Last update: 04-09-2019

820007 - CAL - Calculus

Coordinating unit: 295 - EEBE - Barcelona East School of Engineering

Teaching unit: 749 - MAT - Department of Mathematics

Academic year: 2019

Degree: BACHELOR'S DEGREE IN ELECTRICAL ENGINEERING (Syllabus 2009). (Teaching unit Compulsory)
BACHELOR'S DEGREE IN MECHANICAL ENGINEERING (Syllabus 2009). (Teaching unit Compulsory)
BACHELOR'S DEGREE IN CHEMICAL 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)
BACHELOR'S DEGREE IN CHEMICAL ENGINEERING (Syllabus 2009). (Teaching unit Compulsory)
BACHELOR'S DEGREE IN BIOMEDICAL ENGINEERING (Syllabus 2009). (Teaching unit Compulsory)
BACHELOR'S DEGREE IN ENERGY ENGINEERING (Syllabus 2009). (Teaching unit Compulsory)
BACHELOR'S DEGREE IN BIOMEDICAL ENGINEERING (Syllabus 2009). (Teaching unit Compulsory)
BACHELOR'S DEGREE IN MATERIALS ENGINEERING (Syllabus 2010). (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 ENERGY ENGINEERING (Syllabus 2009). (Teaching unit Compulsory)

ECTS credits: 6 Teaching languages: Catalan, Spanish, English

Teaching staff

Coordinator: ANGELES CARMONA MEJIAS - MAGDA LILIANA RUIZ ORDOÑEZ

Others: Primer quadrimestre:
MERCÉ CLAVEROL AGUAS - M52, M61, M62, M81, M82, T11, T91, T92
RAIMON ELGUETA MONTO - M71, M72
SERGIO GONZÁLEZ LÓPEZ - M51, M52, T12, T91, T92
M. JOSÉ JIMÉNEZ JIMÉNEZ - T21, T22, T31, T32, T81, T82
ALVARO MARTIN LLOPIS - T31, T32
ALBERT MAS BLESA - M21, M22, M31, M32, T81
MARGARIDA MITJANA RIERA - M71, M72, T82
NURIA PARES MARINE - M11, M12, M31, M32
FRANCESC POZO MONTERO - M11, M12
JUAN TRIAS PAIRO - M41, M42, M51, M61, M62

Opening hours

Timetable: Reach your teacher by e-mail for a more detailed information.

Prior skills

This course requires no previous skills.

Requirements

This course has no prerequisites.

Degree competences to which the subject contributes

Last update: 04-09-2019

820007 - CAL - Calculus

Specific:

2. Solve mathematical problems that may arise in engineering. Apply knowledge of linear algebra; geometry; differential geometry; differential and integral calculus; differential equations and partial differential equations; numerical methods; numerical algorithms; statistics and optimisation.

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.

Teaching methodology

The course uses the expositive methodology by 40% and individual work by 60%.

Learning objectives of the subject

General objectives: Students will learn the fundamental concepts of single variable calculus, developing the capacity of abstraction and applying these techniques to mathematical problems encountered in engineering.

Study load

Total learning time: 150h	Hours large group:	45h	30.00%
	Hours medium group:	0h	0.00%
	Hours small group:	15h	10.00%
	Guided activities:	0h	0.00%
	Self study:	90h	60.00%

Last update: 04-09-2019

820007 - CAL - Calculus

Content

Sets of numbers

Learning time: 30h

Theory classes: 8h
Practical classes: 0h
Laboratory classes: 4h
Self study : 18h

Description:
-The set of real numbers: Supreme axiom.
-The set of complex numbers. Binomial, polar and exponential form. Operation with complex numbers. Powers and roots. Euler's formula. Definition of hyperbolic functions and their relation to trigonometric and complex numbers.

Related activities:
Lab session 1. Conics
Lab session 2. Complex numbers

Specific objectives:
The students will learn:
-the axiom of the supreme, key to understand the completeness of real numbers.
-to operate with complex numbers
-to establish relationships between binomial, polar and exponentials forms.

Functions of real variable. Limits and continuity.

Learning time: 30h

Theory classes: 10h
Practical classes: 0h
Laboratory classes: 2h
Self study : 18h

Description:
-Concept of function. Domain and codomain. Basic functions in engineering: Heviside function. Operating with functions. Composition of functions. Inverse function.
-Limit of a function in a point. Definition and basic properties. One-sided limits. Evaluating limits. Extending the concept of a limit (infinite limits, limits at infinity). Limits of indeterminant form. Infinities and equivalent infinities. Orders of infinity.
-Continuity. Continuity theorems (Weierstrass, Bolzano, intermediate value theorem).

Related activities:

Lab Session 3. Limits and Continuity

Specific objectives:
Students will learn:
-to represent a real-valued function
-to understand the importance of the concept of limit and its relationship to continuity.

Last update: 04-09-2019

820007 - CAL - Calculus

Differentiation of real valued functions

Learning time: 35h

Theory classes: 12h
Practical classes: 0h
Laboratory classes: 2h
Self study : 21h

Description:
-Derivative of a function at a point. Relationship between differentiablity and continuity. The derivative as a function. Geometric interpretation: Tangent line. The chain rule. Implicit derivative. Calculus of derivatives.
-Local approximation of a function. Taylor polynomials. Error formula.
-The mean value theorems (Rolle, Cauchy, Lagrange).
-Extrema of a function in an interval.

Related activities:
Lab session 6. Taylor Polinomial

Specific objectives:
The student will learn:
-the basic concepts of derivative.
-to understand the geometric interpretation of the derivative and its applications in engineering.
-to master and to apply the elementary properties of the differentiable functions.
-to master the calculation of derivatives, both analytically and with the help of mathematical software.
-to model and solve various problems by calculating derivatives, optimization, approximating functions and study of functions.

Integration of functions of real variable

Learning time: 42h

Theory classes: 13h
Practical classes: 0h
Laboratory classes: 3h
Self study : 26h

Description:
-Antiderivatives.
-Integration methods: direct methods, change of variable, integration by parts, trigonometric integrals.
-Definite integral (Riemann integral). Integrable functions. The fundamental theorem of calculus. Barrow's rule.
-Calculation of areas of plane regions. Applications.
-Improper integrals.

Related activities:
Lab session 6. Integration
Lab session 7. Lab session exam (10%)

Specific objectives:
Students will learn:
-to express in terms of integrals the problem of calculation the area of a plane region.
-to understand the relationship between derivatives and integrals, given by the fundamental theorem of calculus.
-to use the Barrow's rule.
-to calculate some improper integrals of continuous functions on an unbounded interval.

Last update: 04-09-2019

820007 - CAL - Calculus

Linear algebra	Learning time: 15h Theory classes: 2h Practical classes: 0h Laboratory classes: 4h Self study : 9h

Description:
Matrices. Determinant. Rank of a matrix.
Systems of linear equations. Gaussian elimination.
Inverse matrix.
Linear geometry: equation of a straight line and a plane;
orthogonality and parallelism; distances.

Related activities:
Lab Session 4. Matrices
Lab Session 5. Generic competence assessment

Specific objectives:
Students will learn:
-to solve systems of linear equations and
-to graphically represent the solution of a system of linear equations

Qualification system

First partial exam: 30%
Second partial exam: 50%
Laboratory: 10%
Generic competence (self-directed learning): 10%

The evaluation will be conducted through the assessment by the teacher.

The students can pass the course only by the assessment during the course from two partial exams (first partial exam within the course weeks; the second partial exam will be scheduled in the official final examination period), laboratory and the evaluation of generic competence.

An individual test will be performed in the assessment of the laboratory, during the last laboratory session.

Competence assessment: This course assesses the self-directed learning competency through individual tests during the development of one of the laboratory sessions. More precisely, the test will assess conics.

Finally, as detailed in the academic normative of the EEBE, a reevaluation exam will take place (excluding the Maple Laboratory exam and the Generic Competence). To be able to do the reevaluation exam, the student has to fail and has to attend to all the evaluation exams of the subject and its mark, N, for the part which can be reevaluated has to be such that N > 3,0 (https://eebe.upc.edu/ca/estudis/normatives-academiques/documents/eebe-normativa-avaluacio-i-permanencia-18-19-aprovat-je-2018-06-13.pdf).

Last update: 04-09-2019

820007 - CAL - Calculus

Regulations for carrying out activities

No writing paper, books, papers, manuscripts or notes of any kind are to be taken into an examination room. The use of calculators, cell phones, tablets or any electronic device is not permitted in examinations.

Bibliography

Basic:

Franco Brañas, José Ramón. Introducción al cálculo : problemas y ejercicios resueltos. Madrid [etc.]: Prentice Hall, cop. 2003. ISBN 8420536768.

Lay, David C. Algebra lineal y sus aplicaciones. 3ª ed. México [etc.]: Pearson Educación, 2007. ISBN 9789702609063.

Pozo, Francesc; Parés, Núria; Vidal, Yolanda. Matemáticas para la ingeniería [on line]. 2a ed. Madrid: García-Maroto Editores, 2019 [Consultation: 02/10/2019]. Available on: <http://www.ingebook.com/ib/NPcd/IB_BooksVis?cod_primaria=1000187&codigo_libro=8434>. ISBN 9788417969028.

Rogawski, Jon. Calculus : single variable. 2nd ed. New York: W.H. Freeman and Company, cop. 2012. ISBN 9781429231831.

Salas, Saturnino L.; Hille, Einar; Etgen, Garret J. Calculus : una y varias variables. 4a ed. Barcelona [etc.]: Reverté, 2006. ISBN 8429151567.

Thomas, George Brinton. Cálculo : una variable. 12ª ed. México, D.F: Addison Wesley Longman, 2010. ISBN 9786073201643.

Complementary:

Estela Carbonell, M. Rosa. Fonaments de càlcul [on line]. 2a ed. Barcelona: Edicions UPC, 2005 [Consultation: 01/03/2012]. Available on: <http://hdl.handle.net/2099.3/36637>. ISBN 8483018357.

Estela Carbonell, M. Rosa; Saà Seoane, Joel. Cálculo con soporte interactivo en Moodle. Madrid: Pearson Educación, 2008. ISBN 9788483224809.

Gibergans Bàguena, Josep [et al.]. Matemáticas para la ingeniería con Maple. Barcelona: Edicions UPC, 2008. ISBN 9788483019672.

Others resources:

Web page: https://es.khanacademy.org

Hyperlink

Khan Academy

Resource