# Mathematical Tools I

Code: 106803
ECTS Credits: 6

**2024/2025**

| Degree | Type | Year |
|---|---|---|
| 2504602 Nanoscience and Nanotechnology | FB | 2 |

## Contact

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## Teaching groups languages

You can view this information at the end of this document.

## Prerequisites

There are none. The content and the methods introduced in this course presuppose knowledge of the first year M
*Fonaments de Matemàtiques* and
*Càlcul*.

## Objectives and Contextualisation

The aim of the course is to enable the students to use some mathematical tools which are necessary for the study and modeling of nanosystems: analysis and resolution of ordinary and partial differential equations.

## Learning Outcomes

1. CM06 (Competence) Identify the mathematical nature of certain physical and chemical phenomena, in order to abstract the essential variables that describe them.
2. CM07 (Competence) Solve real-world problems that occur in the field of science and technology using mathematical tools and methods.
3. KM08 (Knowledge) Identify the elementary mathematical models and tools used in calculus, linear algebra and differential equations.
4. KM09 (Knowledge) Understand the idea behind numerical methods: precision, discretisation, numerical error, conditioning, standardisation.
5. KM10 (Knowledge) Identify the basic tools and notions of statistical data processing.
6. KM11 (Knowledge) Recognise the mathematical methods (calculus, algebra, numerical) used for probabilistic modelling.
7. SM09 (Skill) Express oneself clearly using basic mathematical language.
8. SM09 (Skill) Express oneself clearly using basic mathematical language.
9. SM11 (Skill) Use statistical methods and programmes to process data and analyse specific problems.
10. SM12 (Skill) Use graphical and numerical methods to explore, describe and interpret data.
11. SM12 (Skill) Use graphical and numerical methods to explore, describe and interpret data.

## Content

I. INTEGRATION ON CURVES AND SURFACAES

- Líne and surface integrals
- Vector Analysis: Teorems of Green, Gauss nd Stokes

II. DIFFERENTIAL EQUATIONS

- Ordinary Diferential Equacions of the First and Second order
- Fourier Series and Transforms
- Introduction to Partial Differential Equations.

## Activities and Methodology

| Title | Hours | ECTS | Learning Outcomes |
|---|---|---|---|
| Type: Directed | | | |
| Problems classes | 12 | 0.48 | CM07, SM09, SM12 |
| Theory classes | 36 | 1.44 | CM06, KM08, SM09 |
| Type: Supervised | | | |
| Practical classes | 4 | 0.16 | CM07, KM09, SM09, SM12 |
| Type: Autonomous | | | |
| Personal study | 32 | 1.28 | |
| Problem solving | 60 | 2.4 | CM07, KM09 |

- Theory classes: The concepts and methods of the different subjects will be introduced, with a variety of examples.

- Problems classes: Teachers will solve selected exercises from a collection that will be available to the students beforehand.

- Practical classes: They will be held in a computer classroom. Activities will be proposed to be carried out by means of an adequate software. The results of this practical work must be presented within a given deadline.

- Autonomous work: It is imperative that students complement face-to-face activities with autonomous, individual or group work; to practice the resolution of problems is especially important.

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.

## Assessment

## Continous Assessment Activities

| Title | Weighting | Hours | ECTS | Learning Outcomes |
|---|---|---|---|---|
| Delivery of solved problems | 10% | 0 | 0 | CM07, KM08, SM09 |
| Partial exams: | 80% | 6 | 0.24 | CM06, CM07, KM08, KM11, SM09 |
| Results of the practical sessions | 10% | 0 | 0 | KM09, KM10, SM11, SM12 |

Partial exams: Two partial tests will be carried out, with a weight in the final evaluation of 40% each. At the end of the course, a re-evaluation exam for this 80% will be held for students who need it.

Practical sessions and delivery of solved problmes: The remaining 20% will come from the evaluation of the delivered problems and from the results of the practical sessions in equal parts. The presentation of the results of the practical sessions will be mandatory.

Re-evaluation: There will be a re-evaluation for one or both partial exams. Only students who have completed 2/3 of the assessment activities, this means both term tests, may opt for the re-evaluation.

The student who carries out evaluation activities that involve less than 50% of the total evaluation will be considered "not assessable".

## Bibliography


- S. L. Salas, E. Hille, G. Etgen, *Calculus: una y varias variables*, vol II, Reverté (2003). https://bibcercador.uab.cat/permalink/34CSUC_UAB/1c3utr0/cdi_digitalia_books_DIGRVRT0116
- W. E. Boyce, R. C. DiPrima, D. B. Meade, *Boyce's Elementary Differential Equations and Boundary Value Problems,* William, John Wiley & Sons (2017)
- J. David Logan, *A First Course in Differential Equations,* Springer 2006 https://bibcercador.uab.cat/permalink/34CSUC_UAB/1eqfv2p/alma991010559602206709
- J. David Logan, *Applied Partial Differential Equations*, Springer 2004 https://bibcercador.uab.cat/permalink/34CSUC_UAB/avjcib/alma991010893893606709


## Software

maxima: https://maxima.sourceforge.io/

Python

## Language list

| Name | Group | Language | Semester | Turn |
|---|---|---|---|---|
| (PAUL) Classroom practices | 1 | Catalan/Spanish | first semester | afternoon |
| (PLAB) Practical laboratories | 1 | Catalan | first semester | morning-mixed |
| (PLAB) Practical laboratories | 2 | Catalan | first semester | morning-mixed |

| | | | | |
|---|---|---|---|---|
| (TE) Theory | 1 | Catalan | first semester | afternoon |