Course guide
2500210 - GEAMATEMA2 - Mathematics II

Last modified: 18/06/2024

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).
BACHELOR'S DEGREE IN ENVIRONMENTAL ENGINEERING / BACHELOR'S DEGREE IN MINERAL RESOURCE ENGINEERING AND MINERAL RECYCLING (Syllabus 2024). (Compulsory subject).

Academic year: 2024 **ECTS Credits:** 6.0 **Languages:** Catalan

LECTURER

Coordinating lecturer: ANTONIO RODRIGUEZ FERRAN

Others: IRENE ARIAS VICENTE, ANTONIO RODRIGUEZ FERRAN

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
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.

Generical:
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.
14444. Apply business management techniques and labor legislation.

TEACHING METHODOLOGY

Theoretical classes will be given, solving problems and practices.
Some practical classes may be taught in Spanish. The subject is face-to-face and the work in class will be evaluated, in addition to the exams proposed for the course. The participation in class will be very positive. Class attendance will not be enough to pass the subject, which means that the student must spend about 4 hours a week on a regular basis outside the classroom. Support material is used in the format of a detailed teaching plan through the ATENEA virtual campus: contents, programming of assessment activities and directed learning 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

To present mathematical tools for integration of functions (analytical and numerical; in one and several dimensions) and solution of ordinary differential equations (ODEs) with analytical and numerical techniques. For the practical application of these concepts to problems in environmental engineering, computer and programming tools will be provided (Matlab).

Mathematics II. Knowledge about integration and ordinary differential equations and capability for their application to scientific-technological subjects and environmental engineering in general.

STUDY LOAD

Type	Hours	Percentage
Hours medium group	30,0	20.00
Self study	90,0	60.00
Hours large group	30,0	20.00

Total learning time: 150 h

CONTENTS

Matlab review

Description:
- Definition and graphical representation of functions
- For loops

Related competencies :
CE3. Obtain basic knowledge about the use and programming of computers, operating systems, databases and basic numerical calculation and applied to engineering.

Full-or-part-time: 11h
Practical classes: 4h
Self study : 7h

Numerical integration

Description:
- Review of analytical integration: primitive functions and Barrow's rule
- Trapezoidal rule
- Composite trapezoidal rule
- Simpson's rule
- Composite Simpson's rule
- Application example: computation of average concentrations

Related competencies :
CE3. Obtain basic knowledge about the use and programming of computers, operating systems, databases and basic numerical calculation and applied to engineering.
CE2. 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.
CG1. Identify, formulate and solve problems related to environmental engineering.

Full-or-part-time: 23h
Theory classes: 5h
Practical classes: 4h
Self study : 14h

Multiple integration

Description:
- Cavalieri's principle
- Revolution volumes
- Double integral over rectangular domains
- Double integral over non-rectangular domains
- Numerical double integral: composite trapezoidal rule
- Numerical double integral: composite Simpson's rule
- Application example: computation of the volume and the surface of a lake

Related competencies :
CE3. Obtain basic knowledge about the use and programming of computers, operating systems, databases and basic numerical calculation and applied to engineering.
CE2. 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.
CG1. Identify, formulate and solve problems related to environmental engineering.

Full-or-part-time: 23h
Theory classes: 5h
Practical classes: 4h
Self study : 14h

Higher-order ODEs and systems of ODEs

Description:
- Linear second-order ODEs
- Reduction of a second-order ODE to a system of two first-order ODEs
- Systems of ODEs

Related competencies :
CE3. Obtain basic knowledge about the use and programming of computers, operating systems, databases and basic numerical calculation and applied to engineering.
CE2. 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.
CG1. Identify, formulate and solve problems related to environmental engineering.

Full-or-part-time: 23h
Theory classes: 5h
Practical classes: 4h
Self study : 14h

Numerical solution of ODEs

Description:
- Euler's method for scalar problems
- Euler's method for vectorial problems
- Command ode45 in Matlab for scalar and vectorial problems

Related competencies :
CE5. Apply the basic principles of general chemistry, organic and inorganic chemistry and their applications in engineering.
CE4. 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.
CE3. Obtain basic knowledge about the use and programming of computers, operating systems, databases and basic numerical calculation and applied to engineering.
CE2. 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.
CG1. Identify, formulate and solve problems related to environmental engineering.
CG2. 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.

Full-or-part-time: 18h
Theory classes: 4h
Practical classes: 4h
Self study : 10h

Compartment models

Description:
- Mathematical modelling: mass balance
- Analytical solutions for one-compartment models
- Numerical solutions for several-compartment models
- Application examples: reactors in series

Related competencies :
CE3. Obtain basic knowledge about the use and programming of computers, operating systems, databases and basic numerical calculation and applied to engineering.
CE2. 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.
CG1. Identify, formulate and solve problems related to environmental engineering.

Full-or-part-time: 28h
Theory classes: 6h
Practical classes: 6h
Self study : 16h

Exams

Description:
- Consultation classes before exams
- Exams
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Related competencies :
CE3. Obtain basic knowledge about the use and programming of computers, operating systems, databases and basic numerical calculation and applied to engineering.
CE2. 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.
CG1. Identify, formulate and solve problems related to environmental engineering.

Full-or-part-time: 24h
Theory classes: 5h
Practical classes: 4h
Self study : 15h

GRADING SYSTEM

The grade for the course will consist of:

- Activities (NA).

- Two exams (NE1 and NE2).

1. Activities (NA) will include, among others, the resolution of problems and the performance of directed work.

2. The contents of the NE1 and NE2 exams will be in accordance with all the subject taught from the beginning of the course.

- The NE1 exam will be taken approximately halfway through the semester and the subjects taught so far will enter.

- The NE2 exam will be a final exam, where the complete subject taught throughout the course will enter.

The note of the exams will be calculated as:

NE = max (0.3 * NE1 + 0.7 * NE2, NE2)
The final grade for the course will be:

Final Note = 0.25 * NA + 0.75 * NE

EXAMINATION RULES.

Students who fail the ordinary assessment who have regularly taken the assessment tests of the failed subject will have the option of taking a re-assessment test in the period set in the academic calendar. Students who have already passed it or students who have 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 complete 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. Once each exam has been taken, there is the possibility that a student may be called to do an oral interview as a validation of their written exam, this interview being on the subject of the exam. In case of not obtaining a satisfactory assessment in the interview, the exam will be given as failed with a grade of zero.

BIBLIOGRAPHY

Basic:
- Burden R.L.; Faires, J.D. Análisis numérico. 10a ed. Mexico DF: Cengage Learning, 2017. ISBN 9786075264042.
- Zill, D.G. Ecuaciones diferenciales con aplicaciones de modelado. 10a ed. México: Cengage Learning Editores, 2018. ISBN 9786075266312.