to solve a problem

**Full-or-part-time:** 28h 47m
Theory classes: 5h
Practical classes: 4h
Laboratory classes: 3h
Self study : 16h 47m

---

**Topic 6: Introduction to Geometry in the plane and space**

**Description:**
Concept of related space. Linear varieties: points, lines and planes. Equations of straight lines and planes. Relative positions. Perpendicularity. Distance between two linear varieties Parameterization of curves.

Problem solving in class of Topic 6, from a list provided to students
Problem solving in class by students, under the supervision of the teacher

**Specific objectives:**
Remember the concepts related to geometry in plane and space. Acquire knowledge about parameterization of curves

Solve problems of incidence, relative position and perpendicularity of linear varieties. Know how to perform the parameterization of some curves

Assist students individually in any difficulties they may encounter in trying to solve a problem

**Full-or-part-time:** 24h
Theory classes: 4h
Practical classes: 3h
Laboratory classes: 3h
Self study : 14h

---

**Evaluations**

**Full-or-part-time:** 14h 23m
Laboratory classes: 6h
Self study : 8h 23m
GRADING SYSTEM

The note of the subject will consist of:

- Work in class (note: NA).
- Two exams (E1 and E2, marks: NE1 and NE2).

1. Class work (NA) will contain, among others, problem solving in class and/or taking tests. Voluntary class participation will be valued positively.

2. The contents of the E1 and E2 exams will be in accordance with all the subject taught from the beginning of the course.

The Final Grade of the subject will be:

Final Grade = 0.35 * NA + 0.65 * NE,

where the grade of the exams (NE) will be calculated as:

NE = max (0.5 * NE1 + 0.5 * NE2, 0.3 * NE1 + 0.7 * NE2) -

- CRITERIA OF ADMISSION AND QUALIFICATION TO RE-EVALUATION: The students suspended in the ordinary evaluation that have presented regularly in the proofs of evaluation of the asignatura suspended will have option to realize a proof of re-evaluation in the period fixed in the academic calendar. Students who have already passed it or the students qualified as not presented will not be able to take the re-assessment test for a subject. The maximum grade in the case of reassessment will be five (5.0). The non-attendance of a student summoned to the re-evaluation test, held in the fixed period, will not be able to give rise to the realization of another test with later date. Extraordinary assessments will be conducted for those students who, due to accredited force majeure, have not been able to take some of the continuous assessment tests. These tests must be authorized by the corresponding head of studies, at the request of the teacher responsible for the subject, and will be carried out within the corresponding teaching period.

EXAMINATION RULES.

Each assessment activity not performed in the scheduled period will be assigned a score of zero.

Unless expressly authorized by the responsible teacher, a calculator, mobile phone, notes, book, or any other device (electronic or otherwise) that allows storage, reception may not be carried out for the face-to-face assessment tests, send or consult information about the subject and / or manipulate mathematical expressions.

BIBLIOGRAPHY

Basic:

Complementary: