Course guide
3200012 - M2 - Mathematical Methods II

Last modified: 10/07/2023

Unit in charge:	Terrassa School of Industrial, Aerospace and Audiovisual Engineering
Teaching unit:	749 - MAT - Department of Mathematics.

Degree:	BACHELOR'S DEGREE IN CHEMICAL ENGINEERING (Syllabus 2009). (Compulsory subject). BACHELOR'S DEGREE IN ELECTRICAL ENGINEERING (Syllabus 2009). (Compulsory subject). BACHELOR'S DEGREE IN INDUSTRIAL ELECTRONICS AND AUTOMATIC CONTROL ENGINEERING (Syllabus 2009). (Compulsory subject). BACHELOR'S DEGREE IN MECHANICAL ENGINEERING (Syllabus 2009). (Compulsory subject). BACHELOR'S DEGREE IN TEXTILE TECHNOLOGY AND DESIGN ENGINEERING (Syllabus 2009). (Compulsory subject). BACHELOR'S DEGREE IN INDUSTRIAL DESIGN AND PRODUCT DEVELOPMENT ENGINEERING (Syllabus 2010). (Compulsory subject).

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

LECTURER

Coordinating lecturer:	ENRIQUE PEDRO JAIME MONSÓ BURGUÉS

Others:	JORDI SALUDES RODRIGO RAMÍREZ DAVID DÍAZ XAVI PUERTA

PRIOR SKILLS

It is considered highly desirable to have studied the subjects of mathematics provided the curricula of different types of previous education giving access to degree studies.

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
CENG1-DIDP. Ability to solve mathematical problems that may arise in engineering. Aptitude to apply knowledge of: linear algebra; geometry; differential geometry; differential and integral calculus; numerical methods; statistical techniques. (Basic training module).
CE01-INDUS. Ability to solve mathematical problems that may arise in engineering. Aptitude to apply knowledge of linear algebra; geometry; differential geometry; differential and integral calculus; differential and partial differential equations; numerical methods; numerical algorithms; statistics and optimization. (Basic training module)

TEACHING METHODOLOGY

- Lectures presenting content.
- Face-to-face sessions of practical work.
- Independent work study and conducting exercises.
- Preparation and implementation of individual and / or group activities.

In the sessions of explanatory content teacher introduce the theoretical foundations of the subject, concepts, methods and illustrated with suitable examples to facilitate understanding results. The students will independently study to assimilate the concepts, solve exercises either manually or with the help of computer.

Students will become familiar in the use of a mathematical software package in order to use it as a tool for numerical, symbolic and graphic calculation.

LEARNING OBJECTIVES OF THE SUBJECT

Students will have to consolidate the fundamental concepts of differential and integral calculus in several variables, in their analytical and numerical aspects. While it will have to acquire some knowledge of the usual techniques of manipulation and calculation, using support tools will be enhanced: he's familiar with the use of a mathematical software package in order to use it as a calculation tool numeric, symbolic and graphic.
It is also intended that students come into contact with the techniques of numerical solution of problems, in this case, in the context of the problems of the calculus.

STUDY LOAD

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

Total learning time: 150 h

CONTENTS

TOPIC 1: INTRODUCTION TO NUMERICAL ANALYSIS

Description:
1.1. Introduction to numerical methods.
1.2. Numerical solution of non-linear equations. Bisection and the Newton-Raphson method.
1.3. Polynomial interpolation.
1.4. Numerical integration.

Specific objectives:
- Understand the concepts of numerical method, absolute error and relative error.
- Understand bisection techniques and the Newton-Raphson method for solving equations numerically.
- Understand the Lagrange interpolation method and Runge's phenomenon.
- Understand the basic techniques of numerical integration: methods of rectangles, trapezoids and parabolas (Simpson).

Full-or-part-time: 40h
Theory classes: 8h
Practical classes: 8h
Self study : 24h

TOPIC 2: MULTIVARIABLE DIFFERENTIAL CALCULUS

Description:
2.1. Domains. Continuity and contour lines.
2.2. Partial and directional derivatives; gradients.
2.3. Differenciability. Chain rule.
2.4. Linear approximation. Taylor's polinom.
2.5. Optimisation.

Specific objectives:
For students to:
- Understand the concepts of continuous and differentiable multivariable functions.
- Correctly interpret the meaning of partial derivatives, directional derivatives and gradient vectors.
- Properly use the concept of linear approximation.
- Correctly use basic operations and the technique of optimisation.

Full-or-part-time: 40h
Theory classes: 8h
Practical classes: 8h
Self study : 24h

TOPIC 3: MULTIPLE INTEGRATION

Description:
3.1. Concept. Description of domains.
3.2. Fubini's theorem.
3.3. Change of variables.
3.4. Applications.

Specific objectives:
For students to:
- Understand the concept of multiple integrals and Fubini's theorem.
- Properly define domains of integration.
- Become familiar with some applications of multiple integration.

Full-or-part-time: 40h
Theory classes: 8h
Practical classes: 8h
Self study : 24h

TOPIC 4: VECTOR CALCULUS

Description:
4.1. Vector fields. Field lines.
4.2. Line integrals. Conservative fields.
4.3. Curl and divergence. Classical theorems.

Specific objectives:
For students to:
- Understand the concept of vector fields and field lines.
- Understand the concept of line integrals and how to calculate them.
- Understand the concept of conservative fields.
- Understand the concept and meaning of curl and divergence.
- Understand classical theorems of vector calculus: the Green's theorem, the divergence theorem and Stokes' theorem.

Full-or-part-time: 30h
Theory classes: 6h
Practical classes: 6h
Self study : 18h

ACTIVITIES

ACTIVITY 1: COMPUTER-ASSISTED WORK

Description:
The main objective is to be able to solve problems of numerical calculation (item 1) using Maple V.

Material:
Notes about Maple V related to item 1 will be provide at the beginning of the course.

Full-or-part-time: 10h
Self study: 10h

ACTIVITY 2: COMPUTER-ASSISTED WORK

Full-or-part-time: 10h
Self study: 10h

ACTIVITY 3: EXAMS

Full-or-part-time: 8h
Theory classes: 8h

GRADING SYSTEM

The evaluation of the course will be partial evaluations by the following weights:
- Midterm exams: 70% (First exam: 25%, Segond exam: 45%)
- Laboratory: 20%
- Tasks: 10%

EXAMINATION RULES.

Assessments consist of acts of classroom and other activities that are part of the continuous assessment. If the student does not realize any of these activities, the qualification shall be considered as zero.

BIBLIOGRAPHY

Basic:
- Larson, R. E.; Hostetler, R. P.; Edwards, B. H. Cálculo [on line]. 9ª ed. México: McGraw-Hill, 2010 [Consultation: 04/11/2021]. Available on: https://www-ingebook-com.recursos.biblioteca.upc.edu/ib/NPcd/IB_BooksVis?cod_primaria=1000187&codigo_libro=5686.
- Chapra, S. C.; Canale, R. P. Métodos numéricos para ingenieros [on line]. 7ª ed. México: McGraw-Hill, 2015 [Consultation: 08/03/2023]. Available on: https://www-ingebook-com.recursos.biblioteca.upc.edu/ib/NPcd/IB_BooksVis?cod_primaria=1000187&codigo_libro=8100. ISBN 9781456267346.
- Álvarez Quetglas, M.J. [et al.]. Matemàtiques per a l'òptica i l'optometria [on line]. Barcelona: Edicions UPC, 2008 [Consultation: 11/01/2016]. Available on: http://hdl.handle.net/2099.3/36847. ISBN 9788483019603.

Complementary:
- Bonet Reves, C. Càlcul numèric [on line]. Barcelona: Edicions UPC, 1994 [Consultation: 05/04/2022]. Available on: http://hdl.handle.net/2099.3/36356. ISBN 8476533764.
- Salas, S.; Hille, E.; Etgen, G. J. Calculus: una y varias variables [on line]. 4ª ed. Barcelona: Reverté, 2002 [Consultation: 09/05/2022]. Available on: https://ebookcentral-proquest-com.recursos.biblioteca.upc.edu/lib/upcatalunya-ebooks/detail.action?pq-origsite=primo&docID=5635414. ISBN 8429151575.

RESOURCES

Other resources:
- Lists of exercices
- Maple script