

Mathematical Tools II

Code: 106804
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 IV *Fonaments de Matemàtiques* and *Càlcul*.

Objectives and Contextualisation

To provide the ability to use some tools of Applied Statistics and Probability necessary for the study of nanosystems: without presupposing any prior knowledge of Probability or Statistics the students must reach a degree of familiarity with various statistical techniques.

Students will learn to deal with problems related to data analysis, such as planning the research that will generate the data, analyzing the data obtained, and interpreting the results.

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.

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Content

- Descriptive Statistics
- Concepts of Probability
- Probability Distributions
- Sampling Distributions
- Estimation
- Testing of hypotheses

Activities and Methodology

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Practical classes	4	0.16	CM07, KM09, KM10, SM11, SM12
Practical classes	12	0.48	CM07, KM08, KM10, KM11, SM09, SM11, SM12
Theory classes	36	1.44	CM06, CM07, KM09, KM10, KM11, SM11, SM12
Type: Autonomous			
Personal study	36	1.44	CM06, KM08, KM09, KM10, KM11
Preparation of the practical sessions	4	0.16	KM08, KM09, KM10, KM11
Problem solving	52	2.08	CM06, CM07, KM08, KM11, SM09, SM12

- 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.

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Assessment

Continous Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
Delivery of solved problems	10%	0	0	CM07, KM08, KM09, SM09, SM11, SM12
Partial exams	80%	6	0.24	CM06, CM07, KM08, KM09, KM10, KM11, SM09
Results of the practical sessions	10%	0	0	CM07, KM09, KM11, SM09, 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 problems: 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: Only students who have completed 60% of the assessment activities may opt for the re-evaluation; this means both term tests, or one term tests, the practical sessions and all of the problems delivered.

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

Single Assessment (UA):

Students following the single evaluation modality must take a final test similar to the partial exams but comprising all the subject matter. This test will be carried out on the same day that the second partial exam and it will account for a 90% of the grade.

The results of the practical sessions is also mandatory, in the same dates as the other students, and will account for the remaining 10% of the grade.

Bibliography

- R. Delgado de la Torre, *Probabilidad y estadística para ciencias e ingenierías*, Delta, 2008.
- S. M. Ross, *Introduction to Probability and Statistics for Engineers and Scientists*, 4th Ed. Academic Press 2009
- B. C. Gupta, I. Guttman, K. P. Jayalath, *Statistics and Probability with applications for engineers and scientists using minitab, R, and JMP*, Wiley (2020) ([ebook](#))

Software

R, Python

Language list

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

PROVISIONAL