Course guide
390109 - FM2 - Mathematics II

Last modified: 03/06/2024

Unit in charge: Barcelona School of Agri-Food and Biosystems Engineering
Teaching unit: 749 - MAT - Department of Mathematics.

Degree: BACHELOR'S DEGREE IN BIOSYSTEMS ENGINEERING (Syllabus 2009). (Compulsory subject).
BACHELOR'S DEGREE IN FOOD ENGINEERING (Syllabus 2009). (Compulsory subject).
BACHELOR'S DEGREE IN AGRONOMIC SCIENCE ENGINEERING (Syllabus 2018). (Compulsory subject).

Academic year: 2024 **ECTS Credits:** 6.0 **Languages:** Catalan, Spanish

LECTURER

Coordinating lecturer: Boza Rocho, Santiago

Others: Boza Rocho, Santiago
Castañar Cañas, Jose Manuel
Garcia Martinez, Yamila
Ginovart Gisbert, Marta
Pelayo Melero, Ignacio Manuel
Saseta Ibáñez, Federico

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
2. Fundamentals of computer use and programming, operating systems, data bases, software for engineering applications.
3. Ability to solve mathematic problems in an engineering context . Ability to apply the knowledge of integral calculus, differential equations, numeric methods, numeric algorithms,

Generical:
1. Ability to solve problems.

TEACHING METHODOLOGY

The course topics are released on one-hour and two-hour lectures. In the lectures students' involvement is encouraged by means of the performance of low-stake activities in the classroom, such as asking-answering questions regarding one lecture, students presentations on specific topics, or the solving of exercises and problems related to the topics taught.
The solving of exercises and problems will be performed primarily in small groups and computer labs. In these sessions students will be asked to seek appropriate solutions through the application of formulae or algorithms, the implementation of procedures to transform the available information, the interpretation of results and the use of appropriate software in the computer lab sessions.
Autonomous learning will focus on key actions aimed at solving exercises and problems. Several quizzes will be performed as self-learning activities, available on the virtual campus. There will be a written mid-semester exam. A written final global exam will be held at the end of the course.

LEARNING OBJECTIVES OF THE SUBJECT

The subject Mathematics II addresses general formative purposes. It aims to generate learning skills and to promote the assessment of the power and usefulness of mathematical models and procedures, in order to understand and to make decisions in the techno-scientific area. Mathematics plays a fundamental role in helping to understand the techno-scientific environment and to deal with it in an autonomous and creative way. As in all the areas of mathematics, systematic and constant work, accurate reasoning and interpretation, and abstraction will be enhanced throughout the teaching-learning process.
By the end of the course the student will be able to carry out logical reasoning, to develop analytical and critical thinking, to evaluate arguments rigorously and to communicate them effectively.
The course is structured into three core topics: 1) integral calculus, 2) differential equations, and 3) numerical methods and programming. Throughout the course the emphasis is placed on problem solving and applications to branches of engineering and science.
In the area of integral calculus students will achieve fundamental concepts relating to comprehensive, and also resolve with basic methods exercises related to these applications in the case of real functions of real variable. In the area of differential equations, the purpose will be that students work with the practical aspects of solving ordinary differential equations, giving priority to applications in other branches of science and technology. Regarding partial differential equations, students get a brief overview of what they are and their use. Regarding numerical methods, the student will be introduced in the basic numerical techniques and the use of certain specific methods. Regarding the area of programming and applications students will use worksheets and specific programs to solve complex mathematical problemss.

STUDY LOAD

Type	Hours	Percentage
Hours small group	20,0	13.33
Self study	90,0	60.00
Hours large group	40,0	26.67

Total learning time: 150 h

CONTENTS

INTEGRAL CALCULUS

Description:
0. Complex numbers.
1.1. Antiderivative (indefinite integral): definition, non-uniqueness, notation. Basic antiderivatives. Rules for antiderivation: linearity. Integration by parts, by substitution, by partial fractions.
1.2. Definite integrals (proper integrals): definition, calculation methods. Connection with surface areas.
1.3. Improper integrals: definitions. Types of improper integrals. Convergence. Connection with surface areas

Related activities:
Activity 1: Lectures.
Activity 2: Individual written.
Activity 3: Problem and exercise solving.
Activity 4: Computer Lab Sessions.
Activity 5: Questionnaires

Full-or-part-time: 44h
Theory classes: 12h
Laboratory classes: 2h
Self study : 30h

DIFFERENTIAL EQUATIONS

Description:
2.1. Ordinary differential equations (ODEs). Definitions and basic concepts. Separable ordinary differential equations. Homogeneous ordinary differential equations. First-order linear ordinary differential equations. Second-order linear ordinary differential equations with constant coefficients.
2.2. Systems of first-order linear ordinary differential equations with constant coefficients.
2.3. Partial differential equations.

Related activities:
Activity 1: Lectures.
Activity 2: Individual written test.
Activity 3: Problem and exercise solving.
Activity 4: Computer Lab Sessions.
Activity 5: Questionnaires

Full-or-part-time: 50h
Theory classes: 14h
Laboratory classes: 6h
Self study : 30h

NUMERICAL METHODS AND PROGRAMMING

Description:
3.1. Numerical methods. Numerical solution of equations (one and several variables). Numerical integration. Numerical solution of differential equations.
3.2. Programming and applications.

Related activities:
Activity 1: Lectures.
Activity 2: Individual written test.
Activity 3: Problem and exercises solving.
Activity 4: Computer Lab Sessions.
Activity 5: Questionnaires

Full-or-part-time: 56h
Theory classes: 14h
Laboratory classes: 12h
Self study : 30h

ACTIVITIES

ACTIVITY 1. LECTURES

Full-or-part-time: 97h
Theory classes: 38h
Self study: 59h

ACTIVITY 2. INDIVIDUAL WRITTEN TEST

Material:
Calculator. One formulae sheet.

Delivery:
Mid-term exam: 30% of the final grade.
Final exam: 45% of the final grade.

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

ACTIVITY 3. EXERCISES AND PROBLEM SOLVING

Material:
Course material available at Atenea.

Full-or-part-time: 20h
Laboratory classes: 10h
Self study: 10h

ACTIVITY 4. COMPUTER LAB SESSIONS

Material:
Course material available at Atenea.

Full-or-part-time: 15h
Laboratory classes: 10h
Self study: 5h

ACTIVITY 5: QUESTIONNAIRES

Description:
Individual, distance learning activity. Each questionnaire takes at most two hours.

Material:
Available at the virtual campus Atenea.

Delivery:
5% of the final grade.

Full-or-part-time: 16h
Self study: 16h

GRADING SYSTEM

N1: The continuous assessment will be developed mainly in the context of small groups and computer lab sessions.
N2: There will be several questionnaires throughout the course.
N3: There will be a mid-semester written exam.
N4: There will be a final (global) written exam at the end of the semester.

The final mark (Nfinal) will be computed as follows:

Nfinal = 0.20 N1 + 0.05 N2 + 0.30 N3 + 0.45 N4

Students who fail to pass the course can sit for the written exams N3 and N4 in the reassessment exam period.

BIBLIOGRAPHY

Basic:
- Borrelli, R.; Coleman, C.S. Ecuaciones diferenciales. Una perspectiva de modelación. Mèxic: Oxford University Press, 2002.
- Gerald, C.F.; Wheatley, P.O. Análisis numérico con aplicaciones. 6a ed. Mèxic: Pearson Educación, 2000. ISBN 9684443935.
- Zill, D.G. Ecuaciones diferenciales con aplicaciones de modelado. 6a ed. Mèxic: International Thomson Editores, 1997. ISBN 9687529210.
- Ayres, Frank; Mendelson, Elliott; Abellanas, Lorenzo. Cálculo diferencial e integral. 3ª ed. Madrid: McGraw-Hill, 1991. ISBN 8476155603.
- Boyce, William E.; DiPrima, Richard C. Ecuaciones diferenciales y problemas con valores en la frontera. 5ª ed.. México: Limusa Wiley, 2010. ISBN 9786070501517.
- Zill, Dennis G; Cullen, Michael R. Matemáticas avanzadas para ingeniería (Vol. 1) [on line]. Tercera edición. México: McGraw-Hill, [2008] [Consultation: 15/07/2022]. Available on: https://www-ingebook-com.recursos.biblioteca.upc.edu/ib/NPcd/IB_BooksVis?cod_primaria=1000187&codigo_libro=4315. ISBN 9781456219864.
- Bronson, Richard; Costa, Gabriel B. Ecuaciones diferenciales [on line]. 3ª ed. México: McGraw-Hill, [2008] [Consultation: 15/07/2022]. Available on: https://www-ingebook-com.recursos.biblioteca.upc.edu/ib/NPcd/IB_BooksVis?cod_primaria=1000187&codigo_libro=4231. ISBN 9781456218218.

Complementary:
- Fabregat Fillet, Jaume; Ros, Rosa M. Equacions diferencials ordinàries de primer ordre. Barcelona: Universitat Politècnica de Catalunya, 1991. ISBN 8476531117.
- Gibergans Bàguena, Josep. Matemáticas para la ingeniería con Maple. Barcelona: Edicions UPC, 2008. ISBN 9788483019672.
- Estela Carbonell, M. Rosa. Fonaments de càlcul [on line]. Barcelona: Edicions UPC, 2003 [Consultation: 22/12/2022]. Available on: https://upcommons.upc.edu/handle/2099.3/36637. ISBN 848301713X.
- Batlle Arnau, Carles; Massana, Immaculada; Zaragozá, Marisa. Àlgebra i equacions diferencials [Recurs electrònic] [on line]. Barcelona: Edicions UPC, 2000 [Consultation: 22/12/2022]. Available on: https://upcommons.upc.edu/handle/2099.3/36225. ISBN 9788483019757.
- Zill, Dennis G; Wright, Warren S. Cálculo de una variable : trascendentes tempranas. 4ª ed. México: McGraw Hill, cop. 2011. ISBN 9786071505019.