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820007 - CAL - Calculus

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

Teaching unit: 749 - MAT - Department of Mathematics

Academic year: 2018

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

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

Teaching staff

Coordinator: FRANCESC POZO MONTERO - LUIS EDUARDO MUJICA DELGADO

Others: Pozo Montero, Francesc
Mujica Delgado, Luis Eduardo

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

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.

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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%

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Content

Sets of numbers

Learning time: 35h

Theory classes: 9h
Practical classes: 0h
Laboratory classes: 5h
Self study : 21h

Description:

-Introduction to the mathematical reasoning. Proof methods (direct, reductio ad absurdum, indirect proof by contraposition, mathematical induction).
-The set of natural, integer, rational and real numbers.
-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. Introduction to Maple (Part 1)
Lab session 2. Introduction to Maple (Part 2)
Lab session 3. Complex numbers and their representation
Lab session 4. Operations with complex numbers

Specific objectives:

The students will learn:
-to recognise the importance of mathematical reasoning and the different proof methods
-to describe the different sets of numbers
-to operate with complex numbers
-to establish relationships between binomial, polar and exponentials forms.

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Functions of real variable. Limits and continuity.	Learning time: 30h Theory classes: 9h Practical classes: 0h Laboratory classes: 3h Self study : 18h

Description:
-Concept of function. Domain and codomain. Basic functions in engineering. Operating with functions. Composition of functions. Inverse function.
-Limit of a function in a point. Formal definition (epsilon-delta). Basic properties. One-sided limits. Evaluating limits. Sandwich theorem. Zero times bounded rule. Extending the concept of a limit (infinite limits, limits at infinity). Evaluation of limits. Limits of indeterminant form. Equivalent functions.
-Continuity. Continuity theorems (Weierstrass, Bolzano, intermediate value theorem).

Related activities:
Lab Session 6. Functions. Graphical representation
Lab Session 7. Lab session exam (5%)
Lab Session 8. Limits and Continuity (Part 1)
Lab Session 9. Limits and Continuity (Part 2).

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.

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Differentiation of real valued functions

Learning time: 37h 30m

Theory classes: 12h
Practical classes: 0h
Laboratory classes: 3h
Self study : 22h 30m

Description:
-Derivative of a function at a point. Differentiable functions. The derivative as a function. The chain rule. Implicit differentiation. Relationship between differentiablity and continuity.
-Extrema of a function in an interval.
-Study and graphical representation of functions.
-The mean value theorems (Rolle, Cauchy, Lagrange).
-Local approximation of a function. Taylor polynomials. Error formula.

Related activities:
Lab session 10. Differentiation
Lab session 11. Derivative Applications

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.

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Integration of functions of real variable.

Learning time: 37h 30m

Theory classes: 12h
Practical classes: 0h
Laboratory classes: 3h
Self study : 22h 30m

Description:
-Antiderivatives.
-Integration methods. Change of variable, integration by parts, rational (decomposition into partial fractions).
-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 12. Integration
Lab session 13. Applications of definite integrals
Lab session 14. Lab session exam (5%)
Lab session 15. Solution of problems using Maple for the preparation of the second exam

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.

Linear algebra

Learning time: 10h

Theory classes: 3h
Practical classes: 0h
Laboratory classes: 1h
Self study : 6h

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.

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

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Planning of activities

(ENG) PRÀCTICA 1	Hours: 1h Laboratory classes: 1h
(ENG) PRÀCTICA 2	Hours: 1h Laboratory classes: 1h
(ENG) PRÀCTICA 3	Hours: 1h Laboratory classes: 1h
(ENG) PRÀCTICA 4	Hours: 1h Laboratory classes: 1h
(ENG) PRÀCTICA 5	Hours: 1h Laboratory classes: 1h
(ENG) EXAMEN DE PRÀCTIQUES	Hours: 1h Laboratory classes: 1h
FIRST PARTIAL EXAM	Hours: 2h Theory classes: 2h
SECOND PARTIAL EXAM	Hours: 3h Theory classes: 3h

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Qualification system

First partial exam: 35%
Second partial exam: 50%
Laboratory: 10%
Generic competency (self-directed learning): 5%

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 last exam will be scheduled in the official final examination period) and laboratory.

At least an individual test will be performed in the assessment of the laboratory.

Competency assessment: This course assesses the self-directed learning competency through individual tests that may be included in the partial exams. More precisely, the test will assess partial fractions.

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 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 3,0 ? N < 5,0.

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 is not permitted in examinations.

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Bibliography

Basic:

Pozo, Francesc; Parés, Núria; Vidal, Yolanda. Matemáticas para la ingeniería. Madrid: Pearson education, 2013. ISBN 9788415552413.

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

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

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

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

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.

Larson, Ron [et al.]. Cálculo, vol. I. 8ª ed. Madrid [etc.]: McGraw-Hill, cop. 2006. ISBN 9701052749.

Burgos Román, Juan de. Álgebra lineal y geometría cartesiana. 3ª ed. Madrid [etc.]: McGraw-Hill, cop. 2006. ISBN 8448149009.

Others resources:

Hyperlink

GIMEL

Repositori de documents (http://bibliotecnica.upc.es/gimel/)

GIMEL

Repositori de documents (http://www.euetib1.upc.es/gimel)

Audiovisual material

GIMEL-UOC