Universitat Autònoma de Barcelona

2021/2022

Calculus

Code: 103303
ECTS Credits: 7

Degree	Type	Year	Semester
2501922 Nanoscience and Nanotechnology	FB	1	1

The proposed teaching and assessment methodology that appear in the guide may be subject to changes as a result of the restrictions to face-to-face class attendance imposed by the health authorities.

Contact

Name: Juan Eugenio Mateu Bennassar
Email: Joan.Mateu@uab.cat

Use of Languages

Principal working language: catalan (cat)
Some groups entirely in English: No
Some groups entirely in Catalan: Yes
Some groups entirely in Spanish: No

Prerequisites

None

Objectives and Contextualisation

The topics "Calculus" (first quarter, first year), "Foundations of mathematics"(second quarter, first year) and "Mathematical tools"(first quarter, second year) are the mathematical courses within the degree in Nanoscience and Nanotechnology at UAB. These courses are of a basic nature whose main aim is to provide students with the mathematical tools and concepts required to properly model and analyze concepts in physics, chemistry etc. This one, "Calculus", of 7 ECTS, covers the differential and integral calculus in one and several variables, infinite series, basic ordinary differentail equations (exact, separate variables) and finally the basic concepts of vector analysis.

Competences

- Apply the concepts, principles, theories and fundamental facts of nanoscience and nanotechnology to solve problems of a quantitative or qualitative nature in the field of nanoscience and nanotechnology.
- Communicate orally and in writing in ones own language.
- Demonstrate knowledge of the concepts, principles, theories and fundamental facts related with nanoscience and nanotechnology.
- Interpret the data obtained by means of experimental measures, including the use of computer tools, identify and understand their meanings in relation to appropriate chemical, physical or biological theories.
- Learn autonomously.
- Manage the organisation and planning of tasks.
- Obtain, manage, analyse, synthesise and present information, including the use of digital and computerised media.
- Reason in a critical manner
- Resolve problems and make decisions.

Learning Outcomes

1. Abstract the essential variables of the phenomena studied, relate them to each other and deduce properties.
2. Communicate orally and in writing in ones own language.
3. Correctly use specific computer programs and data processors to accurately determine magnitudes of measurement and estimate the associated uncertainty.
4. Identify the mathematical nature of certain physical and chemical phenomena.
5. Learn autonomously.
6. Manage the organisation and planning of tasks.
7. Mathematize certain physical, chemical or biological processes and use accurate mathematical tools to obtain conclusions and interpret the results.
8. Obtain, manage, analyse, synthesise and present information, including the use of digital and computerised media.
9. Propose and resolve differential equations that are used to obtain results related with processes relative to the field of nanotechnology.
10. Propose mathematical models that describe physical and chemical phenomena.
11. Reason in a critical manner
12. Resolve problems and make decisions.
13. Show the necessary calculation skills to work correctly with formulas, chemical equations or physics models.
14. Use calculation and simulation tools to substantiate explanatory hypotheses of experimental measures.
15. Use graphic and numeric methods to explore, summarise and describe data.
16. Use statistical programs and apply statistical data treatment methods to the interpretation of the results.

Content

Unless the requirements enforced by the health authorities demand a prioritization or reduction, the contents are the following:

0. Survey of basic concepts of diffrential and integral calculus in one variable.

1. Ordinary differential equations. Separate variables, exact differential equations.

2. Taylor's formula

3. Series, power series and improper integrals.

4. Differential calculus in several variables.

5. Integral calculus in several variables.

6. Vector Analysis.

Methodology

There are three type of activities that the student is supposed to attend

Lectures: mainly theoretical. Here the contents of the course syllabus will be presented, and applied to solving problems of a physical nature.

Problem solving sessions. Here problems listed in exercise sheets will be solved under the supervision of a teaching assistant.

Seminars. Here the student will learn how to use specific math software, such as Maple,Maxima or Derive, to implement calculations, and to obtain graphic representations of concepts explained in the lectures.

The proposed teaching methodology may experience some modifications depending on the restrictions to face-to-face activities enforced by health authorities.

Annotation: Within the schedule set by the centre or degree programme, 15 minutes of one class will be reserved for students to evaluate their lecturers and their courses or modules through questionnaires.

Activities

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Lectures	45	1.8	1, 2, 13, 6, 4, 7, 8, 9, 10, 11, 16, 12, 3, 14, 15
Practising a toolbox	8	0.32	1, 5, 2, 13, 6, 4, 7, 8, 9, 10, 11, 16, 12, 3, 14, 15
Problem sessions	15	0.6	1, 5, 2, 13, 6, 4, 7, 8, 9, 10, 11, 16, 12, 3, 14, 15
Type: Supervised			
Submission of toolbox exercises	6	0.24	1, 5, 2, 13, 6, 4, 7, 8, 9, 10, 11, 16, 12, 3, 14, 15
Type: Autonomous			
Sudying theoretical concepts and solving problems	84	3.36	1, 5, 2, 13, 6, 4, 7, 8, 9, 10, 11, 16, 12, 3, 14, 15

Assessment

A continuous assessment is performed based on:

a) two mid-term exams, with grades EP1,EP2.

b) Work done in the seminars, with grade LLPR.

Submissions described in b) are mandatory, with no resit assesment.

The final score is obtained in two steps. First, if both EP1,EP2 >3,5, we compute

C1= (0,4)EP1+(0,4)EP2+(0,2)LLPR.

If C1 is greater than or equal to 5, the final score is C1. Otherwise, and in case the student has submitted b) above, the student may attend a resit exam whose score is denoted by RT. Then the final grade is

C2= (0,80)RT+(0,2)LLPR.

In case C1 is greater than or equal to 5, students may attend the resit exam to improve their grade, in which case the final score is max(C1,C2)..

Student's assessment may experience some modifications depending on the restrictions to face-to-face activities enforced by health authorities.

Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
First mid-term test	40%	3	0.12	1, 5, 2, 13, 6, 4, 7, 8, 9, 10, 11, 16, 12, 3, 14, 15
Resit exam	80%	4	0.16	1, 5, 2, 13, 6, 4, 7, 8, 9, 10, 11, 16, 12, 3, 14, 15

Second mid-term test	40%	3	0.12	1, 5, 2, 13, 6, 4, 7, 8, 9, 10, 11, 16, 12, 3, 14, 15
Submisson of toolbox exercises	20%	7	0.28	1, 5, 2, 13, 6, 4, 7, 8, 9, 10, 11, 16, 12, 3, 14, 15

Bibliography

The following books are recommended:

1. M. Brokate, P.Manchanda,A.H.Siddiqi, Calculus for Scientists and Engineers, http://link.springer.com/openurl?genre=book&isbn=978-981-13-8464-6

2. A.I. Khuri, Advanced Calculus with Applications in Statistics, https://onlinelibrary.wiley.com/doi/book/10.1002/0471394882

3. P. Dyke, Two and three dimensional Calculus with applications in science and engineering, https://onlinelibrary.wiley.com/doi/book/10.1002/9781119483731

Other useful references are:

S.L. Salas, E. Hille, G. Etgen, *Calculus*, Vol. 1 i 2, Ed. Reverté, 2002

J. Rogawski, Cálculo. Una y varias variables, Vol. 1 i 2, Ed. Reverté, 2012.

R. G. Bartle, D. R. Shebert, *Introducción al Análisis Matemático*, Ed. Limusa

J. M. Ortega, *Introducció a l'Anàlisi Matemàtica*, Ed. UAB

E. W. Swokowski, *Cálculo con geometría analítica*, 2 ed. Iberoamérica

J.E.Marsden-A.J.Tromba, Calculo Vectorial, Addison Wesley

Software

To decide