PERSONA CIÈNCIA EMPRESA
UNIVERSITAT RAMON LLULL

COURSE: MATHEMATICS

SUBJECT MATTER: Mathematics
MODULE: Basic Formation
PROGRAM: Degree in Chemical Engineering

GENERAL CHARACTERISTICS

Type: ☑ Basic Formation, ☐ Compulsory, ☐ Elective
☐ Final Degree Project, ☐ Internship

Duration: Annual
Semester/s: 1 and 2
Number of ECTS credits: 12
Language/s: Spanish, Catalan

DESCRIPTION

SHORT DESCRIPTION AND JUSTIFICATION

Mathematics is an essential tool in experimental science and engineering. This course aims to deepen into the mathematical knowledge acquired in the secondary education, and develop the ability to apply that knowledge in the area of Chemical Engineering.

The general contents of the subject includes: Complex numbers. Linear algebra. Vector space. Linear transformations. Matrix diagonalization. Real functions: Limit, continuity, derivation, integration. Multivariable calculus. Multiple Integral. Differential equations and system of differential equations. Functional series and integral transformations.

COMPETENCES

- Be able to understand and apply basic knowledge of Mathematics that, based on the knowledge acquired in general secondary education, is necessary for the practice in the field of Chemical Engineering (CB1, E1).
- Be able to identify, formulate and solve basic problems in Mathematics in the fields of Chemical Engineering and Chemistry (CB2, E7).
- 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 derivative equations; numerical methods; numerical algorithms; statistics and optimization (FB1).

PREREQUISITES

According to the program planning and academic regulations.

CONTENTS

- **Complex number**
  Imaginary and complex numbers. Basic operations. Exponential and logarithmic functions.
- **Linear algebra**
  Matrices. Basic operations. Symmetry and y trace. Function matrix. Determinant. Invers matrix. Gaussian elimination. Lineal systems of equations. Cramer's rule. Least squares fitting.
- **Vector space and linear transformations**
  Vector space. Basis and dimension. Change of basis. Linear transformations in the Euclidean space. Matrix representation of a LT.
- **Inner product space and secular equations**
  Inner product. Metric. Norm, distance and angles. Ortonormalization. Matrix diagonalization
- **Real functions**
  Definition. Limit. Continuity. Continuous functions and their properties
- **Derivation**
  Definition. Properties of differential functions. High-order derivatives. Extremum. Taylor and Mc Laurin series. Indeterminate. L'Hôpital's rule.
- **Integration**
  First Fundamental Theorem of Calculus. Change of variables. Integration by Parts. Rational integrals.
- **Ordinary differential equations**
  Differential equations and initial value problems. Solutions. Separation of variables. Homogeneous differential equations. First order linear differential equations.
- **Laplace transform**
  Definition and existence theorem. Properties. Problem solving and initial value problems.
- **Multivariable calculus.**
  Limit. Continuity. Partial derivative. Differentiation. Gradient and directional derivative. Extremum. Iterated integral. Double integral.
- **System of linear differential equations**
  System of equations. System's reduction. Solution of an homogenous system. Calculating particular solutions.

METHODOLOGY

LEARNING ACTIVITIES

Learning Activities	Hours	ECTS Credits	Competences
Lectures	70	2.6	E1, CB1, FB1
Case and Problem-Solving Sessions	51	1.9	E1, E7, CB1, CB2, FB1
Seminars	5	0.2	E1, E7, CB1, CB2, FB1
Practical & Lab Work	11	0.4	E1, E7, CB1, CB2, FB1
Presentations		-	-
Personal study	176	6.5	E1, E7, CB1, CB2, FB1
Assessment Tasks (Exams, Continuous Assessment...)	11	0.4	E1, E7, CB1, CB2, FB1
TOTAL	**324**	**12.0**	

TEACHING METHODOLOGY

The expository sessions of the course (which account for the 75% approx. of sessions) combine the exposure of theoretical content with solving examples and exercises, directly related with the theory explained. The practical sessions (25% approx.) are devoted exclusively to solve cases and problems. Additionally, some exercises are proposed as personal study and they are later corrected by the professor.

The course will also have seminar sessions devoted to the resolution of questions raised by students, collecting synthetically the material studied so far. For personal study, students have available a collection of problems and exercises and textbooks.

ASSESSMENT

ASSESSMENT METHODS

Assessment Methods	Weight	Competences
Final Exam	40%	E1, E7, CB1, CB2, FB1
Midterm Exam/s	30%	E1, E7, CB1, CB2, FB1
Follow-up Activities	30%	E1, CB1, FB1
Reports and Presentations	-	
Lab or Field Work	-	
Projects	-	
Host Student Evaluation	-	
Participation	-	

LEARNING OUTCOMES

- Students must demonstrate that they know and understand the main concepts and properties of calculus, differential calculus and linear algebra. (→ E1, CB1)
- Students must demonstrate knowledge and skill in applying basic operations and procedures of infinitesimal and differential calculus, and of linear algebra. (→ E1, CB1)
- Students must demonstrate proficiency in calculus and linear algebra for selecting and applying the most suitable mathematical methods in solving problems related with chemical engineering. (→ E7, CB2, FB1)

QUALIFICATION

The evaluation of the course consider the scores of the follow-up activities, whose averages represent a continuous assessment mark (EC), two partial exams, whose average represents a second note (EP) and the final exam (EF), obtaining a mark out of 10. The final grade (FG) is calculating by the formula:

$$FG = 0.3*EC + 0.3*EP + 0.4*EF.$$

The final exam has two different parts, covering the subjects of each partial exam. The final score is calculated as the average of the two parts, only if the score are greater than 3.5 out 10 in both parts. On the contrary, the final score will be the lowest score of both parts.

When the score obtained at the final exam corresponding to a midterm exam improve the mark obtained earlier, this mark will replace it.

In the final examinations, the student that in any of the midterm exams has a score of 4.0 out 10 or higher, he can choose between giving up this part of the exam (assuming for this part of the exam the mark corresponding to the midterm exam) or submit it to the effect of improving the grade.

ASSESSMENT OF THE COMPETENCES

For the evaluation of E7/CB2 competency, it is used the final exams mark as indicator. For the evaluation of competency E1/CB1 and FB1, the indicator used is the final mark of the subject.

BIBLIOGRAPHY

- LARSON, HOSTETLER, EDWARDS, "*CÁLCULO con geometria analítica*", McGraw-Hill, México D.F. 2006 (8ª ed.).
- ANTON, H., "Introducción al Álgebra Lineal", Limusa-Wiley, México 2007 (3ª ed.).
- GROSSMAN, FLORES, "Álgebra lineal", McGraw-Hill, México D.F. 2012 (7ª ed.).
- ZILL, D.G., *Ecuaciones diferenciales con aplicaciones de modelado*, International Thomson Eds., México D.F. 2002 (7ª ed.).

DOCUMENT HISTORY

PREVIOUS REVISIONS
August 22, 2017, Roger Estrada
June 14, 2016, Roger Estrada
September 10, 2015, Roger Estrada
September 10, 2014, Roger Estrada
September 16, 2013, Joaquín Menacho i Roger Estrada
September 12, 2012, Joaquín Menacho
September 9, 2011, Joaquín Menacho
September 7, 2010, Joaquín Menacho
October 30, 2009, Joaquín Menacho
September 15, 2009, Joaquín Menacho
June 22, 2009, Joaquín Menacho

CURRENT REVISION
July 4, 2018, Roger Estrada