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340021 - FOMA-N1O43 - Fundamentals of Mathematics

Coordinating unit: 340 - EPSEVG - Vilanova i la Geltrú School of Engineering

Teaching unit: 749 - MAT - Department of Mathematics

Academic year: 2018

Degree: BACHELOR'S DEGREE IN INDUSTRIAL DESIGN AND PRODUCT DEVELOPMENT ENGINEERING (Syllabus 2009). (Teaching unit Compulsory)
BACHELOR'S DEGREE IN ELECTRICAL ENGINEERING (Syllabus 2009). (Teaching unit Compulsory)
BACHELOR'S DEGREE IN INDUSTRIAL ELECTRONICS AND AUTOMATIC CONTROL 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: Prat Farran, Joana D'Arc

Others: Ybern Carballo, M. De Las Nieves

Prior skills

To use and simplfy algebraic expressions.
To calculate and simplify function derivatives, using the basic rules of product, quocient and chaine rule.
To solve linear systems with Gauss and Cramer rule.
To operate with matrix (sum, product, invers and determinant).

Degree competences to which the subject contributes

Specific:

1. CE1. Ability to solve arithmetic problems related to engineering. Aptitude to apply knowledge concerning: linear algebra, geometry, differential geometry, differential and integral calculus, differential and partial equations, numerical methods, numerical algorithms, statistics and optimization.

Transversal:

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

Teaching methodology

The theory classes consist of theoretical explanations, description of examples and solution of selected problems, using various traditional and digital media.
In several parts of the subject, open source software will be used to solve applied problems.
The student will have non-attendance activities within the continuous evaluation.

Learning objectives of the subject

Use the fundamental tools of the differential calculus to study functions of one variable, and obtain approximations of functions through the Taylor polynomial.

Understand the fundamental theorem of integration and its use in the solution of various problems.

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Understand and know how to apply the basic numerical methods to calculate zeros and area calculus numerically. Understand machine precision and relative and absolute errors.

Learn about the fundamental concepts and some examples of the use of vector spaces and linear applications.

Recognize a rotation matrix in space, calculate its axis of rotation and the angle.

Make use of open source to solve some problems.

Study load

Total learning time: 150h	Hours large group:	60h	40.00%
	Hours medium group:	0h	0.00%
	Hours small group:	0h	0.00%
	Guided activities:	0h	0.00%
	Self study:	90h	60.00%

Content

1. Linear algebra	Learning time: 36h Theory classes: 18h Self study : 18h

Description:
1. Vector spaces: To find out linear dependency/independency of vectors and calculate dimensions and basis of subspaces.
2. Linear maps: how to calculate the kernel and image and dimensions, its interpretation to solve linear systems. Rotations.
3. Use of linear algebra to geometric and model problems.

Related activities:
Tasks 1, 2, 3 and 4

Specific objectives:
The student will be able to:
Determine the dependence / linear independence of vectors.
Determine if a certain set of vectors is a vector subspace.
Calculate the dimension and a base of a vector subspace.
Determine whether an application between vector spaces is a linear application.
Calculate the matrix associated with a linear application in the canonical base.
Calculate the dimension and a base of the image and the kern of a linear application.
Use the range theorem to calculate image or kernel dimensions.
Calculate the properties of the linear system solutions in terms of linear application dimensions associated
Calculate the anti-image of a vector for a given linear application.
Use linear algebra to model and solve complex problems.

2. Differential calculus	Learning time: 38h Theory classes: 18h Self study : 20h

Description:

Real functions of one real variable: Study of continuity, study of derivability and tangent line calculus, errors and approximations, Taylor polynomial, calculus of relatives extremes, numerical methods to find zeros and use of Octave/Matlab.
1 Review of elemental functions and piecewise functions.
2 Continuity. Bolzano's and Weierstrass Theorems.
3 Derivatives. Geometric interpretation of the derivative. Rule of Hôpital.
4 Errors and approximation. Taylor polynomial. Residual.
5 Aplication to the study of local functions: Extremes.
6 Numerical methods to find zeros: bisection, regula falsi and Newton-Raphson methods in Octave/Matlab platform.

Related activities:

Tasks 1, 2, 3 and 4

Specific objectives:

The student will be able to:
Study (and build on demand) the continuity and derivability of functions defined in pieces from elementary functions transferred, etc.
Use the theorems for continuous functions.
Calculate limits using the rule of L'Hôpital in simple cases.
Explain the geometric meaning of the derivative in a point, and some examples of its use.
Understand the concept of absolute and relative error and error propagation.
Understand floating point representation.
Calculate the Taylor polynomial of an order of either a function at a point, and the form of the residue.
Study the local behavior of a function: growth and relative extremes.
Know how to use the functions (method of bisection, Newton-Raphson method, Octave functions) to numerically calculate zeros in an Octave / Matlab entron.

3. Integral calculus	Learning time: 28h Theory classes: 14h Self study : 14h

Description:

Real functions of one real variable: Calculus of definite integrals by change of variables, by parts and of rational functions (Barrow rule). Numerical methods to calculate definite integrals and its application under Octave/Matlab platform.
1 Fundamental algebra Theorem. Definite integral like an area. Barrow rule.
2 Definite integral by change of variable, by parts and of rational functions.
3 Applications of definite integrals.
4 Numerical methods to calculate definite integrals: trapezoidal method, Simpson method and Octave/Matlab functions.

Related activities:

Tasks 2, 3 and 4

Specific objectives:

The student will be able to:
Apply the integration by parts and the changes correctly to the defined integrals.
Calculate primitives of rational functions using the decomposition in simple fractions, and of specific types of Functions using given substitutions.
Express the concepts and fundamental results about integrals and interpret them in terms of areas delimited by Function graphs and axis shaft.
To enunciate the fundamental theorem of the integral calculation and explain its importance.
Merge the Barrow rule with the integration by parts and variable changes.
Calculate areas of complex regions limited by various curves.
Recognize the multiple applications of the integration process, and calculate volumes, masses and other object integrals
of revolution

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Planning of activities

TASK 1	Hours: 2h Theory classes: 2h
Description: Individual writed exam, the week of firsts exams, of contens given until then.	

TASK 2	Hours: 2h Theory classes: 2h
Description: Continued evaluation of the rest of contens given after Task 1 unttil the end of course, done the last week of exams.	

TASK 3	Hours: 20h Guided activities: 20h
Description: Avaluation non-attendance that can consist of projects or/and tests via wiris platform.	

TASK 4	Hours: 3h Theory classes: 3h
Description: Individual writed final exam of all Contents.	

Qualification system

A1=mark Task 1, attended exam (all content done until the middle period of exams)
A2=mark Task 2, attended exam (all content done after the middle period of exams until the last period of exams)
A3=mark Task 3, continuous evaluation (all content)
A4= mark Task 4, final exam (all content)

The final mark is:

FINAL MARK = MAX (0.3*A1+0.3*A2+0.4*A3, 0.4*A3 +0.6*A4)

where all qualifications are calculated over 10.

Task A4 will be reevaluated.

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Regulations for carrying out activities

The tasks A1, A2 and A4 are on-site and individual and will be carried out in the week reserved for the first test period of the course and in the final evaluation period that appears in the academic Calendar respectively.
Activity A3 is mainly non-attendance and the group's teacher designs how it will be developed.
The specific rules for each activity will be indicated in sufficient time.

Bibliography

Basic:

Anton, Howard. Introducción al álgebra lineal : con aplicaciones en negocios, economía, ingeniería, física, ciencias de la computación, teoría de la aproximación, ecología, sociología, demografía y genética. 5a ed. México, DF: Limusa, 2011. ISBN 9786070502903.

Estela Carbonell, M. Rosa. Fonaments de càlcul. 2a ed. Barcelona: Edicions UPC, 2005. ISBN 8483018357.

Kreyszig, Erwin. Matemáticas avanzadas para ingeniería. 3a ed. México, D.F. [etc.]: Limusa, 2006. ISBN 9789681853113.

Amer Ramon, Rafael. Curs d'àlgebra lineal. 2a ed.. Terrassa: Universitat Politècnica de Catalunya, 1998. ISBN 8484987841.

Lay, David C.. Álgebra lineal y sus aplicaciones. 4a ed. México [etc.]: Pearson Educación, 2012. ISBN 9786073213981.

Strang, Gilbert. Linear algebra and its applications. 4th ed. Australia [etc.]: Thomson, 2006. ISBN 9780534422004.

Complementary:

Stewart, James. Cálculo de una variable : trascendentes tempranas. 6a ed. México: International Thomson, 2008. ISBN 9789706866530.

Others resources: