UAB
Universitat Autònoma de Barcelona

Mathematics for Geology

Code: 101045
ECTS Credits: 10

2025/2026

Degree	Type	Year
Geology	FB	1

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Teachers

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Teaching groups languages

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

Prerequisites

The subject has no official prerequisites. Due to its content, it should be easy to assimilate for students who have a good high school education. They have taken Mathematics subjects and passed the entrance exam to the University. But experience tells us the opposite. Geological students have many basic deficiencies in mathematics. Thus, without any criticism, they accept that sin(pi)=0.03 if the calculator tells them so. They also have many difficulties in simple algebraic calculations: simplifying, finding a common factor, calculating with roots, when faced with an equation of the type x^2-3x^2 log x=0, they do not know what to do, or they do not know how to solve a linear system of two equations with three unknowns, or derive the function f(x)= xe^x, etc. People who see that they have these deficiencies should try to overcome them. They should be aware that they will have to make much more effort than their classmates. They can also resort to reviewing concepts of the style in their high school books.

1) Simple algebraic calculation. Powers, roots and logarithms.

2) Combinatorics and power of a binomial.

3) Direct calculation of derivatives of real functions.

It is also very important that the Geological student appreciates that mathematics can be useful in their professional life and may be essential. Currently, many of them believes that they are not important or are inaccessible to them. The mentality of these students towards mathematics must change a lot.

Objectives and Contextualisation

This subject should serve to consolidate basic knowledge of mathematics that will be useful for understanding concepts used in Geology, for example variation with respect to depth of temperature inside the Earth. They will also be necessary to address, in higher courses, other more specialized subjects of the Geology Degree.

Competences

- Learn and apply the knowledge acquired, and use it to solve problems.
- Synthesise and analyse information critically.
- Use mathematical tools to solve geological problems.
- Work independently.

Learning Outcomes

1. Apply mathematical techniques to problems in geology.
2. Calculate determinants and decompositions of matrices.
3. Calculate probabilities in elementary situations.
4. Correctly handle numerical methods with attention to margins of error.
5. Formulate and solve hypothesis contrast problems in one or two populations.
6. Handle random variables and know their usefulness for modelling real phenomena.
7. Interpret the basic properties of point estimators and interval estimators.
8. Learn and apply the knowledge acquired, and use it to solve problems.
9. Make appropriate use of the rules of derivation and integration of functions.
10. Produce and interpret graphic and numerical expressions.
11. Recognise real situations in which the most common probabilistic distributions appear.
12. Resolve and discuss linear equation systems.
13. Solve geometric plane and space problems.
14. Synthesise and analyse information critically.
15. Synthesise and descriptively analyse data sets.
16. Use a statistical package to handle large data sets.
17. Use software packages for numerical and symbolic calculation.
18. Use the basic mathematical language used in geology.
19. Use the concept of independence.
20. Work independently.

Content

Àlgebra Lineal i geometria (3 ECTS)

1. Repàs de conceptes bàsics.
Nombres racionals i nombres reals. Operacions, arrels. Relació d'ordre. Equacions, inequacions.

2. Sistema d'equacions lineals. Matrius.
Definicions. Operacions elementals per files. Càlcul matricial.
Matriu inversa. Resolució de sistemes lineals. Determinants

3. Geometria plana.

Distància entre punt i recta. Triangles i funcions trigonomètriques. Resolucions de triangles. Equacions trigonomètriques

4. Geometria a l'espai.
Els espais vectorials R^2, R^3. Subespais i varietats. Vectors linealment independents i bases. Producte escalar i producte vectorial. Distàncies entre varietats.

Càlcul (3 ECTS)

1. Funcions reals de variable real.
Repàs de conceptes bàsics. Definició de funció. Domini i recorregut. Gràfiques. Operacions amb funcions. Funció inversa. Exemples de funcions importants (polinòmiques, exponencials, ...).

2. Límits i continuïtat.
Límit d'una funció en un punt. Generalitzacions del concepte de límit. Càlcul de límits de funcions. Continuïtat d'una funció en un punt i en un interval. Discontinuïtats d'una funció. Teorema de Bolzano.

3. Derivades i aplicacions
La derivada d'una funció en un punt. Regles de derivació. La regla de la cadena. Teorema del valor mig. Creixement i decreixement d'una funció. Extrems locals. Extrems i valors extrems absoluts. Concavitat i punts d'inflexió. Aplicacions: problemes d'optimització.

4. Càlcul integral.
Primitives. Integral definida d'una funció continua. Teorema fonamental del càlcul. Teorema de Barrow. Tècniques d'integració. Aplicacions del Càlcul Integral.

Càlcul numèric i gràfic (2 ECTS)

1. Errors.

Definicions. Errors operacionals. Llei de propagació d'errors. Aplicacions.

2.Escales.
Definicions. Construcció d'escales. Error de les escales. Aplicacions.

3 Ajust de dades empíriques.
Equacions empíriques. Rectificació. Casos més corrents. Aplicacions.

4. Resolució numèrica d'equacions.
El mètode de Bolzano, bisecció, secant i Newton. Acotació dels errors. Aplicacions.

5. Interpolació i extrapolació
El mètode de Lagrange. Els "splines" cúbics.

6. Derivació i integració numèriques i gràfiques.
Fórmules de derivació. Acotació de l'error. El mètode dels trapezis. La fórmula de Simpson i regla 3/8

Estadística (2 ECTS)

1.1 Propietats bàsiques de la probabilitat. Probabilitat condicionada. Fórmula de les Probabilitats Totals. Fórmula de Bayes.

1.2 Variables aleatòries.

Variables discretes: Bernoulli, Binomial, Hipergeomètrica.

1.3 La distribució Normal.

Aproximació de la Binomial per la Normal.

2.1 Introducció a l'Estadística.

Població i mostra, paràmetres i estimadors. Distribució de la mitjana mostral en el cas normal amb variància coneguda. El Z-estadístic. Interval de confiança per a la mitjana de la normal amb variància coneguda.

2.2 La distribució t de Student.

El cas de variància desconeguda: el T-estadístic. Interval de confiança per a la mitjana de la normal amb variància desconeguda.

2.3 Introducció als tests d'hipòtesis. Tests d'hipòtesis per a la mitjana de la normal amb variància coneguda. Tests d'hipòtesis per a la mitjana de la normal amb variància desconeguda.

Activities and Methodology

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Practices	19	0.76	14, 1, 8, 2, 3, 7, 4, 6, 5, 10, 11, 12, 13, 15, 20, 9, 19, 18, 17, 16
Problems in the classroom	16	0.64	14, 1, 8, 2, 3, 7, 4, 6, 5, 10, 11, 12, 13, 15, 20, 9, 19, 18, 17, 16
Theory	50	2	14, 1, 8, 2, 3, 7, 4, 6, 5, 10, 11, 12, 13, 15, 20, 9, 19, 18, 17, 16
Type: Autonomous			
Personal and team work made by the students	153	6.12	14, 1, 8, 2, 3, 7, 4, 6, 5, 10, 11, 12, 13, 15, 20, 9, 19, 18, 17, 16

This annual subject has a complicated structure since it consists of four areas of mathematics that are related to each other, but at the same time somewhat independent of each other. They are the part of Algebra and Geometry (A), Calculus (C), Numerical Calculus (CN) and Statistics (E), which will be given the generic name of modules and will provide us with explanations in the guide. Each of them has theory, problems and practices. Specifically, there are 30 hours of theory, 5 of problems and 6 of practices in (A) and (C), 10 hours of theory, 3 hours of problems and 4 hours of practices for (CN) and 10 hours of theory, 3 of problems and 3 of practices for (E).

In view of the face-to-face hours, it is clear that in the learning process of this subject, the constant work of the student throughout the year will be fundamental. You will have the help of the teaching team at all times and will have online tutoring and consultation schedules.

The face-to-face hours are distributed as follows:

Theory: The teacher introduces the basic concepts corresponding to the subject matter, showing examples of their application, which will be done in the classroom using the traditional chalk and blackboard method.

Problems: The understanding of the concepts introduced in theory is worked on by completing problems and discussing practical cases. Students will previously have lists on the Virtual Campus that the student will have to work on their own. Given the few hours of problems available, only model problems can be done in the problem class.

Practical classroom. The student will learn to use symbolic, numerical and statistical mathematical calculation program packages (Maxima, Excel). The practical classes will be held in the computer rooms. In these classes, the application of mathematical tools to problems that require the use of a computer program will be worked on. The objective of this learning will be for the student to be able to use the computer to address (and be able to solve) any mathematical question that they may need to consider in the future.

The use of the Virtual Campus will be of vital importance. This will be the most important channel of communication between students and teachers. Course material will be posted there, for example problem lists or theory summaries. It will also be the means to make the qualifications known. It will be important to consult the Virtual Campus frequently.

The tutoring schedule of the teachers will be made public. It is highly recommended that students make use of these tutoring hours to resolve any doubts that arise throughout the course. In any case, help in resolving doubts by telematic means will be guaranteed.

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
Parcial exams	70%	12	0.48	14, 1, 8, 2, 3, 7, 4, 6, 5, 10, 11, 12, 13, 15, 20, 9, 19, 18, 17, 16

With the objective of avoiding possible translation errors of legal interpretation and also with the objective of facilitating the learning of the Catalan language for students who do not know it, we will put here a short text highlighting the essential points of the evaluation. It is advised that they must make a look at the corresponding section of the guide in Catalan. If in doubt, ask your teachers, they will be happy to answer your questions.

The subject consists of the following assessment activities:

a) Process and scheduled assessment activities

The assessment of each module is similar and will essentially consist of an assessment of the practices and the theory.

Each module will be graded based on E = grade of a theory exam and/or problems of the entire module, P = grade of practices, C = grade of a possible intermediate control.

The grade for each module, denoted by Q(module), will be calculated as

Q(A)= 0.7*E + 0.2*P + 0.1*C

Q(C)= 0.7*E + 0.2*P + 0.1*C

Q(CN)= 0.7*E + 0.3*P

Q(E)= 0.75*E + 0.25*P

The grade for partials will be

$$QP= 0.3*(Q(A)+ Q(C))+0.2*(Q(CN)+Q(E)).$$

If QP is greater than or equal to 5, the course is approved for partials.

b) Recovery process.

Students who have not passed partial exams will be able to retake the modules they have not passed, or improve their grade, by taking the retake exam that will take place at the end of the course. For each module, the grade E will be retaken, but not the P or C. There is no restriction on taking the retake exams. The grade obtained is denoted ER in each module that is taken.

The grade for each module will be calculated by replacing the value E with the maximum value {E, ER} in the previous formulas.

The final grade for the subject, which we will denote QF, will then be obtained with the same formula

QF= 0.3 * (QA+ QC) + 0.2 * (QCN+QE).

where QA,QC,QCN,QE are the grades of the corresponding modules after retake.

In the event that, after the recovery, the grade of any module is lower than 3, and QF is greater than or equal to 5. the teaching team must assess the situation.

The student will have a NO AVALUABLE if, at most, they have taken 4 evaluation tests of the entire subject (midterm exams, final exams, practical, etc.). Thus, the student who has taken 5 or more tests represents that they have been following the course and will be awarded the grade that results from the formulas.

Bibliography

Bibliografia bàsica

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- Introducción al Álgebra Lineal, H. Anton,(editorial Limusa), 1986
- Àlgebra Lineal con Aplicaciones. G. Nakos, D. Joyner, International Thomson, Mexico, 1999.

2) Càlcul
- Calculus I, S. Salas, E. Hille, editorial Reverté, 1994.

3) Càlcul numèric i gràfic
- Càlcul numèric, C. Bonet, A. Jorba, Mª T. Martínez-Seara, J. Masdemont, M. Ollé, A. Susin i M. València. Edicions UPC. Barcelona 1994

4) Estadística
- Probabilidad y Estadística para Ciencias e Ingenierías, R. Delgado, Publicaciones Delta 2008.

Bibliografia adicional

- Mathematics in Geology, J. Ferguson. Allen & Unwin. Londres,1988.
-Mathematics: A Simple Tool for Geologists, D. Waltham. Blackwell Science. Oxford, 2000.

Software

The Maxima program will be used in the Algebra and Calculus practices. In Numerical Calculus the EXCEL spreadsheet will be used. The student will be able to use other free-to-use programs such as Sage or Wolfram Alpha, and others licensed by the University.

This type of knowledge in the use of programs will be absolutely essential in his future if he is to make use of mathematics.

Groups and Languages

Please note that this information is provisional until 30 November 2025. You can check it through this link. To consult the language you will need to enter the CODE of the subject.

Name	Group	Language	Semester	Turn
(PAUL) Classroom practices	1	Catalan	annual	morning-mixed
(PLAB) Practical laboratories	1	Catalan	annual	morning-mixed
(PLAB) Practical laboratories	2	Catalan	annual	morning-mixed
(TE) Theory	1	Catalan	annual	morning-mixed