Course guides
330056 - M2 - Mathematics II

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 MINERAL RESOURCE ENGINEERING AND MINERAL RECYCLING (Syllabus 2021). (Compulsory subject).

Academic year: 2021  ECTS Credits: 6.0  Languages: Catalan

LECTURER

Coordinating lecturer: JOSEP FREIXAS BOSCH
Others: MONTSERRAT ALSINA AUBACH - JOSEP M. CORS IGLESIAS - MARGARITA DOMENECH BLAZQUEZ - JOSEP FREIXAS BOSCH - FRANCISCO PALACIOS QUIÑONERO - M. ALBINA PUENTE DEL CAMPO - JOSEP MARIA ROSSELL GARRIGA - JOSEP RUBIÓ MASSEGÚ - ENRIC VENTURA CAPELL
Dominguez Diaz, Ricard
Gimenez Pradales, Jose Miguel

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 1. Planning oral communication, answering questions properly and writing straightforward texts that are spelt correctly and are grammatically coherent.
3. TEAMWORK - Level 1. Working in a team and making positive contributions once the aims and group and individual responsibilities have been defined. Reaching joint decisions on the strategy to be followed.
4. SELF-DIRECTED LEARNING - Level 1. Completing set tasks within established deadlines. Working with recommended information sources according to the guidelines set by lecturers.

TEACHING METHODOLOGY

Face-to-face sessions in large groups where the teacher will present the basics of each topic with examples, indicate exercises or tasks to students.
Autonomous student work sessions to study and deepen what the teacher has exposed with the help of the textbook to do the proposed exercises and tasks.
Face-to-face sessions in small groups where the teacher will resolve doubts that the student has after his autonomous study and / or exercises will be done.
Activities 1 and 2 are part of the face-to-face sessions in large group (or small), activity 3 are questionnaires that are done in person and activity 4 is part of the face-to-face sessions in large group.
LEARNING OBJECTIVES OF THE SUBJECT

At the end of Mathematics II, the student must be able to:
- Recognize curves and surfaces of the second degree.
- Find and interpret the singular points of the surfaces expressed as graphs of a function.
- Model real geometric places using curves, regions or surfaces.
- Determine centers of mass and moments of inertia of basic figures.
- Use the appropriate mathematical tools to calculate work, potential and flow.

STUDY LOAD

<table>
<thead>
<tr>
<th>Type</th>
<th>Hours</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hours large group</td>
<td>30,0</td>
<td>20.00</td>
</tr>
<tr>
<td>Self study</td>
<td>90,0</td>
<td>60.00</td>
</tr>
<tr>
<td>Hours small group</td>
<td>30,0</td>
<td>20.00</td>
</tr>
</tbody>
</table>

Total learning time: 150 h

CONTENTS

1. FUNCTIONS OF SEVERAL VARIABLE

Description:
Conics and quadrics.
Representation of functions of several variables and contour lines.
Optimization.

Related activities:
Written activity A1, activity A3, which is a questionnaire, and activity A4, which is a written test related to the learning objectives of the subject contents, are carried out.

Full-or-part-time: 30h
Theory classes: 6h
Laboratory classes: 6h
Self study: 18h

2. MULTIPLE INTEGRATION

Description:
Applications of the integral calculus of one variable.
The double integral: definition and properties. Variable change. Applications.
The triple integral: definition and properties. Variable change. Applications.

Related activities:
Written activity A2, activity A3, which is a questionnaire, and activity A4, which is a written test related to the learning objectives of the subject contents, are carried out.

Full-or-part-time: 60h
Theory classes: 12h
Laboratory classes: 12h
Self study: 36h
3. VECTORIAL CALCULUS

Description:
Parameterized curves. Arc length.
Line integral of scalar fields and vector fields. Applications.
Parameterized surfaces. Area of a surface.
Surface integral of scalar fields and vector fields. Applications.
Divergence and rotational. Integral theorems.

Related activities:
Activities A2, A3, which is a questionnaire, and activity A4, which is a written test related to the learning objectives of the subject contents, are carried out.

Full-or-part-time: 60h
 Theory classes: 12h
 Laboratory classes: 12h
 Self study: 36h

ACTIVITIES

A1: FUNCTIONS OF SEVERAL VARIABLES

Description:
SURFACES, PROJECTIONS AND LEVEL CURVES. OPTIMIZATION
Written test to be done in the class individually.

Specific objectives:
Evaluate the achievement of the objectives of Content 1 in its most practical aspect:
- Identify conics and quadrics.
- Calculate the domain and interpret level curves of a scalar field.
- Know the properties of partial derivative, directional and gradient and know how to calculate them.
- Raise and solve optimization problems.

Material:
Notes, textbook, problem lists and miscellaneous material available at ATENEA.

Delivery:
The resolved test must be delivered to the teacher.
It represents a part of the continuous evaluation.

Full-or-part-time: 5h
 Theory classes: 1h
 Laboratory classes: 1h
 Self study: 3h
### A2: MULTIPLE INTEGRATION

**Description:**
VOLUMES OF REVOLUTION
VOLUMES, MASSES, CENTERS OF GRAVITY AND MOMENTS OF INERTIA.
Written test to be done in the class individually.

**Specific objectives:**
Evaluate the achievement of the objectives of Content 2 in its most practical aspect:
- Calculate volumes of revolution by simple integration.
- Calculate areas, volumes, masses, centers of gravity and moments of inertia by double integration.
- Calculate volumes, masses, centers of gravity and moments of inertia by triple integration.

**Material:**
Textbook, notes, problem lists and various material available at ATENEA.

**Delivery:**
The resolved test must be delivered to the teacher.
It represents a part of the continuous evaluation.

**Full-or-part-time:** 4h
Laboratory classes: 1h
Self study: 3h

### A3: QUESTIONNAIRES

**Description:**
Q1: SCALAR FIELDS AND APPLICATIONS OF THE DEFINED INTEGRAL
Q2: LINE INTEGRALS. SURFACE INTEGRALS
Questionnaire not face-to-face individually

**Specific objectives:**
Evaluate the achievement of the objectives of Contents 1 and 3 in their most practical aspect:
- Study scalar fields.
- Calculate volumes of revolution
- Calculate lengths, masses, centers of gravity and moments of inertia using online integrals.
- Identify if a field is conservative and find potential functions.
- Calculate the work done by a force field.
- Calculate areas, masses, centers of gravity and moments of inertia using surface integrals.
- Calculate the flow of a field through a surface.

**Material:**
Textbook, problem lists and miscellaneous material available at ATENEA.

**Delivery:**
The questionnaire is made and saved through the ATENEA platform.
It represents a part of the continuous evaluation.

**Full-or-part-time:** 4h
Laboratory classes: 1h
Self study: 3h
A4: E1 I E2: WRITTEN TESTS

Description:
Written tests to be done in theory class individually.

Specific objectives:
Evaluate the general achievement of the objectives of contents 1, 2 and 3.
- Assimilate the concepts and use the properties relative to scalar fields and be able to apply them to solve optimization problems.
- Assimilate the concepts and use the properties relative to the double or triple integrals of scalar fields and be able to apply them to calculate areas, volumes, centers of mass or moments of inertia.
- Assimilate the concepts and use the properties related to line and surface integrals and be able to apply them.

Material:
Test statements (delivered at the time of the test).

Delivery:
The resolved test must be delivered to the teacher.
They represent a part of the continuous evaluation of the specific contents of the subject.

Full-or-part-time: 16h
Theory classes: 4h
Self study: 12h

GRADING SYSTEM
The grade is obtained from the grades corresponding to activities 1, 2, 3 and 4 with a maximum value of 10 each.
The objectives of the subject will be considered achieved if the final grade of the continuous assessment: 
\[ N_c = 0.1 \times A_1 + 0.1 \times A_2 + 0.1 \times A_3 + 0.7 \times A_4 \]
is greater than or equal to 5.
Students with a grade point average (Nc) below 5 can take a global exam (grade: Ng).
The student's final grade will be 
\[ N_f = \text{maximum (Nc, Ng)} \]

EXAMINATION RULES.
All activities are compulsory.
If any of the activities of the subject is not carried out, it will be considered a zero.

BIBLIOGRAPHY

Basic: