Course guide
205266 - MNQ - Numerical and Quantitative Methods

Last modified: 20/06/2024

Unit in charge: Terrassa School of Industrial, Aerospace and Audiovisual Engineering
Teaching unit: 749 - MAT - Department of Mathematics.
732 - OE - Department of Management.

Degree: BACHELOR'S DEGREE IN INDUSTRIAL TECHNOLOGY ENGINEERING (Syllabus 2010). (Compulsory subject).

Academic year: 2024 **ECTS Credits:** 7.5 **Languages:** Catalan

LECTURER

Coordinating lecturer: ANGELA ARAGON
ELENA MARTÍ BADIA

Others: GISELA PUJOL
JORDI SALUDES

PRIOR SKILLS

Topics on calculus, and modeling of linear equations.

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
CE01-INDUS. Ability to solve mathematical problems that may arise in engineering. Aptitude to apply knowledge of linear algebra; geometry; differential geometry; differential and integral calculus; differential and partial differential equations; numerical methods; numerical algorithms; statistics and optimization. (Basic training module)
CE06-INDUS. Adequate knowledge of the concept of a company, institutional and legal framework of the company. Organization and management of companies. (Basic training module)

Transversal:
CT06 N2. Self-directed learning - Level 2Completing 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.

TEACHING METHODOLOGY

The course is divided into three parts:
* Lecture sessions.
* Practical sessions (exercises and problems).
* Self-study and doing exercises and activities.
In the content of the sessions, teachers will introduce the theoretical foundations of the subject, concepts, methods and illustrate with examples appropriate to facilitate understanding.
In practical sessions in the classroom, teachers guide students in applying theoretical concepts to problem solving, based on critical thinking at all times. The exercises will be proposed that students solve exercises in the classroom and outside the classroom, to promote contact and use the basic tools needed to solve problems.
Students, autonomously, should work the material provided by the teacher and the result of the work sessions, to assimilate concepts. Teachers will provide a study plan and monitoring activities (ATENEA).

LEARNING OBJECTIVES OF THE SUBJECT

Provide to the students with the basic tools and methods of computation and mathematical programming to study how to implement other subjects for the degree.

STUDY LOAD

Type	Hours	Percentage
Hours small group	14,0	7.45
Hours large group	61,0	32.45
Self study	113,0	60.11

Total learning time: 188 h

CONTENTS

Module 1: Numerical Methods.

Description:
I.- Introduction: Basic concepts on numerical methods. Absolute and relative errors. Numerical errors due to truncation and rounding.
II.- Nonlinear equations: Numerical solution to nonlinear equations by using the bisection, secant, Newton, and iteration of the fixed point algorithms. Bolzano and Rolle Theorems. Numerical errors.
III.- Approximation of functions: Polynomial function approximation. Taylor and Weierstrass theorem to numerical error estimation. Newton's Theorem on polynomial approximation of functions.
IV.- Approximation of functions. Polynomial function approximation by using the concept of minimal quadrats. Numerical errors.
V.- Numerical Integration: Numerical integration of functions by using the trapecio, Simpson, and â□□ Simpson rules. Numerical errors.
VI.- Ordinary differential equations: Numerical solution to ordinary differential equations by the Euler's method. Introduction to the Runge-Kutta's rule. Numerical errors.

Specific objectives:
Faculty to solve engineering mathematical problems by using numerical methods. Feasibility of applied numerical concepts to solve nonlinear equations, differential equations, statistics optimization, etc. Ability to program numerical methods in Python or similar.

Full-or-part-time: 150h
Theory classes: 46h
Laboratory classes: 14h
Self study : 90h

Module 2: Quantitative Methods.

Description:
I.- Enterprise definition and its structure
II.- Linear Programming
III.- Dual Model and Sensibility
IV.- Mix-Integer Linear Programming

Specific objectives:
To learn the concept of an enterprise and understand its institutional and juridic rules.
To use organization and management methods to enterprises.
To apply mix-integer linear programming to enterprises.

Full-or-part-time: 37h 30m
Theory classes: 15h
Self study : 22h 30m

ACTIVITIES

ACTIVITY 1: LARGE GROUP SESSIONS / THEORY

Description:
Prior and subsequent preparation of the theory sessions and attendance at these.

Specific objectives:
Transfer the necessary knowledge for a correct interpretation of the content developed in the large group sessions, resolution of doubts about the course items, and development of generic skills.

Material:
During some sessions, face-to-face exercises will be carried out in class, individually, or in small groups.

Full-or-part-time: 112h 15m
Self study: 56h 15m
Theory classes: 56h

ACTIVITY 2: SMALL GROUP SESSIONS / PRACTICES

Description:
Preparation before and after the sessions of problems, practices and assistance to these

Specific objectives:
Acquire the skills for a correct interpretation of the problems of the subject, as well as a satisfactory resolution of these.
Preparation for the practical part of the subject exams.
Development of generic skills.

Material:
During these sessions, the teaching staff and the student would develop practical exercises, face-to-face in class or virtual, individually or in small groups.

Full-or-part-time: 36h 55m
Self study: 22h 55m
Laboratory classes: 14h

ACTIVITY 3: MIDTERM EXAM

Description:
Individual and written test on the contents of module 1.

Specific objectives:
The test must demonstrate that the student has acquired and assimilated the basic concepts, principles and fundamentals related to the module1.

Material:
Statement of the partial proof.

Delivery:
The delivery will be the resolution of the proof.

Full-or-part-time: 2h
Theory classes: 2h

ACTIVITY 4: FINAL EXAM

Description:
Individual and written test of modules 1 and 2.

Specific objectives:
The test has to demonstrate that the student has acquired and assimilated the basic concepts, principles and fundamentals related to module 1 and 2.

Material:
Statement of the final test

Delivery:
The delivery will be the resolution of the proof.

Full-or-part-time: 3h
Theory classes: 3h

ACTIVITY 5: PRACTICES

Description:
Practices of module 1.

Specific objectives:
Synthesis exercise of module 1.

Material:
Statement and work guidelines.

Delivery:
Activity memory.

Full-or-part-time: 33h 20m
Self study: 33h 20m

GRADING SYSTEM

- Partial exam module 1: 25%
- Final exam of module 1: 30%
- Final exam of module 2: 20%
- Tasks of the 1st evaluation of module 1: 12.5%
- Tasks of the 2nd evaluation of module 1: 12.5%

Remark: In this subject, there is no revaluation nor other.

BIBLIOGRAPHY

Basic:
- Kincaid, D.; Cheney, W. Análisis numérico: las matemáticas del cálculo científico. Argentina: Addison-Wesley Iberoamericana, 1994. ISBN 0201601303.
- Dahlquist, G.; Björck, A. Numerical methods. Englewood Cliffs: Prentice-Hall, 1974. ISBN 0136273157.
- Burden, R.L.; Faires, J. D. Análisis numérico. 7a ed. México: International Thomson, 2002. ISBN 9706861343.
- Press, W.H. [et al.]. Numerical recipes: the art of scientific computing. 3rd ed. Cambridge: Cambridge University Press, 2007. ISBN 9780521884075.

RESOURCES

Other resources:
Python
Theoretical lectures
Set of exercises
Atenea open questions