

Course guide

310607 - 310607 - Mathematical Methods

Last modified: 24/01/2024

Unit in charge: Barcelona School of Building Construction
Teaching unit: 749 - MAT - Department of Mathematics.

Degree: BACHELOR'S DEGREE IN GEOINFORMATION AND GEOMATICS ENGINEERING (Syllabus 2016).
(Compulsory subject).

Academic year: 2023 **ECTS Credits:** 6.0 **Languages:** Catalan, Spanish, English

LECTURER

Coordinating lecturer: Joan J. Rodríguez Jordana

Others: Guillem Grabolosa, Antoni

PRIOR SKILLS

Understand the fundamentals of calculus in one variable. Domain, continuity and differentiability of functions of one variable concepts.
Plot a function of one variable. Elementary functions.

To know the graph of elementary functions.

Knowing the analysis of several variables functions: directional derivatives, differential application.

Applying the concept of linearization of a function.

Understanding the integration of functions and applications.

To study and solve, if any, systems of linear equations including overdetermined, both analytically and numerically.

To analyze and interpret the eigenvalues and eigenvectors of a square matrix

REQUIREMENTS

To have passed Calculus and Algebra of previous term (recommendation).

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:

4. Capacity of spatial vision and knowledge of the graphic representation techniques, for traditional methods of metric and geometric geometry but also for applications of assisted design by a computer.

5. Capacity for the resolution of mathematic problems that can be set out in engineering. Aptitude to apply the knowledge about: linear algebra, geometry, differential geometry, differential and integral calculus, differential equations and in partial derivatives, numeric methods, numeric algorithm, statistics and optimization.

6. (ENG) Gestió i execució de projectes d'investigació, de desenvolupament i d'innovació dins l'àmbit d'aquesta enginyeria.

Transversal:

1. SELF-DIRECTED LEARNING - Level 1. Completing set tasks within established deadlines. Working with recommended information sources according to the guidelines set by lecturers.

2. EFFICIENT ORAL AND WRITTEN COMMUNICATION - Level 1. Planning oral communication, answering questions properly and writing straightforward texts that are spelt correctly and are grammatically coherent.

3. THIRD LANGUAGE. Learning a third language, preferably English, to a degree of oral and written fluency that fits in with the future needs of the graduates of each course.

TEACHING METHODOLOGY

Face-to-face sessions in large groups where the teacher presents each topic, with examples and exercises. They are basically blackboard classes with the support of projected material from a computer such as presentations or files of symbolic calculation programs.

Autonomous work sessions by each student to deepen and study what has been exposed in class with the help of textbooks and to do the proposed exercises.

Face-to-face sessions in a small group where teachers resolve doubts and do practical work using the available software.

The problem classes will consist of different ways of working:

- Resolution on the blackboard by the teachers of previously proposed problems
- Problem solving and exercises in small groups and subsequent oral presentation.

The practical sessions will consist of solving problems that require the use of symbolic calculation packages. Each practice is organized from a previously prepared file with the instructions, functions and necessary material from which the proposed problem has to be solved.

LEARNING OBJECTIVES OF THE SUBJECT

The main goal of the subject is provide the language and the math knowledge that will be used in different subjects of the degree, for the ones that have a more technic charater and also the more basic ones. In addition there is an instrumental goal, that consists in learning the calculus techniques that are common in the geoinformation and geomatic environment. This aspect is also showed in the practical classes, using predifined files in order to be used in the computer.

STUDY LOAD

| Type | Hours | Percentage |
|--------------------|-------|------------|
| Self study | 90,0 | 60.00 |
| Hours large group | 24,0 | 16.00 |
| Hours medium group | 36,0 | 24.00 |

Total learning time: 150 h

CONTENTS

C1 Differential geometry of curves and surfaces

Description:

Differentiable curves. Parametrized curves.
Arc length. Curvature and torsion. Frénet formulas.

Differentiable surfaces: explicit, implicit and parameterized definition.
Regular surfaces. Tangent plane and normal line.
First fundamental quadratic form.
Application to the computation to the arc length of a curve, area and angle between curves on a surface.

Specific objectives:

How to parametrize a regular curve both in the plane and in the tridimensional space.
Recognize when a curve is parameterized by arc parameter.
Identifying the curvature parameters with the properties of a curve.
Know how to define and parametrize a clotoid

Knowing the different ways of representing a differentiable surface.
Learn simple parameterized surfaces.
Being able to compute the tangent plane and the normal vector to a differentiable surface.

Understand the information given by the first fundamental quadratic form.
Being able to use it to calculate the length of a curve on a surface and the angle between two curves.

Related activities:

L1, P1

Full-or-part-time: 48h

Theory classes: 9h
Practical classes: 6h
Laboratory classes: 3h
Self study : 30h

C2 Differential equations

Description:

Concept of differential equation and solution.
Basic methods of solving first-order ordinary differential equations

Specific objectives:

Knowing the concept of differential equation and general solution and particular solution.
Knowing how to solve linear and exact differential equations.
Knowing how to use the appropriate symbolic calculus software to solve differential equations and represent the solutions.

Related activities:

L2, P1

Full-or-part-time: 29h

Theory classes: 5h
Practical classes: 6h
Laboratory classes: 3h
Self study : 15h

C3 Complex variable

Description:

The complex numbers. The body of complex numbers. Polar and trigonometric form of a complex number. Moivre's formulas.

Complex variable functions. Differentiation. Cauchy-Riemann equations. Holomorphic functions. Conformal transformations. Harmonic functions. Laplace's equation

Specific objectives:

Operate with complex numbers.

Interpret geometrically the concept of derivation in the complex field.

Get the Cauchy-Riemann equations.

Knowing the properties of the elementary complex variable functions.

Understand the concept of conform map.

Interpret the complex variable functions as transformations of the plane.

Related activities:

L3,P2

Full-or-part-time: 53h

Theory classes: 8h

Practical classes: 3h

Laboratory classes: 7h

Self study : 35h

C4 Statistics

Description:

Descriptive statistics

-Central tendency and dispersion measures

-Graphs

Probability and random variables.

-Probability, density and distribution functions.

-Expectation and variance of a random variable.

Discrete random variables. Binomial and Poisson.

Specific objectives:

Solve problems related to probability and statistics.

Use the right tools for modeling and solving related problems.

Manipulate data, apply appropriate methods and discuss the conclusions of the results.

Using a suitable software for the treatment of statistical data.

Related activities:

L4, P2

Full-or-part-time: 29h

Theory classes: 5h

Practical classes: 6h

Laboratory classes: 3h

Self study : 15h

ACTIVITIES

L1, L2 DIFERENTIAL GEOMETRY AND DIFFERENTIAL EQUATIONS LABS

Description:

L1: Curves and surfaces

L2: Differential equations

Practices to do individually with computer

The language of these activities is English

Specific objectives:

Parameterize curves and its representation.

Identify properties of planar curves.

Knowing how to calculate the tangent, binormal and normal vectors in a regular point of a curve.

Knowing how to calculate the tangent plane and the normal line of a regular parametrized surface.

Use the first fundamental quadratic form for calculating length curves.

Knowing how to solve differential equations

Material:

Available software.

Guide of the practice and other materials in ATENEA

Delivery:

The practice will be uploaded usin ATENEA

It is a part of the total grade.

Full-or-part-time: 2h

Laboratory classes: 2h

L3, L4: COMPLEX VARIABLE AND STATISTICS LABS

Description:

Use of complex variable in symbolic calculation programs

Statistical study of practical cases.

Continuous random variables.

The language of this activity is English.

Specific objectives:

Solve practical cases in which are involved the concepts of the unit.

Material:

Available software.

Guide of the practice and other materials in ATENEA

Full-or-part-time: 2h

Laboratory classes: 2h



P1: MIDTERM EXAM

Description:

Midterm exam

Specific objectives:

Solve problems related with curves and surfaces. Solving differential equations exercises.
Write the result clearly and reasoned.

Material:

List of questions and problems distributed at the beginning of the session.

Delivery:

Delivery of the writing to the end of the activity.
it is a part of the evaluation.

Full-or-part-time: 2h

Laboratory classes: 2h

P2: LAST TERM EXAM

Description:

Test at the end of the term.

Specific objectives:

To evaluate the achievement of the skills on complex variable and statistics.

Material:

List of questions and problems to be solved

Delivery:

Delivery of the written solution to the end.
It is a part of the evaluation.

Full-or-part-time: 2h

Laboratory classes: 2h

COMPETENCE

Description:

The L1 and L2 tests are in English. During the L1 and L2 tests, the language of communication will be English.

Specific objectives:

Test competence 04 COE N1

Full-or-part-time: 1h

Theory classes: 1h



RP1: REEVALUATION EXAM

Description:

Optional written exam to increase the mark obtained in P1 and/or P2.

Specific objectives:

Option to increase the first and/or the second midterm exam

Material:

List of problems and questions to be solved.

Delivery:

Reasoned answers to the statement distributed at the beginning of the test.

Full-or-part-time: 2h 30m

Theory classes: 2h 30m

WP: WEEKLY PROJECT

Description:

Exercises will be proposed periodically to be solved and delivered to the class

Specific objectives:

Improve the commitment with the subject

Material:

Written statements

Full-or-part-time: 2h 30m

Theory classes: 2h 30m

GRADING SYSTEM

It consists of evaluating the midterm exams (P1, P2) and the everyday work (TQ).

The week of realization and the value of each test/practice is:

- Midterm exams

P1: Half semester. Value of the exam 35%

P2: End of semester. Value of the exam 40%.

- TQ: 25%

TQ values the attendance and active participation in class and essentially, the exercises proposed in class periodically.

The retake exam will consist in an only exam of problems and questions about the content of the whole subject. The marks of TQ are maintained.

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Basic:

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