

# Course guide

## 330527 - GQ - Quality Management

**Last modified:** 04/05/2023

**Unit in charge:** Manresa School of Engineering  
**Teaching unit:** 750 - EMIT - Department of Mining, Industrial and ICT Engineering.  
749 - MAT - Department of Mathematics.

**Degree:** BACHELOR'S DEGREE IN AUTOMOTIVE ENGINEERING (Syllabus 2017). (Compulsory subject).

**Academic year:** 2023    **ECTS Credits:** 4.5    **Languages:** Catalan

### LECTURER

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**Coordinating lecturer:** JOSEP FREIXAS BOSCH & JORDI ALBIOL RODRÍGUEZ

**Others:** RESTA DE PROFESSORAT EPSEM DELS DEPARTAMENTS MAT I EMIT

### DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

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#### Specific:

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 equations and partial derivatives; numerical methods; numerical algorithms; statistics and optimization.

CE17. Quality control knowledge.

#### Transversal:

1. ENTREPRENEURSHIP AND INNOVATION - Level 3. Using knowledge and strategic skills to set up and manage projects. Applying systemic solutions to complex problems. Devising and managing innovation in organizations.
2. EFFICIENT ORAL AND WRITTEN COMMUNICATION - Level 3. Communicating clearly and efficiently in oral and written presentations. Adapting to audiences and communication aims by using suitable strategies and means.

### TEACHING METHODOLOGY

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In the content presentation sessions the teacher will introduce the theoretical bases of the subject, concepts, methods and results and illustrate them with convenient examples to facilitate understanding.

Students, independently will have to study in order to assimilate the concepts, solve the proposed exercises either with the help of the computer or not.

Face-to-face sessions where the teacher will resolve the doubts that the students have after their autonomous study, and / or will do practices.

Assessment activities 1 and 2 (A1 and A2 respectively) are part of the face-to-face sessions and may consist of partial assessment tests and / or work to be done and delivered individually.

### LEARNING OBJECTIVES OF THE SUBJECT

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Upon completion of the subject of Quality Management, the student must be able to:

- Solve problems related to probability and statistics fluently.
- Use with good judgment probabilistic and statistical tools for modeling and solving problems of reliability and quality control.
- Manipulate data, apply the appropriate theoretical methods and draw conclusions from the results obtained.
- Know and be able to apply the quality management tools taught during the course.



## STUDY LOAD

Type	Hours	Percentage
Hours small group	22,5	20.00
Hours large group	22,5	20.00
Self study	67,5	60.00

**Total learning time:** 112.5 h

## CONTENTS

### 1. PROBABILITY

**Description:**

Notion of probability, conditional probability, total probabilities and Bayes formula: applications.  
Independence of events.  
Applications to reliability.  
Circuits in series, parallel, combinations of series and parallel and bridge structures.  
Active and passive redundancy.

**Related activities:**

Activity 1: as a part of Evaluation 1 (A1)

**Full-or-part-time:** 11h 15m

Theory classes: 2h 15m

Laboratory classes: 2h 15m

Self study : 6h 45m

### 2. DISCRETE DISTRIBUTIONS

**Description:**

Discrete random variables.  
Probability and accumulated probability functions.  
Moments of a discrete random variable.  
Discrete notable distributions: uniform, geometric, binomial and Poisson.  
Applications to the reliability of k-de-n systems.

**Related activities:**

Activity 2: as a part of Evaluation 1 (A1)

**Full-or-part-time:** 15h

Theory classes: 3h

Laboratory classes: 3h

Self study : 9h



### 3. CONTINUOUS DISTRIBUTIONS

**Description:**

Continuous random variables.

Density and distribution functions.

Moments of a continuous random variable. Continuous notable distributions: uniform, normal and exponential.

Normal approximation of binomial and Poisson distributions.

Reliability functions of these remarkable distributions.

Failure rate and its relationship to reliability.

Measurement of the importance of components in repairable and non-repairable systems.

**Related activities:**

Activity 3: as a part of Evaluation 1 (A1)

**Full-or-part-time:** 18h 45m

Theory classes: 3h 45m

Laboratory classes: 3h 45m

Self study : 11h 15m

### 4. NOTIONS OF STATISTICAL INFERENCE

**Description:**

Random sampling and sample distributions.

Estimation problem.

Notion of point estimators and confidence intervals.

Statistical decision: hypothesis test.

Tests for mean and population variance.

Other tests of hypothesis, randomness, independence and normality.

**Related activities:**

Activity 4: as a part of Evaluation 1 (A1)

**Full-or-part-time:** 7h 30m

Theory classes: 1h 30m

Laboratory classes: 1h 30m

Self study : 4h 30m

### 5. ASSURANCE OF QUALITY: RELIABILITY

**Description:**

Reliability and failure.

Life tests of fixed duration.

Life tests of fixed faults.

Non-constant failure rate. Weibull model.

Accelerated Life Tests.

**Related activities:**

Activity 5: as a part of Evaluation 2 (A2)

**Full-or-part-time:** 15h

Theory classes: 3h

Laboratory classes: 3h

Self study : 9h



## 6. QUALITY ASSURANCE: REGRESSIONS

### Description:

Simple linear regression. Linear statistical models.  
Least squares method.  
Linear model using matrices.  
Coefficients  $R$  and  $r$ . Residual analysis.  
Inference and contrast of hypotheses.  
Multiple linear regression.

### Related activities:

Activity 6: as a part of Evaluation 2 (A2)

**Full-or-part-time:** 22h 30m

Theory classes: 4h 30m

Laboratory classes: 4h 30m

Self study : 13h 30m

## 7. QUALITY MANAGEMENT AND CONTROL

### Description:

Statistical quality control.  
Exploratory data analysis.  
Continuous improve.  
6 sigma and DMAIC improvement methodologies.  
ISO and IATF16949 quality regulations.

### Related activities:

Activity 7: as a part of Evaluation 2 (A2)

**Full-or-part-time:** 15h

Theory classes: 9h

Laboratory classes: 3h

Self study : 3h

## ACTIVITIES

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### COURSE ACTIVITIES

**Description:**

For the first four topics of the course: a test to be performed in the classroom and activities to be performed outside the classroom. All of them must be delivered and made individually.

For the topics, fifth, sixth and seventh: a test to be performed in the classroom and activities to be performed outside the classroom. All of them must be delivered and made individually.

**Specific objectives:**

At the end of these activities the student must be able to:

1. Know and be able to apply different probabilistic tools aimed at quality management and system reliability.
2. Have initiative and criteria to apply probabilistic methods and procedures that contribute to the improvement of quality.
3. Know and be able to apply different tools to improve quality management.
4. Organize, graphically represent a collection of data to treat them statistically in the most convenient way for quality management.
5. Know how to apply quality management tools and know contents of the main regulations in the automotive industry.
6. Apply quality improvement systems to an organization.

**Material:**

Lists of problems and diverse material available at ATENEA. Software available.

**Delivery:**

All activities are mandatory.

**Full-or-part-time:** 1h 30m

Theory classes: 1h 30m

## GRADING SYSTEM

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The final grade (NF) is obtained from the partial grade (QP) and the final grade (QF).

The objectives of the subject will be considered achieved if QP is greater than or equal to 5 where  $QP = 0.5 * (A1 + A2)$  and A1 and A2 comprise respectively all the evaluation activities of each of the two halves of the course.

The student whose QP mark is less than 5 must do a final exam and obtain a 5 or a greater mark to pass the subject.

Students with a QP grade of less than 5 must take a global exam and obtain a grade greater than or equal to 5 in order to pass the subject.

The final grade is obtained from:  $NF = \text{maximum}(QP, QF)$ .

Regarding the assessment of CT1 competence. ENTREPRENEURSHIP AND INNOVATION, at the end of the course the student must show initiative, weighing risks and opportunities and assuming the consequences. Acquire basic knowledge about organizations and management techniques as well as detect or generate opportunities and solutions to known problems and become familiar with the tools and techniques of generating ideas.

## EXAMINATION RULES.

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All activities are mandatory.

If one of the activities of the subject is not carried out, it will be considered qualified with zero.

## BIBLIOGRAPHY

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### Basic:

- Forcada, Santiago; Rubió Masegú, Josep. Elements d'estadística [on line]. Barcelona: Edicions UPC, 2007 [Consultation: 06/11/2020]. Available on: <http://hdl.handle.net/2099.3/36675>. ISBN 9788483019269.
- Sarrión Gavilán, María Dolores; Benítez Márquez, María Dolores. Estadística descriptiva [on line]. Madrid: McGraw-Hill, cop. 2013 [Consultation: 14/09/2022]. Available on: [https://www-ingebook-com.recursos.biblioteca.upc.edu/ib/NPcd/IB\\_BooksVis?cod\\_primaria=1000187&codigo\\_libro=5753](https://www-ingebook-com.recursos.biblioteca.upc.edu/ib/NPcd/IB_BooksVis?cod_primaria=1000187&codigo_libro=5753). ISBN 9788448183318.
- Rausand, Marvin; Høyland, Arnljot. System reliability theory : models, statistical methods, and applications. 2nd ed. Hoboken: John Wiley & Sons, cop. 2004. ISBN 047147133X.
- American Society for Quality. Glossary and tables for statistical quality control. Fourth edition. Milwaukee, Wisconsin: ASQ Quality Press, 2004. ISBN 9780873896313.
- Zio, Enrico; Baraldi, Piero; Cadini, Francesco. Basics of reliability and risk analysis : worked out problems and solutions [on line]. Singapore: World Scientific, cop. 2011 [Consultation: 29/07/2022]. Available on: <https://ebookcentral-proquest-com.recursos.biblioteca.upc.edu/lib/upcatalunya-ebooks/detail.action?docID=312287>. ISBN 9789814355032.
- Gómez, Miguel. Quality in the automotive industry : an easy approach to MSA. Breslavia: Createspace, 2019. ISBN 9783000628153.
- Devore, Jay L; García Hernández, Ana Elizabeth; Torres Flores, Jesús Miguel; León Cárdenas, Javier. Probabilidad y estadística para ingeniería y ciencias. 9ª ed. México: Cengage Learning, 2016. ISBN 9786075228280.

### Complementary:

- Prat Bartés, Albert. Métodos estadísticos : control y mejora de la calidad [on line]. 2ª ed. Barcelona: Edicions UPC, 2004 [Consultation: 19/12/2019]. Available on: <http://hdl.handle.net/2099.3/36342>. ISBN 8483017865.
- Lipschutz, Seymour; Schiller, John J; Cortiñas Vázquez, Pedro; Santos Peña, Julián; ; Guzmán Justicia, Luis. Introducción a la probabilidad y estadística. Madrid [etc.]: McGraw-Hill/Interamericana de España, DL 2001. ISBN 8448125045.
- Ebeling, Charles E. An Introduction to reliability and maintainability engineering. 2nd ed. Long Grove, Illinois: Waveland Press, cop. 2010. ISBN 9781577666257.

## RESOURCES

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### Other resources:

Specific material indicated in the platform "Atena"