1. **Key Information**

Module Code: 13605  
Module Title: Statistics II  
Credit Points: 6  
Module Status: Compulsory  
Module Block: Basic Knowledge  
Course Title: BSc in Engineering and Management  
Module Theme: Mathematics

2. **Lecturer:** Vicente Asensio  
**Tutorial Hours:** Friday from 12h to 14h (by appointment)

3. **Required Reading:**

- *Statistical Quality Control*  
  D. C. Montgomery  
- *Design and Analysis of Experiments*  
  D. C. Montgomery  
- *Applied Regression Analysis*  
  N. R. Draper  
- *Time Series Analysis*  
  J. D. Hamilton

4. **General overview of the module**

We will begin the subject with useful techniques aimed to analyse dependence relationships: *Linear Regression Models*. Next, we will focus on the particular challenges we can face using *Time Series Analysis*, where the variable ‘time’ plays an essential role. In the second part of the subject we will examine how to develop an effective *Design Of Experiments (DOE)* with the aim to optimize processes. Related to this topic, we will study *Statistical Process Control (SPC)* as a useful tool for process management. The statistical competences you will acquire at the end of the course will help you in your professional career as regards to process improvement. Additionally, they will constitute a valuable support for making more informed decisions in your workplace.

5. **Recommended prior knowledge**

<table>
<thead>
<tr>
<th>Code</th>
<th>Subject</th>
</tr>
</thead>
<tbody>
<tr>
<td>13604</td>
<td>Statistics I</td>
</tr>
</tbody>
</table>

6. **Module objectives – Learning outcomes**

**Basic and general Competences**

- CB5 – To develop learning competences for lifelong learning.
- 02 – To apply technologies, skills and economic tools for engineering and management.
- 03 – To define, solve and describe complex technical problems.
- 04 – To learn how to analyze elements that are crucial in the business decision-making.
- 05 – To communicate using scientific languages, based on graphical and symbolic elements used in engineering and management.

**Specific Competences**

- 13 – To solve mathematical problems through the application of knowledge of algebra, linear algebra, geometry, differential geometry, differential and integer calculus, differential and partial equations, numerical methods, numerical algorithms, statistics and optimizations.

7. **Teaching and learning units**

1. **Linear regression models**
   - Simple Linear Regression  
   - Least Squares method  
   - Standard errors and coefficient of determination  
   - Hypothesis test and confidence intervals  
   - Multiple regression

2. **Time – series analysis**
   - Components of a time-series  
   - Moving averages method  
   - Seasonal index method  
   - Exponential smoothing  
   - Autoregressive models

3. **Analysis of variance**
   - ANOVA tables: one-way ANOVA, two way ANOVA with one or more observations per cell  
   - Post – hoc analysis  
   - Means and interaction plots  
   - Hypotheses tests for equality of several means and interaction.

4. **Design of experiments**
   - Introduction to design of experiments  
   - Two – level factorial design  
   - Fractional factorial design
5. Statistical process control
- Application of statistics for process improvement
- Introduction to control charts
- Mean and range control charts
- Process capacity

8. Teaching and learning methods

<table>
<thead>
<tr>
<th>Unit</th>
<th>Theory (Classroom)</th>
<th>Practical (Classroom)</th>
<th>Practical (Laboratory)</th>
<th>Practical (Field work)</th>
<th>Practical (ICT)</th>
<th>Self-guided study</th>
<th>TOTAL HOURS</th>
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<tbody>
<tr>
<td>1</td>
<td>4</td>
<td>4</td>
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<td>TOTAL HOURS</td>
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<td>105</td>
<td>165</td>
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9. Assessment

**Students enrolling for the first time:**

<table>
<thead>
<tr>
<th>Type</th>
<th>Description</th>
<th>Acts No</th>
<th>Weight (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Continuous assessment:</strong></td>
<td></td>
<td></td>
<td>40</td>
</tr>
<tr>
<td>Academic assignments</td>
<td>The submission of practical work either carried out individually or in groups, including computer lab assignments</td>
<td>4</td>
<td>20</td>
</tr>
<tr>
<td>Multiple choice tests</td>
<td>These tests can combine both theoretical and practical content.</td>
<td>4</td>
<td>20</td>
</tr>
<tr>
<td><strong>Synthesis tests:</strong></td>
<td></td>
<td></td>
<td>60</td>
</tr>
<tr>
<td>Open response test</td>
<td>Statements of problems that the student has to solve individually (with limited time) to apply the tools learned during the lectures.</td>
<td>1</td>
<td>20</td>
</tr>
<tr>
<td>Open response test</td>
<td>Statements of problems that the student has to solve individually (with limited time) to apply the tools learned during the lectures.</td>
<td>1</td>
<td>40</td>
</tr>
</tbody>
</table>

All students must comply with the rules of writing, spelling, and grammar in the development of their work and their assessment tests.

Attendance is compulsory to ensure that you extract the most value from the module and meet the learning requirements. Therefore, session absence accounting for more than 15% of the prescribed hours will result in the inability to be awarded a mark for continuous assessment. Consequently, the maximum mark that can be achieved will be that obtained solely from Synthesis tests.

Continuous assessment is attendance based and non-recoverable. Therefore, the mark obtained for this part of the assessment will serve for both the first and second call. The synthesis test could be repeated at the end of the semester.

In order to pass the module a mark equal to or greater than 5 must be obtained in the final synthesis test and the weighted mark of the synthesis tests must be equal to or greater than 5. If this is met, the final mark will be calculated by weighting the synthesis tests with the continuous assessment, having to achieve a final grade equal to or greater than 5 to pass the module. If it is not met, the final grade will be the mark of the synthesis tests.

**Students enrolling for the second time:**

<table>
<thead>
<tr>
<th>Type</th>
<th>Description</th>
<th>Acts No</th>
<th>Weight (%)</th>
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</thead>
<tbody>
<tr>
<td><strong>Continuous assessment:</strong></td>
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<td>20</td>
</tr>
<tr>
<td>Academic assignments</td>
<td>The submission of practical work either carried out individually or in groups, including computer lab assignments</td>
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<td>20</td>
</tr>
<tr>
<td><strong>Synthesis tests:</strong></td>
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<td>80</td>
</tr>
<tr>
<td>Open answer questions</td>
<td>Statements of problems that the student has to solve individually (with limited time) to apply the tools learned during the lectures.</td>
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<td>80</td>
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</table>

All students must comply with the rules of writing, spelling and grammar in the development of their work and their assessment tests.
It is not compulsory to attend sessions. However, it is recommended so that the student can extract the most value from the module and effectively meet the learning requirements.

Continuous assessment is non-recoverable. Therefore, the mark obtained for this part of the assessment will serve for both the first and second call. The synthesis test could be repeated at the end of the semester.

In order to pass the module a mark equal to or greater than 5 must be obtained in the final synthesis test and the weighted mark of the synthesis tests must be equal to or greater than 5. If this is met, the final mark will be calculated by weighting the synthesis tests with the continuous assessment, having to achieve a final grade equal to or greater than 5 to pass the module. If it is not met, the final grade will be the mark of the synthesis tests.