

Course guide

310200 - 310200 - Calculus

Last modified: 06/06/2024

Unit in charge: Barcelona School of Building Construction
Teaching unit: 749 - MAT - Department of Mathematics.

Degree: **Academic year:** 2024 **ECTS Credits:** 6.0
Languages: Catalan, English

LECTURER

Coordinating lecturer: TONI GUILLAMON GRABOLOSE

Others:

PRIOR SKILLS

Basic knowledge, at the high-school level, on calculus of limits, continuity and derivatives of one-variable functions. Computation of primitives of one-variable functions, as well as the definite integral and its applications. Graphs of one-variable functions.

REQUIREMENTS

Basic knowledge on:

- a) polynomials and their roots;
- b) elementary functions of one real variable and their properties;
- c) concept of derivative of a function of one real variable.

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:

1. Capacity for the resolution of mathematic problems that can be set out in engineering. Aptitude to apply the knowledge about: linear algebra, geometry, differential geometry, differential and integral calculus, differential equations and in partial derivatives, numeric methods, numeric algorithm, statistics and optimization.
2. (ENG) Determinar, mesurar, avaluar i representar el terreny, objectes tridimensionals, punts i trajectòries.
3. (ENG) Planificació, projecte, direcció, execució i gestió de processos de mesura, sistemes d'informació, explotació d'imatges, posicionament i navegació; modelització, representació i visualització de la informació territorial en, sota i sobre la superfície terrestre.

Transversal:

4. THIRD LANGUAGE. Learning a third language, preferably English, to a degree of oral and written fluency that fits in with the future needs of the graduates of each course.
- 04 COE N1. EFFICIENT ORAL AND WRITTEN COMMUNICATION - Level 1. Planning oral communication, answering questions properly and writing straightforward texts that are spelt correctly and are grammatically coherent.

TEACHING METHODOLOGY

Hours of supervised learning consist of theoretical sessions that start with a brief presentation by the teacher about general abilities related to the more basic concepts. Afterwards, by means of practical exercises, the student is invited to get actively involved in the learning process.

LEARNING OBJECTIVES OF THE SUBJECT

At the end of the course, the student should be able to:

- Expand functions of one variable in series.
- Interpolate two-dimensional data sets.
- Define the concept of differentiable function of several variables.
- Calculate, interpret and apply partial derivatives, directional derivatives, differential and Hessian matrix.
- Linearize vector fields.
- Solving overdetermined systems of nonlinear equations.
- Define the concepts of double and triple integral, and calculate them.
- Use changes of variables to solve integrals.
- State and compute line integrals.

STUDY LOAD

Type	Hours	Percentage
Hours medium group	15,0	10.00
Self study	90,0	60.00
Hours large group	30,0	20.00
Hours small group	15,0	10.00

Total learning time: 150 h

CONTENTS

C1 Single variable calculus

Description:

Review on elementary functions and derivation.
Interpolation of bidimensional datasets.
Series expansions.
Single variable integration: definition and change of variables.

Specific objectives:

At the end of the activity, the student has to be capable of:

- Choose and use suitable methods to interpolate bidimensional datasets.
- Expand single variable functions and control its error.
- Compute, at a basic level, integrals of single variable functions.

Related activities:

MV1,E1

Full-or-part-time: 42h

Theory classes: 6h 30m
Practical classes: 6h 30m
Guided activities: 1h
Self study : 28h

C2 Multivariable differential calculus

Description:

Scalar and vector fields.
Directional and partial derivatives.
Differential map.
Linearization of vector fields.
Optimization in several variables. Extrema.
Least square method. Overdetermined systems of nonlinear equations.
Composition of vector fields. Chain's rule.
Implicit derivation.

Specific objectives:

At the end of the activity, students should be able to:
Calculate directional and partial derivatives, gradients, differential and Hessian matrix. Solving optimization problems in several variables and conditional extremes. Calculate the linearization of vector fields and apply the least squares method. Calculate the differential matrix of functions' composition. Calculate the derivatives of functions defined implicitly. Solve application exercises using a calculator as a tool for symbolic calculation.

Related activities:

MV2,E1,E2

Full-or-part-time: 60h

Theory classes: 9h
Practical classes: 9h
Guided activities: 2h
Self study : 40h

C3 Multivariable integral calculus

Description:

Double ntegral.
Calculation of the double integral.
Change of variables.
Calculation of areas of flat surfaces.
Triple integral.
Calculation of the triple integral.
Moments of inertia and center of gravity of a solid body.
Line integral and conservative fields.

Specific objectives:

At the end of the activity, students should be able to:
Use all the computing resources required to calculate double and triple integrals and apply them to special cases of the calculation of areas and moments of inertia and center of gravity of a solid body. Identify a conservative field. Calculate line integrals and potential functions. Solve application exercises using symbolic calculation.

Related activities:

MV3, E2

Full-or-part-time: 48h

Theory classes: 7h 30m
Practical classes: 7h 30m
Guided activities: 1h
Self study : 32h

ACTIVITIES

MV1: CONTINUOUS ASSESSMENT: DERIVATION IN ONE VARIABLE

Description:

Short 60-minutes control or problem-solving to deliver. The activity can involve working in groups, the use of mathematical software or oral presentation.

Specific objectives:

At the end of the activity the student should have consolidated the concepts of derivative of one variable function, its physical and geometric interpretation and should be capable of expand oone variable functions in Taylor series.

Material:

Individual student's notes and those available at ATENEA. Mathematics software. Web resources linked in ATENEA.

Delivery:

The activity is delivered in person. Its resolution is posted at ATENEA.

Related competencies :

CEM1. Capacity for the resolution of mathematic problems that can be set out in engineering. Aptitude to apply the knowledge about: linear algebra, geometry, differential geometry, differential and integral calculus, differential equations and in partial derivates, numeric methods, numeric algorithm, stadistics and optimization.

CT5. (ENG) Determinar, mesurar, avaluar i representar el terreny, objectes tridimensionals, punts i trajectòries.

CT8. (ENG) Planificació, projecte, direcció, execució i gestió de processos de mesura, sistemes d'informació, explotació d'imatges, posicionament i navegació; modelització, representació i visualització de la informació territorial en, sota i sobre la superfície terrestre.

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Full-or-part-time: 1h

Guided activities: 1h

(ENG) MV2: AVALUACIÓ CONTINUADA LINEALITZACIÓ CAMPS ESCALARS

Description:

Short 60-minutes control or problem-solving to deliver. The activity can involve working in groups, the use of mathematical software or oral presentation.

Specific objectives:

En acabar l'activitat l'estudiant ha de ser capaç de calcular aplicacions diferencials de funcions en vàries variables, derivades direccionals i linealitzar camps vectorials.

Material:

Apunts individuals de l'alumne i del tema disponibles a ATENEA. Programari de matemàtiques. Recursos web enllaçats a ATENEA.

Delivery:

L'activitat es lliura presencialment. Es pot consultar la seva resolució a través d'ATENEA.

Related competencies :

CEM1. Capacity for the resolution of mathematic problems that can be set out in engineering. Aptitude to apply the knowledge about: linear algebra, geometry, differential geometry, differential and integral calculus, differential equations and in partial derivates, numeric methods, numeric algorithm, stadistics and optimization.

CT5. (ENG) Determinar, mesurar, avaluar i representar el terreny, objectes tridimensionals, punts i trajectòries.

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Full-or-part-time: 1h

Guided activities: 1h

(ENG) E1: AVALUACIÓ BLOC 1 i BLOC 2.1

Description:

Solving problems related to the contents of Block 1 and Block 2.1.

Specific objectives:

En finalitzar l'activitat, l'estudiant o estudianta ha de ser capaç de mostrar la seva competència en resoldre problemes d'aplicació del contingut del Bloc 1 i del Bloc 2.1.

Material:

Enunciat per a la realització de la prova.

Calculadora com a suport de càlcul (opcional).

Delivery:

Lliurament en paper.

Es pot consultar la seva resolució a través d'ATENEA.

Related competencies :

CEM1. Capacity for the resolution of mathematic problems that can be set out in engineering. Aptitude to apply the knowledge about: linear algebra, geometry, differential geometry, differential and integral calculus, differential equations and in partial derivatives, numeric methods, numeric algorithm, statistics and optimization.

CT5. (ENG) Determinar, mesurar, avaluar i representar el terreny, objectes tridimensionals, punts i trajectòries.

CT8. (ENG) Planificació, projecte, direcció, execució i gestió de processos de mesura, sistemes d'informació, explotació d'imatges, posicionament i navegació; modelització, representació i visualització de la informació territorial en, sota i sobre la superfície terrestre.

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Full-or-part-time: 2h

Theory classes: 2h

(ENG) MV3: AVALUACIÓ CONTINUADA OPTIMITZACIÓ EN VÀRIES VARIABLES

Description:

Short 60-minutes control or problem-solving to deliver. The activity can involve working in groups, the use of mathematical software or oral presentation.

Specific objectives:

En acabar l'activitat l'estudiant ha de ser capaç de resoldre els problemes d'integració desenvolupats fins al moment a l'assignatura.

Material:

Apunts individuals de l'alumne i del tema disponibles a ATENEA. Programari de matemàtiques. Recursos web enllaçats a ATENEA.

Delivery:

L'activitat es lliura presencialment. Es pot consultar la seva resolució a través d'ATENEA.

Full-or-part-time: 1h

Guided activities: 1h

(ENG) MV4: AVALUACIÓ CONTINUADA INTEGRACIÓ EN VÀRIES VARIABLES

Description:

Short 60-minutes control or problem-solving to deliver. The activity can involve working in groups, the use of mathematical software or oral presentation.

Specific objectives:

En acabar l'activitat l'estudiant ha de ser capaç de resoldre els problemes d'integració desenvolupats fins al moment a l'assignatura.

Material:

Apunts individuals de l'alumne i del tema disponibles a ATENEA. Programari de matemàtiques. Recursos web enllaçats a ATENEA.

Delivery:

L'activitat es lliura presencialment. Es pot consultar la seva resolució a través d'ATENEA.

Related competencies :

CEM1. Capacity for the resolution of mathematic problems that can be set out in engineering. Aptitude to apply the knowledge about: linear algebra, geometry, differential geometry, differential and integral calculus, differential equations and in partial derivatives, numeric methods, numeric algorithm, statistics and optimization.

CT5. (ENG) Determinar, mesurar, avaluar i representar el terreny, objectes tridimensionals, punts i trajectòries.

CT8. (ENG) Planificació, projecte, direcció, execució i gestió de processos de mesura, sistemes d'informació, explotació d'imatges, posicionament i navegació; modelització, representació i visualització de la informació territorial en, sota i sobre la superfície terrestre.

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Full-or-part-time: 1h

Guided activities: 1h

(ENG) E2: AVALUACIÓ BLOC 2.2 i BLOC 3

Description:

Solving problems related to the contents of Block 2.2 and Block 3.

Specific objectives:

En finalitzar l'activitat, l'estudiant o estudianta ha de ser capaç de mostrar la seva competència en resoldre problemes d'aplicació dels continguts del Bloc 2.2. i del Bloc 3.

Material:

Enunciat per a la realització de la prova.

Calculadora com a suport de càlcul (opcional).

Delivery:

Lliurament en paper.

Es pot consultar la seva resolució a través d'ATENEA.

Related competencies :

CEM1. Capacity for the resolution of mathematic problems that can be set out in engineering. Aptitude to apply the knowledge about: linear algebra, geometry, differential geometry, differential and integral calculus, differential equations and in partial derivatives, numeric methods, numeric algorithm, statistics and optimization.

CT5. (ENG) Determinar, mesurar, avaluar i representar el terreny, objectes tridimensionals, punts i trajectòries.

CT8. (ENG) Planificació, projecte, direcció, execució i gestió de processos de mesura, sistemes d'informació, explotació d'imatges, posicionament i navegació; modelització, representació i visualització de la informació territorial en, sota i sobre la superfície terrestre.

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Full-or-part-time: 2h

Theory classes: 2h

Reevaluation

Description:

Solving problems that correspond to the contents of the previous evaluation activities: E1 (Blocks 1 and 2.1) and E2 (Blocks 2.2 and 3). Both proofs will be held according to the official EPSEB exams' agenda.

Specific objectives:

All the objectives of the course.

Material:

Statement of the exam.

Calculator as a support tool (optional).

Delivery:

On paper.

Resolution will be published on ATENEA.

Full-or-part-time: 1h

Guided activities: 1h

GRADING SYSTEM

Six evaluation activities will be carried out: 3 controls of continuous assessment or directed activities (MV1, MV2, MV3, MV4), 5% each, 1 control dedicated to Block 1 and part of Block 2 (E1) in the first period of exams, 40%, and 1 part dedicated to Block 2 and Block 3 (E2), 40%. The sequential order of the tests will be: MV1, MV2, E1, MV3, MV4, E2. In the reevaluation, two tests will be offered: E1-E2-R and R, which will count 50% of the total assessment each.

EXAMINATION RULES.

- 1) If some assessment control is not performed, the grade will be "zero".
- 2) During the controls, you can have calculator, but is not necessary.
- 3) Care should be taken in the written statement of the content of activities; coherence and rigor are required.

BIBLIOGRAPHY

Basic:

- Bruguera, Montserrat [et al.]. Curs de matemàtiques: àlgebra lineal i càlcul infinitesimal. Barcelona: EPSEB, 2003.
- Larson, R.L.; Hostetler R.B ; Edwards, B.H. Cálculo I i II. 8a ed. Madrid: McGraw-Hill, 2006.
- Bronson, Richard. Ecuaciones diferenciales. 3a ed. México, [etc.]: McGraw Hill, 2008. ISBN 9789701065099.
- Spiegel, Murray R. Ecuaciones diferenciales aplicadas. Prentice Hall, 1992.
- Finney, Ross L. Calculus : a graphing approach. Mexico: Addison-Wesley, 1993.

Complementary:

- Courant, Richard ; John, Fritz. Introducción al cálculo y al análisis matemático. Mexico: Limusa, 1978.
- Deminovich, B.P. ; Baranenkova, G. Problemas y ejercicios de análisis matemático. 11a ed. Madrid: Paraninfo, 1993. ISBN 8428300496.
- Thomas G. B., Finney R. L. Cálculo de varias variables. 9a ed. Mexico: Addison Wesley Logman, 1999.
- Zill, Dennis G. Ecuaciones diferenciales con aplicaciones de modelado. 8a ed. México: International Thomson, 2007. ISBN 9706864873.

RESOURCES

Audiovisual material:

- Sage (www.sagemath.org)

Computer material:

- Maple.

Hyperlink:

- ATENEA (<http://atenea.upc.edu/moodle/>). Entorn virtual de docència de la UPC desenvolupat utilitzant com a base tecnològica la plataforma de programari obert Moodle.
- Tutories de fase inicial (estudiants amb nivell baix de matemàtiques). (ENG) Resum teòrics, problemes resolts i problemes proposats de temes preliminars. <http://atenea.upc.edu>

Other resources:

On the virtual campus (ATENEA), we keep updated a logbook where we briefly summarize the content of each sessions, the individual tasks suggested and the resources to carry them out or to consolidate learning. The most used external resource are the videos from Khan Academy(www.khanacademy.org).