

Course guide

330061 - M3 - Mathematics III

Last modified: 19/05/2023

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

Degree: BACHELOR'S DEGREE IN CHEMICAL ENGINEERING (Syllabus 2009). (Compulsory subject).
BACHELOR'S DEGREE IN ELECTRICAL ENGINEERING (Syllabus 2009). (Compulsory subject).
BACHELOR'S DEGREE IN INDUSTRIAL ELECTRONICS AND AUTOMATIC CONTROL ENGINEERING (Syllabus 2009). (Compulsory subject).
BACHELOR'S DEGREE IN MECHANICAL ENGINEERING (Syllabus 2009). (Compulsory subject).
BACHELOR'S DEGREE IN CHEMICAL ENGINEERING (Syllabus 2016). (Compulsory subject).
BACHELOR'S DEGREE IN INDUSTRIAL ELECTRONICS AND AUTOMATIC CONTROL ENGINEERING (Syllabus 2016). (Compulsory subject).
BACHELOR'S DEGREE IN MECHANICAL ENGINEERING (Syllabus 2016). (Compulsory subject).
BACHELOR'S DEGREE IN MINERAL RESOURCE ENGINEERING AND MINERAL RECYCLING (Syllabus 2021). (Compulsory subject).

Academic year: 2023 **ECTS Credits:** 6.0 **Languages:** Catalan

LECTURER

Coordinating lecturer: Domenech Blazquez, Margarita

Others: Alsina Aubach, Montserrat
Cors Iglesias, Josep M.
Freixas Bosch, Josep
Gimenez Pradales, Jose Miguel
Puente Del Campo, M. Albina
Rossell Garriga, Josep Maria
Rubió Masegú, Josep
Samaniego Vidal, Daniel
Ventura Capell, Enric

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:

1. CE1: Ability to solve mathematical problems that may arise in engineering. Ability to apply knowledge about: linear algebra, geometry, differential geometry, differential and integral calculus, differential and partial differential equations, numerical methods, numerical algorithms, statistics and optimization.

Transversal:

2. 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.
3. TEAMWORK - Level 2. Contributing to the consolidation of a team by planning targets and working efficiently to favor communication, task assignment and cohesion.
4. 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.

TEACHING METHODOLOGY

In the content exposition sessions, the teacher will introduce the theoretical bases of the subject, concepts, methods and results, illustrating them with suitable examples to facilitate understanding.

The students will have to study independently to assimilate the concepts, solve the proposed exercises either by hand or with the help of the computer.

Face-to-face sessions in small groups where the teacher will solve the doubts that the students have after their autonomous study and there will be practices.

Activities 1, 2 and 3 are part of the small group face-to-face sessions while activity 4 is part of the large group face-to-face sessions.

LEARNING OBJECTIVES OF THE SUBJECT

Learning objectives

On completion of the subject Mathematics III, students must be able to:

- Solve differential equations and Fourier analysis problems with the help of Maple software without difficulties.
- Think in increasingly abstract terms.
- Understand and apply deductive reasoning.
- Organise and apply theoretical knowledge to solve concrete problems.
- Interpret the results obtained with the help of computer tools.

STUDY LOAD

Type	Hours	Percentage
Hours large group	30,0	20.00
Hours small group	30,0	20.00
Self study	90,0	60.00

Total learning time: 150 h

CONTENTS

1. ORDINARY DIFFERENTIAL EQUATIONS.

Description:

- First-order ODEs. Euler method.
- Second-order linear ODEs with constant coefficients. Applications.
- Nth-order homogeneous linear ODEs with constant coefficients.

Related activities:

Test E1 and Activity A1

Full-or-part-time: 25h

Theory classes: 5h

Laboratory classes: 5h

Self study : 15h

2. LAPLACE TRANSFORM

Description:

- Definition and properties.
- Inverse transform. Properties.
- Application to solving linear ODEs with constant coefficients and initial conditions.

Related activities:

Test E1 and Activity A1

Full-or-part-time: 30h

Theory classes: 6h

Laboratory classes: 6h

Self study : 18h

3. NUMERICAL SERIES AND FOURIER SERIES

Description:

- Numerical series. Criteria of convergence.
- Fourier series. Dirichlet's theorem.
- Exponential form of the Fourier series. Parseval's identity.

Related activities:

Test E2 and Activity A2

Full-or-part-time: 40h

Theory classes: 9h

Laboratory classes: 10h

Self study : 21h

4. FOURIER TRANSFORM

Description:

- Definition and properties.
- Inverse transform and properties.
- Convolution.
- Application to the study of linear systems.

Related activities:

Test E2 and Activity A2

Full-or-part-time: 40h

Theory classes: 9h

Laboratory classes: 9h

Self study : 22h

5. PARTIAL DIFFERENTIAL EQUATIONS

Description:

- Definition and examples.
- Separation of variables and Fourier series to solve PDEs.

Related activities:

Activity A3

Full-or-part-time: 15h

Theory classes: 1h

Self study : 14h

ACTIVITIES

ACTIVITY A1: DIFFERENTIAL EQUATIONS AND THE LAPLACE TRANSFORM

Description:

An activity that must be carried out individually in the computer room.

Specific objectives:

On completion of the activity, students must be able to:

1. Solve an ordinary differential equation.
2. Calculate the Laplace transform of a function.
3. Apply the Laplace transform to solve a linear ODE.

Material:

Software that is available in the computer room.

Guidelines for practicals, lists of problems and a variety of materials available on ATENEA.

Delivery:

The assignment must be handed in to the professor.

It must be completed to pass the subject.

It forms part of continuous assessment.

Full-or-part-time: 4h

Laboratory classes: 1h

Self study: 3h

ACTIVITY A2: FOURIES SERIES AND TRANSFORM

Description:

An activity that must be carried out individually in the computer room.

Specific objectives:

On completion of the activity, students must be able to:

1. Identify whether a numerical series is convergent or divergent.
2. Calculate the trigonometric Fourier series of a periodic function.
3. Calculate the exponential Fourier series of a periodic function.
4. Calculate the Fourier transform of a function.
5. Apply the Fourier transform to the study of linear systems.

Material:

Software that is available in the computer room.

Guidelines for practicals, lists of problems and a variety of materials available on ATENEA.

Delivery:

The assignment must be handed in to the professor.

It must be completed to pass the subject.

It forms part of continuous assessment.

Full-or-part-time: 4h

Laboratory classes: 1h

Self study: 3h

ACTIVITY A3: PARTIAL DIFFERENTIAL EQUATIONS

Description:

An activity that must be carried out individually.

Specific objectives:

On completion of the activity, students must be able to:

1. Solve given temperature distribution and vibration problems using separation of variables.

Material:

Software that is available in the computer room.

Guidelines for practicals, lists of problems and a variety of materials available on ATENEA.

Delivery:

The assignment must be handed in to the professor.

It forms part of continuous assessment.

Full-or-part-time: 3h

Self study: 3h

ACTIVITY 4: WRITTEN TESTS E1 AND E2

Description:

Individual tests in the classroom related to the learning objectives for the subject.

Specific objectives:

To assess the general attainment of the objectives of topics 1, 2, 3 and 4

Material:

Exam papers (given to students at the exam).

Delivery:

The answers to the test must be handed in to the professor.

It forms part of continuous assessment.

Full-or-part-time: 16h

Theory classes: 4h

Self study: 12h

GRADING SYSTEM

The mark is calculated from the NE mark corresponding to Activity 4 and the NA mark corresponding to activities 1, 2 and 3, up to a maximum value of 10 for each one.

The learning objectives are considered to have been met if the final mark for continuous assessment $NC=0.7*NE+0.3*NA$ is greater than or equal to 5.

Students with a mark for the subject (NC) of less than 5 may take a final examination (mark: NG).

The student's final mark will be $NF=\text{maximum}(NC, NG)$

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:

- Zill, Dennis G. Ecuaciones diferenciales con problemas con valores en la frontera. 9a ed. Cuajimalpa: Cengage Learning, 2018. ISBN 9786075266305.
- Blanchard, Paul; Devaney, R. L.; Hall, Glen R. Differential equations. 4th ed. Pacific Grove: Brooks/Cole, 2011. ISBN 9781133110590.
- Harris, K.; López, R. J. Discovering calculus with Maple. 2nd ed. New York: John Wiley & Sons, 1995. ISBN 0471009733.
- Hsu, Hwei P.; Mehra, R. Análisis de Fourier [on line]. Argentina: Addison-Wesley Iberoamericana, 1987 [Consultation: 03/04/2024]. Available on : <https://ebookcentral-proquest-com.recursos.biblioteca.upc.edu/lib/upcatalunya-ebooks/detail.action?pq-origsite=primo&docID=6118465>. ISBN 0201029421.

Complementary:

- Gabel, R. A.; Roberts, R. A. Señales y sistemas lineales. México: Limusa, 1975.