Course guide
330212 - MBE - Basic Engineering Mathematics

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

Degree: BACHELOR’S DEGREE IN ICT SYSTEMS ENGINEERING (Syllabus 2010). (Compulsory subject).
Academic year: 2022  ECTS Credits: 6.0  Languages: Catalan

LECTURER

Coordinating lecturer: Rossell Garriga, Josep Maria
Others: MONTSERRAT ALSINA AUBACH - JOSEP M. CORS IGLESIAS - MARGARITA DOMENECH BLAZQUEZ - JOSEP FREIXAS BOSCH - JOSE MIGUEL GIMENEZ PRADALES - FRANCISCO PALACIOS QUIÑONERO - M. ALBINA PUENTE DEL CAMPO - JOSEP RUBIÓ MASSEGÚ - ENRIC VENTURA CAPELL
Freixanet De La Iglesia, Maria Josep

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 a large group in which the professor explains the foundations of each topic, gives examples and sets the students exercises or tasks.
Independent study sessions in which students study the professor’s explanations, look at them in depth with the help of the textbook and do the exercises or tasks proposed.
Face-to-face sessions in a small group in which the professor answers students’ queries after their independent study and/or students carry out practicals.

LEARNING OBJECTIVES OF THE SUBJECT

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

- Solve linear algebra and single variable calculus problems with the support 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

<table>
<thead>
<tr>
<th>Type</th>
<th>Hours</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Self study</td>
<td>90.0</td>
<td>60.00</td>
</tr>
<tr>
<td>Hours large group</td>
<td>30.0</td>
<td>20.00</td>
</tr>
<tr>
<td>Hours small group</td>
<td>30.0</td>
<td>20.00</td>
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</tbody>
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Total learning time: 150 h

CONTENTS

1. SINGLE VARIABLE DIFFERENTIAL CALCULUS

Description:
- Basic functions in engineering
- Differentiation and applications of the derivative
- Linear approximation
- Relative and absolute extrema
- Zeros of functions: bisection and Newton-Raphson methods

Related activities:
- Activities A1, A3 and P1

Full-or-part-time: 47h
- Theory classes: 10h
- Laboratory classes: 10h
- Self study: 27h

2. SINGLE VARIABLE INTEGRAL CALCULUS

Description:
- Area between curves. Definite integrals: Barrow’s rule
- Indefinite integrals
- Integration techniques: direct integration, by substitution, by parts and rational functions
- Improper integrals
- Numerical integration: trapezoidal rule and Simpson’s rule

Related activities:
- Activities A1, A3 and P1

Full-or-part-time: 37h
- Theory classes: 8h
- Laboratory classes: 8h
- Self study: 21h
### 3. LINEAR SYSTEMS, MATRICES AND DETERMINANTS

**Description:**
- Calculation of matrices and determinants
- Systems of linear equations
- Gauss method: numerical solution
- Least squares curve fitting

**Related activities:**
- Activities A2, A3 and P2

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

### 4. LINEAR ALGEBRA

**Description:**
- Rn spaces
- Vector subspaces generated by a set of vectors
- Basis, dimension
- Change of basis
- Eigenvalues and eigenvectors
- Diagonalisation

**Related activities:**
- Activities A2, A3 and P2

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

### 5. COMPLEX NUMBERS

**Description:**
- Basic knowledge of complex numbers

**Specific objectives:**
This subject must be learned by the students independently, based on notes and questionnaires that are made available to them.

**Related activities:**
- P1

**Full-or-part-time:** 6h
- Self study: 6h
ACTIVITIES

A1: TOPICS 1 and 2
Description:
This activity must be carried out individually in the classroom.

Specific objectives:
On completion of the activity, students must be able to:
- Calculate the derivative of explicitly and implicitly defined functions.
- Find tangent and normal lines to a curve.
- Approximate functions linearly.
- Study increasing and decreasing functions.
- Find the relative and absolute extrema of a function.
- Formulate and solve optimisation problems.
- Calculate primitives directly, by parts and by substitution.
- Calculate definite integrals using a primitive.
- Calculate the area between two curves
- Calculate improper integrals.
- Operate with complex numbers (independent learning)

Material:
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: 4h
Laboratory classes: 1h
Self study: 3h

A2: TOPICS 3 and 4
Description:
This activity must be carried out individually in the classroom.

Specific objectives:
On completion of the activity, students must be able to:
- Operate with matrices.
- Calculate determinants and apply their properties.
- Find the rank of a matrix.
- Solve systems of linear equations.
- Fitting curves by least squares.
- Calculate the basis and dimension of a subspace generated by a set of vectors.
- Write vector coordinates with respect to a basis.
- Find the eigenvalues and eigenvectors of a matrix.
- Find out whether a matrix is diagonalisable with the minimum amount of calculation.

Material:
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: 4h
Laboratory classes: 1h
Self study: 3h
**A3: TOPICS 1, 2, 3 and 4**

**Description:**
This activity must be carried out individually in the classroom.

**Specific objectives:**
On completion of the activity, students must be able to:
Make basic calculations related to the content of the subject with Maple.

**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 passed to pass the subject.
It forms part of continuous assessment.

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

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**P1: TOPICS 1, 2 and 5**

**Description:**
Individual test 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 and 5.
To assess the attainment of the individual learning competence.

**Material:**
Test papers (given out at the time of the test)
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:** 8h
Theory classes: 2h
Self study: 6h
P2: TOPICS 3 and 4

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 3, 4.

Material:
Test papers (given out at the time of the test)
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: 8h
Theory classes: 2h
Self study: 6h

GRADING SYSTEM

The mark NC is calculated from the marks corresponding to activities A1, A2, A3, P1 i P2 in the following way: NC = 0.4*P1+0.3*P2+0.1*(A1+A2+A3)
The learning objectives are considered to have been met if the final mark for continuous assessment NC 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: NF).
The student's final mark will be ND=maximum (NC, NF).

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: