

## 3200012 - M2 - Mathematical Methods II

Coordinating unit:	205 - ESEIAAT - Terrassa School of Industrial, Aerospace and Audiovisual Engineering
Teaching unit:	749 - MAT - Department of Mathematics
Academic year:	2019
Degree:	BACHELOR'S DEGREE IN INDUSTRIAL DESIGN AND PRODUCT DEVELOPMENT ENGINEERING (Syllabus 2010). (Teaching unit Compulsory) BACHELOR'S DEGREE IN INDUSTRIAL ELECTRONICS AND AUTOMATIC CONTROL ENGINEERING (Syllabus 2009). (Teaching unit Compulsory) BACHELOR'S DEGREE IN ELECTRICAL ENGINEERING (Syllabus 2009). (Teaching unit Compulsory) BACHELOR'S DEGREE IN TEXTILE TECHNOLOGY AND DESIGN ENGINEERING (Syllabus 2009). (Teaching unit Compulsory) BACHELOR'S DEGREE IN CHEMICAL ENGINEERING (Syllabus 2009). (Teaching unit Compulsory) BACHELOR'S DEGREE IN MECHANICAL ENGINEERING (Syllabus 2009). (Teaching unit Compulsory)
ECTS credits:	6
Teaching languages:	Catalan, Spanish

### Teaching staff

Coordinator:	GISELA PUJOL VAZQUEZ
Others:	SANTIAGO FORCADA PLAZA - JOSEP GIBERGANS BAGUENA - VICTOR MAÑOSA FERNANDEZ - ENRIC MONSO BURGUES - TERESA NAVARRO GONZALO - MIQUEL RALLO CAPDEVILA - ASSUMPTA SABATER PRUNA - Xavier Molinero - Xavier Puerta - David Díaz

### Opening hours

Timetable:	To announce at the beginning of the course.
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### 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:

3. (ENG) Capacitat per a la resolució dels problemes matemàtics que puguin platenjar-se a l'enginyeria. Aptitud per aplicar els coneixements sobre: àlgebra lineal; geometria, geometria diferencial; càlcul diferencial i integral; equacions diferencials i amb derivades parcials; mètodes numèrics; algorítmica numèrica; estadística i optimització.
- G01. (ENG) DIS: Capacitat per a la resolució dels problemes matemàtics que puguin plantejar en l'enginyeria. Aptitud per aplicar els coneixements sobre :àlgebra lineal, geometria, geometria diferencial, càlcul diferencial i integral , mètodes numèrics, tècniques d'estadística.

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### 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

Total learning time: 150h	Hours large group:	30h	20.00%
	Hours medium group:	30h	20.00%
	Hours small group:	0h	0.00%
	Guided activities:	0h	0.00%
	Self study:	90h	60.00%

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### Content

#### TOPIC 1: INTRODUCTION TO NUMERICAL ANALYSIS

Learning time: 40h

Theory classes: 8h  
Practical classes: 8h  
Self study : 24h

##### 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).

#### TOPIC 2: MULTIVARIABLE DIFFERENTIAL CALCULUS

Learning time: 40h

Theory classes: 8h  
Practical classes: 8h  
Self study : 24h

##### Description:

- 2.1. Domains. Continuity and contour lines.
- 2.2. Partial and directional derivatives; gradients.
- 2.3. Differentiability. 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.

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<p>TOPIC 3: MULTIPLE INTEGRATION</p>	<p>Learning time: 40h Theory classes: 8h Practical classes: 8h Self study : 24h</p>
<p>Description: 3.1. Concept. Description of domains. 3.2. Fubini's theorem. 3.3. Change of variables. 3.4. Applications.</p> <p>Specific objectives: For students to:</p> <ul style="list-style-type: none"> <li>- Understand the concept of multiple integrals and Fubini's theorem.</li> <li>- Properly define domains of integration.</li> <li>- Become familiar with some applications of multiple integration.</li> </ul>	
<p>TOPIC 4: VECTOR CALCULUS</p>	<p>Learning time: 30h Theory classes: 6h Practical classes: 6h Self study : 18h</p>
<p>Description: 4.1. Vector fields. Field lines. 4.2. Line integrals. Conservative fields. 4.3. Curl and divergence. Classical theorems.</p> <p>Specific objectives: For students to:</p> <ul style="list-style-type: none"> <li>- Understand the concept of vector fields and field lines.</li> <li>- Understand the concept of line integrals and how to calculate them.</li> <li>- Understand the concept of conservative fields.</li> <li>- Understand the concept and meaning of curl and divergence.</li> <li>- Understand classical theorems of vector calculus: the Green's theorem, the divergence theorem and Stokes' theorem.</li> </ul>	

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### Planning of activities

ACTIVITY 1: COMPUTER-ASSISTED WORK	Hours: 10h Self study: 10h
<p>Description: The main objective is to be able to solve problems of numerical calculation (item 1) using Maple V.</p> <p>Support materials: Notes about Maple V related to item 1 will be provide at the beginning of the course.</p>	
ACTIVITY 2: COMPUTER-ASSISTED WORK	Hours: 10h Self study: 10h
ACTIVITY 3: EXAMS	Hours: 8h Theory classes: 8h

### Qualification system

The evaluation of the course will be partial evaluations by the following weights:

- Midterm exams: 70% (First exam: 25%, Second exam: 45%)
- Laboratory: 20%
- Tasks: 10%

### Regulations for carrying out activities

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.

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### Bibliography

#### Basic:

Larson, R.E.; Hostetler, R.P.; Edwards, B.H. Cálculo. 8ª ed. Madrid: Mc Graw-Hill, 2006. ISBN 970-10-5710-4.

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.

Chapra, S.C.; Canale, R.P. Métodos numéricos para ingenieros. 6ª ed. México: McGraw-Hill, 2011. ISBN 9786071504999.

#### Complementary:

Salas, S.; Hille, E.; Etgen, G.J. Calculus: una y varias variables (vol. 1 i vol. 2) [on line]. 4ª ed. Barcelona: Reverté, 2002 [Consultation: 16/07/2019]. Available on: <[http://www.ingebook.com/ib/NPcd/IB\\_BooksVis?cod\\_primaria=1000187&codigo\\_libro=7715](http://www.ingebook.com/ib/NPcd/IB_BooksVis?cod_primaria=1000187&codigo_libro=7715)>. ISBN 84-291-5157-5.

Bonet Reves, C. Càlcul numèric [on line]. Barcelona: Edicions UPC, 1995 [Consultation: 11/01/2016]. Available on: <<http://hdl.handle.net/2099.3/36356>>. ISBN 84-89636-71-0.

#### Others resources:

- Lists of exercices
- Maple script