250206 - FONMATEM - Mathematic Fundamentals

Coordinating unit: 250 - ETSECCPB - Barcelona School of Civil Engineering
Teaching unit: 751 - DECA - Department of Civil and Environmental Engineering
Academic year: 2018
Degree: BACHELOR'S DEGREE IN PUBLIC WORKS ENGINEERING (Syllabus 2010). (Teaching unit Compulsory)
ECTS credits: 6
Teaching languages: Catalan, Spanish

Teaching staff
Coordinator: FRANCISCO JAVIER OZON GORRIZ
Others: FRANCISCO JAVIER OZON GORRIZ

Opening hours
Timetable: Each teacher will define the timetable when the course start.

Degree competences to which the subject contributes

Specific:
3096. Ability to solve the types of mathematical problems that may arise in engineering. Ability to apply knowledge of: linear algebra; geometry; differential geometry; differential and integral calculus; differential equations and partial derivatives; numerical methods; numerical algorithms; statistics and optimisation.

Transversal:
591. 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.
597. EFFECTIVE USE OF INFORMATION RESOURCES - Level 1. Identifying information needs. Using collections, premises and services that are available for designing and executing simple searches that are suited to the topic.
600. SELF-DIRECTED LEARNING - Level 1. Completing set tasks within established deadlines. Working with recommended information sources according to the guidelines set by lecturers.
Students will learn to perform differential and integral calculus of one variable. They will also learn to solve mathematical problems encountered in engineering that involve these concepts.

On completion of the course, students will have acquired the ability to:
1. Use trigonometric functions and derivation and integration techniques;
2. Use differential calculus to solve maxima and minima problems related to simple engineering problems;
3. Solve integrals of one variable and identify how this technique can be applied to simple engineering problems.

Real numbers; Trigonometry; Successions and calculation of limits; Numerical series and convergence; Theory of functions, including analysis of continuity and limits; Differential calculus of functions of a real variable, including maxima and minima problems in simple engineering problems.
## Study load

<table>
<thead>
<tr>
<th>Study load</th>
<th>Theory classes:</th>
<th>Practical classes:</th>
<th>Laboratory classes:</th>
<th>Guided activities:</th>
<th>Self study:</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total learning time: 150h</td>
<td>26h</td>
<td>17h</td>
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<td>6h</td>
<td>84h</td>
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### Content

**Basic concepts. Sequences and numerical series**

**Learning time:** 38h 24m  
Theory classes: 8h  
Practical classes: 5h  
Laboratory classes: 3h  
Self study: 22h 24m

**Description:**  
Sets of numbers. Absolute value and distance  
Review of the fundamental trigonometric concepts and their basic properties and relations.  
Definition and properties of open and closed sets and intervals.  
Determination of the interior, the boundary and the closure of simple sets on the n-dimensional Euclidean space.  
Session 5. Group work on conics  
Session 6. Sequences  
Session 7. Indeterminations and computing limits  

**Specific objectives:**  
Introduce the sets of numbers on which the subject will be developed. Review the concepts of absolute value and proximity  
To facilitate the use of the trigonometric identities in the applications. To introduce the basic trigonometric functions.  
The student should be able to determine the interior, the adherence and the boundary of a set and distinguish between different types of intervals.  
Formalize the concept of approximation

<table>
<thead>
<tr>
<th>Study of functions and its continuity</th>
<th>Learning time: 33h 36m</th>
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<tbody>
<tr>
<td>Theory classes: 7h</td>
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<td>Practical classes: 4h</td>
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<tr>
<td>Laboratory classes: 3h</td>
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<tr>
<td>Self study: 19h 36m</td>
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</table>

**Description:**  
Session 10. Concepts and basic operations with functions.  
Session 11. Trigonometric and other basic functions  
Session 12. Limit of a function at a point. Definition of continuity  
Session 13. Computing limits  
Session 14. Solving problems on quadrics (work in group)  
Session 15. Weierstrass and Bolzano’s theorems. The bisection method  
Session 16. Continuity problems and application of the bisection method
### Differential calculus of one variable functions

**Learning time:** 38h 24m  
- Theory classes: 7h  
- Practical classes: 6h  
- Laboratory classes: 6h  
- Self study: 22h 24m

**Description:**
- Session 18. Derivative concept. Algebraic properties  
- Rolle and Mean Value theorems. L'Hopital Rule. High order derivatives. Taylor polynomial  
- Session 22. Problem solving on local approximation of functions (work in group)  
- Session 23. Extreme values of one variable functions  
- Session 24. Computing maximum and minimum values

### Integral calculus

**Learning time:** 33h 36m  
- Theory classes: 4h  
- Practical classes: 2h  
- Laboratory classes: 8h  
- Self study: 19h 36m

**Description:**
- Session 26. Riemann Integral definition  
- Session 27. Computations of integrals  
- Session 28. Barrow's Rule and change of variable  
- Session 29. Problem solving on integral computation  
- Session 31. Applications:
The grade (T) is calculated as follows:

\[ T = \frac{T_1 + T_2}{2}, \]

where \( T_i \) with \( i=1,2 \) is the grade from each group work.

Two exams \( (E_i, i=1,2) \) will be administered throughout the quarter. Each one corresponds to a content block.

If all \( E_i \) grades are greater than or equal to 3, the final grade will be:

\[ N = 0.7 \times \frac{E_1 + E_2}{2} + 0.3 \times T \]

If \( N \) is greater than or equal to 5, the student will pass the course.

If \( N \) is less than 3, students will have to make up those parts corresponding to \( E_i \) grades in the additional testing period \( (E Ri) \).

If we call \( EE_i = \max (E_i, E Ri) \), and \( E Ri \) is greater than or equal to 3, \( i = 1,2 \), the final grade will then be calculated as follows:

\[ N = 0.7 \times \frac{EE_1 + EE_2}{2} + 0.3 \times T \]

Criteria for re-evaluation qualification and eligibility: students that failed the ordinary evaluation and have regularly attended all evaluation tests will have the opportunity of carrying out a re-evaluation test during the period specified in the academic calendar. Students who have already passed the test or were qualified as non-attending will not be admitted to the re-evaluation test. The maximum mark for the re-evaluation exam will be five over ten (5.0). The non-attendance of a student to the re-evaluation test, in the date specified will not grant access to further re-evaluation tests. Students unable to attend any of the continuous assessment tests due to certifiable force majeure will be ensured extraordinary evaluation periods.

These tests must be authorized by the corresponding Head of Studies, at the request of the professor responsible for the course, and will be carried out within the corresponding academic period.

It is mandatory to do the exams and their corresponding make up tests (where appropriate); otherwise the student will fail the course and will get an NP (Incomplete) final grade.

**Bibliography**

**Basic:**