Course guide
330460 - MAEM - Mathematics Applied to Mining Engineering

Last modified: 25/04/2024

Unit in charge: Manresa School of Engineering
Teaching unit: 749 - MAT - Department of Mathematics.

Degree: BACHELOR'S DEGREE IN MINERAL RESOURCE ENGINEERING AND MINERAL RECYCLING (Syllabus 2021). (Compulsory subject).
BACHELOR'S DEGREE IN MINERAL RESOURCE ENGINEERING AND MINERAL RECYCLING / BACHELOR'S DEGREE IN ENVIRONMENTAL ENGINEERING (Syllabus 2024). (Compulsory subject).

Academic year: 2024 **ECTS Credits:** 3.0 **Languages:** Catalan

LECTURER

Coordinating lecturer: Gilibets Palau, Inmaculada
Rossell Garriga, Josep Maria

Others: Alsina Aubach, Montserrat
Freixas Bosch, Josep
Domenech Blazquez, Margarita
Cors Iglesias, Josep M.
Sanchis Ferri, Francisco Miguel
Puente Del Campo, Maria Albina
Gimenez Pradales, Jose Miguel
Ventura Capell, Enric
Rubió Massegú, Josep
Delgado Rodríguez, Jorge
Bastardas Ferrer, Gemma

PRIOR SKILLS

Basic knowledge of linear algebra and calculus

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
CE10. (ENG) Coneixement de càlcul numèric bàsic i aplicat a l'enginyeria.
CE9. (ENG) Comprensió dels conceptes d'aleatoritat dels fenòmens físics, socials i econòmics, així com d'incertesa.
CE8. (ENG) Capacitat per a la resolució d'equacions diferencials ordinàries i la seva aplicació en problemes d'enginyeria.

Transversal:
07 AAT N2. SELF-DIRECTED LEARNING - Level 2: Completing set tasks based on the guidelines set by lecturers. Devoting the time needed to complete each task, including personal contributions and expanding on the recommended information sources.
04 COE N2. EFFICIENT ORAL AND WRITTEN COMMUNICATION - Level 2. Using strategies for preparing and giving oral presentations. Writing texts and documents whose content is coherent, well structured and free of spelling and grammatical errors.

Basic:
CB2. Students will be able to apply their knowledge to their work or vocation in a professional manner and demonstrate that they possess the competencies that are typically demonstrated by elaborating and defending arguments and solving problems in the field of study.
CB3. That students have the ability to gather and interpret relevant data (usually within their area of study) to make judgments that include a reflection on relevant social, scientific or ethical issues.
CB4. Students can transmit information, ideas, problems and solutions to a specialized and non-specialized audience.
CB5. Students have developed those learning skills necessary to undertake further studies with a high degree of autonomy.

TEACHING METHODOLOGY

In the lectures, the professor introduces the theory, concepts, methods and results pertaining to the subject and illustrates them with examples that aid comprehension. Students' participation, reflection and debate in the classroom and Moodle are encouraged.
Students must study and do the exercises proposed independently so as to assimilate the topics covered. In the practical sessions, problems are solved with computers and any questions that come up are addressed.

LEARNING OBJECTIVES OF THE SUBJECT

Upon completion of the subject MATHEMATICS APPLIED TO MINING ENGINEERING, students must be able to:
- Organise and apply theoretical knowledge to solve engineering problems.
- Interpret the results obtained with the help of computer tools.
- Apply critical reasoning in decision making.
- Demonstrate knowledge of the concepts of randomness and uncertainty associated with physical, social and economic phenomena.

STUDY LOAD

Type	Hours	Percentage
Self study	45,0	60.00
Hours large group	15,0	20.00
Hours small group	15,0	20.00

Total learning time: 75 h

CONTENTS

Errors

Description:
Basic concepts
Representation of floating-point numbers
Types of errors and propagation

Specific objectives:
Identify the different types of errors that may be made
Demonstrate awareness of error propagation in operations

Related activities:
A1, E1

Full-or-part-time: 4h
Theory classes: 2h
Self study : 2h

Interpolation and approximation of functions

Description:
Introduction
Types of interpolation problems
Polynomial interpolation
Data fitting

Specific objectives:
Solve interpolation problems numerically
Calculate interpolation error

Related activities:
A1, E1

Full-or-part-time: 10h
Theory classes: 2h
Laboratory classes: 2h
Self study : 6h

Numerical integration

Description:
Basic and compound quadrature formulas
Gaussian quadrature

Specific objectives:
Use formulas to approximate definite integrals of functions

Related activities:
A1, E1

Full-or-part-time: 10h
Theory classes: 2h
Laboratory classes: 2h
Self study : 6h

Ordinary differential equations

Description:
Introduction
Initial value problems: Taylor and Runge-Kutta methods

Specific objectives:
Describe and use numerical methods to solve ordinary differential equations
Evaluate the methods used

Related activities:
E1

Full-or-part-time: 10h
Theory classes: 2h
Laboratory classes: 2h
Self study : 6h

Numerical solution of non-linear equations

Description:
Introduction
Bisection method
Newton method
Fixed-point method

Specific objectives:
Evaluate and use the most appropriate method for finding the zeros of a non-linear equation

Related activities:
A2

Full-or-part-time: 18h
Theory classes: 3h
Laboratory classes: 4h
Self study : 11h

Solution of linear systems

Description:
Introduction. Matrix norms
Direct and iterative methods

Specific objectives:
Describe, analyze and use numerical methods to solve systems of linear equations

Related activities:
E2

Full-or-part-time: 21h
Theory classes: 3h
Laboratory classes: 6h
Self study : 12h

Engineering simulation: randomness and uncertainty

Description:
Random actions and parameters
Monte Carlo method
Probability of error

Specific objectives:
Understand the concepts of randomness and uncertainty in engineering models and simulation

Related activities:
E2

Full-or-part-time: 3h
Theory classes: 1h
Self study : 2h

ACTIVITIES

Activity A1

Description:
Individual assignment

Specific objectives:
Calculate the interpolating polynomial and find the error
Choose the right calculation method for fitting data
Evaluate and use quadrature formulas and find the error
Use appropriate computer tools

Material:
Software
Materials available in the Atenea course

Delivery:
The assignment must be handed in to the professor before the deadline

Full-or-part-time: 1h
Theory classes: 1h

Activity A2

Description:
Group assignment

Specific objectives:
Detect the solutions to a non-linear equation
Apply the most appropriate solving method
Compare different solving methods
Use appropriate computer tools

Material:
Software
Materials available in Athena course

Delivery:
The assignment must be handed in to the professor before the deadline

Full-or-part-time: 2h
Self study: 2h

Exams E1, E2

Description:
Individual written exam in the classroom on the topics' learning objectives

Specific objectives:
Evaluate the achievement of the topics' objectives and demonstrate it in solving a specific engineering problem
Exam E1 covers topics 1, 2, 3 and 4
Exam E2 covers topics 5, 6 and 7

Material:
Exam paper (to be handed in at the exam)

Delivery:
The exam must be handed in to the professor in the time available

Full-or-part-time: 12h
Self study: 8h
Theory classes: 4h

GRADING SYSTEM

The mark is calculated from:
- The mark for participation (NP), which is awarded for attendance at practicals, individual work and the tasks proposed in the classroom that are handed in. This mark is definitive and the activities cannot be retaken.
- The mark for activities (NA), which is awarded for the reports on individual or group practical work that are handed in.
- The mark for written exams (NE) that control content learning.
The final mark for continuous assessment is calculated using the formula NC=0.7*NE + 0.2*NA+0.1*NP and the objectives are considered to have been met if it is equal to or greater than 5.
Students with a mark for the subject (NC) of less than 5 may take a final examination (mark NG). In this case, students' final mark is NF=maximum(NC, 0.1*NP + 0.9*NG).

EXAMINATION RULES.

All the activities are compulsory.
If students do not carry out one of the activities for the subject they will be given a mark of 0.

BIBLIOGRAPHY

Basic:
- Faires, J. Douglas; Burden, Richard L. Métodos numéricos. 3ª ed. Madrid: International Thomson Paraninfo, cop. 2004. ISBN 8497322800.
- Chapra, Steven C; Canale, Raymond P. Métodos numéricos para ingenieros [on line]. 5ª ed. México [etc.]: McGraw-Hill, cop. 2007 [Consultation: 19/09/2022]. Available on: https://www-ingebook-com.recursos.biblioteca.upc.edu/ib/NPcd/IB_BooksVis?cod_primaria=1000187&codigo_libro=8100. ISBN 9789701061145.