

Course guide

240012 - 240012 - Calculus I

Last modified: 16/05/2023

Unit in charge: Barcelona School of Industrial Engineering
Teaching unit: 749 - MAT - Department of Mathematics.

Degree: BACHELOR'S DEGREE IN INDUSTRIAL TECHNOLOGY ENGINEERING (Syllabus 2010). (Compulsory subject).

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

LECTURER

Coordinating lecturer: Joan Solà-Morales Rubió
Carles Bonet Revés

Others:

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:

1. Capacity to solve mathematical problems that can appear in engineering . Aptitude to apply knowledge about: linear algebra; geometry; differential geometry; differential and integral calculus; differential equations and derived partial equations; numerical methods; numerical algorithm; statistics and optimisation.

TEACHING METHODOLOGY

In theory sessions the basic theoretical body of the subject is presented, together with illustrations and examples of the most important notions and results.

In the problem sessions, exercises are solved to consolidate the concepts introduced in the theory classes.

In the "Taller de Matemàtiques" practices, exercises will be carried out by means of the Matlab / Octave program that will reinforce the contents of the course, especially the graphical and numerical tools.

LEARNING OBJECTIVES OF THE SUBJECT

The Calculus 1 course intends to provide students with basic tools, analytic and numerical, to analyse single variable real functions, and at the same time show its use in modelling technical and science problems.

This course also intends to be an introduction in the degree's studying methodology, as well as a fundamental support to correctly understand the rest of subjects, this is the reason why the subject's instrumental character will be strongly emphasised.

STUDY LOAD

Type	Hours	Percentage
Self study	90,0	60.00
Hours large group	56,0	37.33
Hours small group	4,0	2.67

Total learning time: 150 h



CONTENTS

1.-Continuity

Description:

Function domains. Composition of functions and inverse function .Lateral limits. Limits. Continuity. Infinite limits. Limits in the infinite. Asymptotes.

Related competencies :

CE1. Capacity to solve mathematical problems that can appear in engineering . Aptitude to apply knowledge about: linear algebra; geometry; differential geometry; differential and integral calculus; differential equations and derived partial equations; numerical methods; numerical algorithm; statistics and optimisation.

Full-or-part-time: 25h

Theory classes: 10h

Self study : 15h

2.- Derivation

Description:

Definition of derivative. Basic derivation rules. The chain rule. Implicit derivation and the derivative of the iverse function.. Extremes. Rolle's theorem and medium value theorem, Taylor's polynomial. Monotony. Concavity and convexity. Graphs.

Related competencies :

CE1. Capacity to solve mathematical problems that can appear in engineering . Aptitude to apply knowledge about: linear algebra; geometry; differential geometry; differential and integral calculus; differential equations and derived partial equations; numerical methods; numerical algorithm; statistics and optimisation.

Full-or-part-time: 35h

Theory classes: 14h

Self study : 21h

3.- Integration

Description:

Primitives. Basic methods of integration. Changes of variables. Rational and trigonometric integrals. Defined integration. Area calculation. Barrow's rule. Improper integral concept. Convergence criteria.

Related competencies :

CE1. Capacity to solve mathematical problems that can appear in engineering . Aptitude to apply knowledge about: linear algebra; geometry; differential geometry; differential and integral calculus; differential equations and derived partial equations; numerical methods; numerical algorithm; statistics and optimisation.

Full-or-part-time: 37h 30m

Theory classes: 15h

Self study : 22h 30m



4.- Series

Description:

Sequences of real numbers. Numerical series and convergence. Convergence criteria. Power series. Taylor series. Fourier series.

Related competencies :

CE1. Capacity to solve mathematical problems that can appear in engineering . Aptitude to apply knowledge about: linear algebra; geometry; differential geometry; differential and integral calculus; differential equations and derived partial equations; numerical methods; numerical algorithm; statistics and optimisation.

Full-or-part-time: 37h 30m

Theory classes: 15h

Self study : 22h 30m

5.- Mathematics workshop

Description:

Introduction to Matlab/Octave, graphic representation of functions, zeroes of functions . Integración numérica

Related competencies :

CE1. Capacity to solve mathematical problems that can appear in engineering . Aptitude to apply knowledge about: linear algebra; geometry; differential geometry; differential and integral calculus; differential equations and derived partial equations; numerical methods; numerical algorithm; statistics and optimisation.

Full-or-part-time: 15h

Laboratory classes: 6h

Self study : 9h

ACTIVITIES

MATHEMATICS WORKSHOP

Description:

Introduction to Matlab/Octave and graphical representation of functions (2h)

Zeroes of functions: bisection, Newton,... (2h)

Numerical Integration (2h)

Full-or-part-time: 15h

Laboratory classes: 6h

Self study: 9h

GRADING SYSTEM

The student will be evaluated in three tests:

- A partial test in midterm (EP), in a date set by the School.
- A laboratory test of the Mathematics Workshop (ET), which will take place during the semester.
- Final exam (EF), date determined by the School.

The final grade (NF) will be computed by the following formula:

$$NF = \max(0.60*EF + 0.30*EP + 0.10*ET, 0.9*EF + 0.10*ET)$$

The grade corresponding to Mathematics Workshop will not be changed. Hence, in case of taking the reevaluation exam (ER), the final grade will be given by:

$$NF = 0.9*ER + 0.1*ET$$

EXAMINATION RULES.

For the exams, it is permitted to use a handwritten personal collection of formulas in a DIN A4 paper, no photocopies are allowed. The use of a scientific calculator is allowed as long as it cannot graph functions, save information, or transmit or receive data.

BIBLIOGRAPHY

Basic:

- Puig i Sadurní, J. Taller de matemàtiques : pràctiques en Matlab/Octave, amb un apèndix en Python [on line]. Barcelona: Iniciativa Digital Politècnica, 2011 [Consultation: 09/09/2022]. Available on: <https://upcommons.upc.edu/handle/2099.3/36550>. ISBN 9788476539132.
- Larsson, Ron. Cálculo : 1 de una variable [on line]. 9a ed. México: McGraw Hill, 2010 [Consultation: 19/10/2020]. Available on: http://www.ingebook.com/ib/NPcd/IB_BooksVis?cod_primaria=1000187&codigo_libro=5686. ISBN 9786071502735.
- Quarteroni, A. ; Saleri, F. Cálculo Científico con MATLAB y Octave [on line]. Milano: Springer, 2006 [Consultation: 08/09/2020]. Available on: <http://dx.doi.org/10.1007/978-88-470-0718-5>. ISBN 9788847005037.
- Spivak, Michael; Castellet, Manuel; Casacuberta, Carles. Calculus : càlcul infinitesimal [on line]. 2a ed.. Barcelona: Reverté, 1995 [Consultation: 16/11/2022]. Available on: <https://web-p-ebsohost-com.recursos.biblioteca.upc.edu/ehost/ebookviewer/ebook?sid=307787fc-4dd8-4595-a14e-4c308be5f09b%40redis&vid=0&format=EB>. ISBN 9788429151374.
- Burgos Román, Juan de. Cálculo infinitesimal de una variable [on line]. 2a ed. Madrid: McGraw-Hill, cop. 2007 [Consultation: 22/06/2022]. Available on: https://www-ingebook-com.recursos.biblioteca.upc.edu/ib/NPcd/IB_BooksVis?cod_primaria=1000187&codigo_libro=3964. ISBN 9788448156343.
- Jarauta Bragulat, Eusebi. Anàlisi matemàtica d'una variable : fonaments i aplicacions. Barcelona: Edicions UPC, 2001. ISBN 8483015161.
- Ortega Aramburu, Joaquín M. Introducció a l'anàlisi matemàtica. 2a ed. Bellaterra: Publicacions de la Universitat Autònoma de Barcelona, 2002. ISBN 8449022711.
- Stewart, James. Cálculo de una variable : trascendentes tempranas. 6a ed.. México: Cengage Learning, cop. 2008. ISBN 9789706866530.
- Perelló, Carles. Càlcul infinitesimal : amb mètodes numèrics i aplicacions. Barcelona: Enciclopèdia Catalana, 1994. ISBN 8477395187.
- Leseduarte Milán, M. Carme [et al.]. Càlcul d'una variable [on line]. Barcelona: Edicions UPC, 2009 [Consultation: 16/11/2022]. Available on: <http://hdl.handle.net/2099.3/36643>. ISBN 9788498803563.

RESOURCES

Other resources:

The subject will have a website in which all the necessary material will be uploaded, such as problem lists or information on the laboratory sessions, and all that information that helps autonomous learning.