# SUBJECT TEACHING GUIDE

## G321 - Further Calculus

### Degree in Chemical Engineering
### First Degree in Chemical Engineering

### Academic year 2023-2024

| 1. IDENTIFYING DATA | | | | |
|---|---|---|---|---|
| Degree | Degree in Chemical Engineering<br>First Degree in Chemical Engineering | | Type and Year | Core. Year 1<br>Core. Year 1 |
| Faculty | School of Industrial Engineering and Telecommunications | | | |
| Discipline | Subject Area: Mathematics<br>Basic Training Module | | | |
| Course unit title and code | G321 - Further Calculus | | | |
| Number of ECTS credits allocated | 6 | Term | Semester based (2) | |
| Web | https://www.giematic.unican.es/ | | | |
| Language of instruction | Spanish | English Friendly | No | Mode of delivery | Face-to-face |

| | |
|---|---|
| Department | DPTO. MATEMATICA APLICADA Y CIENCIAS DE LA COMPUTACION |
| Name of lecturer | ANGEL COBO ORTEGA |
| E-mail | angel.cobo@unican.es |
| Office | E.T.S. de Ingenieros Industriales y de Telecomunicación. Planta: - 4. DESPACHO (S4045) |
| Other lecturers | IVAN LEON MERINO |

| 3.1 LEARNING OUTCOMES |
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| - The student will learn the main concepts of multiple integration and will apply these concepts for solving practical problems. |
| - The student will learn the main concepts of vector calculus and will apply these concepts for solving practical problems. |
| - The student will learn how to solve line integrals and will know the most significant physical and geometric applications. |
| - The student will learn how to solve surface integrals and will know the most significant physical and geometric applications. |
| - The student will learn the basic concepts and resolution methods of first order differential equations. |
| - The student will learn the basic concepts and resolution methods of linear second order differential equations. |
| - The student will be able to modeling and solve some simple technical problems that involve differential equations. |
| - The student will learn Euler´s methods for obtaining a numerical approximation of the solution to an initial value problem and will implement this methods using the computer. |
| - The student will learn the main concepts of Laplace Transforms and will used them to solve initial value problems for linear differential equations. |
| - the student will learn the main concepts of partial differential equations and will be able to solve some of them using numerical methods. |

| 4. OBJECTIVES |
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| To introduce the student to some important basic concepts of Vector Calculus and Multiple Integration. |
| To introduce the student to the role of ordinary differential equations in engineering, and their methods of solution. |
| To introduce the student to the numerical methods for ordinary differential equations. |
| To introduce the student to the classical theory of Laplace Transforms and some of its applications to the analysis and design of engineering systems. |
| To introduce the student to the basic concepts of partial differential equations. |
| To be able to use mathematical software as an aid for solving problems. |

| 6. COURSE ORGANIZATION | |
|---|---|
| CONTENTS | |
| 1 | MULTIPLE INTEGRALS |
| 1.1 | Concept of double integral and calculation methods |
| 1.2 | Change of variables in double integrals |
| 1.3 | Practical applications of double integrals |
| 1.4 | Triple integrals |
| 1.5 | Change of variables: cylindrical and spherical coordinates |
| 1.6 | Change of variables: cylindrical and spherical coordinates |
| 2 | LINE AND SURFACE INTEGRALS |
| 2.1 | Scalar and vector fields |
| 2.2 | Parameterized curves |
| 2.3 | Line integral of scalar fields |
| 2.4 | Line integral of vector fields |
| 2.5 | Conservative fields |
| 2.6 | Green's theorem |
| 2.7 | Surfaces in space |
| 2.8 | Surface integrals of scalar fields |
| 2.9 | Surface integrals of vector fields |
| 2.10 | Divergence and Stoke's theorems |
| 3 | DIFFERENTIAL EQUATIONS AND INTEGRAL TRANSFORMS |
| 3.1 | Concept of differential equations and application examples |
| 3.2 | Analytical solution of differential equations |
| 3.3 | Numerical solution of differential equations |
| 3.4 | Linear differential equations with constant coefficients |
| 3.5 | Systems of first order linear differential equations |
| 3.6 | Introduction to partial differential equations |
| 3.7 | Fourier and Laplace transforms |
| 3.8 | Application of Laplace transform to solve differential equations |

## 7. ASSESSMENT METHODS AND CRITERIA

| Description | Type | Final Eval. | Reassessn | % |
|---|---|---|---|---|
| Assessment of the first thematic block. | Written exam | No | Yes | 20,00 |
| Assessment of the second thematic block | Written exam | No | Yes | 20,00 |
| Assessment of the third thematic block | Written exam | No | Yes | 20,00 |
| Monitoring activities in class | Others | No | Yes | 20,00 |
| Participation in virtual learning platforms | Activity evaluation with Virtual Media | No | Yes | 20,00 |
| Final exam (for students who have not passed the continuous evaluation) | Written exam | Yes | Yes | 0,00 |
| TOTAL | | | | 100,00 |
| Observations | | | | |
| The course will have a continuous assessment process | | | | |
| Observations for part-time students | | | | |
| Part-time students will have a different evaluation process based on exams and practical work | | | | |

## 8. BIBLIOGRAPHY AND TEACHING MATERIALS

**BASIC**

Materiales en formato electrónico disponibles en el curso virtual de la asignatura y cuadernos computacionales distribuidos a través de la plataforma Google Colab