

## Quality Engineering and Industrial Statistics (E060240)

**Course size** *(nominal values; actual values may depend on programme)*

**Credits 6.0** **Study time 180 h**

**Course offerings and teaching methods in academic year 2025-2026**

A (semester 2)	English	Gent	seminar
B (semester 2)	Dutch	Gent	

**Lecturers in academic year 2025-2026**

De Vuyst, Stijn TW18 lecturer-in-charge

**Offered in the following programmes in 2025-2026**

	crdts	offering
Bridging Programme Master of Science in Industrial Engineering and Operations Research(main subject Manufacturing and Supply Chain Engineering)	6	A
Master of Science in Electrical Engineering (main subject Communication and Information Technology )	6	A
Master of Science in Electromechanical Engineering(main subject Control Engineering and Automation)	6	A
Master of Science in Business Engineering(main subject Data Analytics)	6	A
Master of Science in Business Engineering (Double Degree)(main subject Data Analytics)	6	A
Master of Science in Electromechanical Engineering(main subject Electrical Power Engineering)	6	A
Master of Science in Electrical Engineering (main subject Electronic Circuits and Systems)	6	A
Master of Science in Industrial Engineering and Operations Research(main subject Manufacturing and Supply Chain Engineering)	6	A
Master of Science in Electromechanical Engineering(main subject Maritime Engineering)	6	A
Master of Science in Electromechanical Engineering(main subject Mechanical Construction)	6	A
Master of Science in Electromechanical Engineering(main subject Mechanical Energy Engineering)	6	A
Master of Science in Business Engineering (Double Degree)(main subject Operations Management)	6	A
Master of Science in Business Engineering(main subject Operations Management)	6	A
Master of Science in Industrial Engineering and Operations Research(main subject Transport and Mobility Engineering)	6	A
Master of Science in Chemical Engineering	6	A
Master of Science in Chemical Engineering	6	A
Master of Science in Civil Engineering	6	A
Master of Science in Computer Science Engineering	6	A
Master of Science in Industrial Engineering and Operations Research	6	B
Master of Science in Materials Engineering	6	A
Master of Science in Photonics Engineering	6	A
Master of Science in Sustainable Materials Engineering	6	A
Postgraduate Programme in Innovation and Entrepreneurship in Engineering – Advanced	6	A
Postgraduate Programme in Innovation and Entrepreneurship in Engineering – Foundations	6	A

**Teaching languages**

English, Dutch

**Keywords**

Data analysis, Production process characterization, Modeling, Improvement,

(Approved)

Monitoring, Quality control, Design of experiments, Linear regression, Control charts, measurement and process capability

### Position of the course

This course is an advanced course in applied industrial statistics. A primary course in probability and statistics is required.

Goal: To teach the students a profound knowledge of industrial statistics and familiarize them with common statistical tools for quality control, process monitoring and process improvement; to activate the knowledge through cases, projects and exercises - with pen & paper as well as with statistical software.

### Contents

- Introduction to quality systems: quality concepts, philosophies and systems
- Multidimensional data: Exploratory Data Analysis and Principal Component Analysis.
- Overview of preliminaries (industrial) statistics: random samples, statistical inference, tests of hypotheses, point estimation of quality parameters, confidence intervals for quality parameters
- Simple and multiple linear regression.
- Statistical process control: methods and philosophy of statistical process control, control charts for variables, control charts for attributes
- Other process monitoring techniques and capability analysis: Cumulative Sum and Exponentially Weighted Moving Average control charts, other statistical process monitoring and control techniques, process and measurement system capability analysis
- Acceptance sampling plan systems: acceptance sampling for attributes and variables
- Design and analysis of experiments: designed experiments, experiments with a single factor, analysis of variance (ANOVA), randomized blocks
- Design and analysis of experiments: designed experiments with multiple factors,  $2^k$  factorial design, blocking
- Design and analysis of experiments: fractional factorial designs,  $2^{k-p}$  designs, confounding, resolution,
- Analysis of factorial designs: connection to regression models, dummy coding, contrasts, post-hoc model adequacy check
- Process optimization with designed experiments: response surface methods and other approaches to process optimization, Taguchi approach to quality and robust designs

Implementation of all these aspects using software for statistical computing, in casu R.

### Initial competences

Basic Statistics Course and basic knowledge of probability theory

### Final competences

- 1 Being able to describe and quantify variability in quality data
- 2 Being able to select, execute and interpret the results of suitable hypothesis tests for quality data
- 3 Being able to build suitable models from measurement data using linear regression and interpret them correctly
- 4 Being able to perform one- and two-way ANOVA and analyse the results
- 5 Being able to select, design, interpret and assess the performance of suitable control charts
- 6 Being able to calculate and interpret process and measurement capability
- 7 Being able to set up suitable and effective experiments
- 8 Being able to select suitable techniques of acceptance sampling, dimension their parameters and reflect on the benefits and advantages of other techniques
- 9 Being able to critically reflect on the objectivity, validity and relevance of statistical results
- 10 Possess sufficient working knowledge of R in order to correctly perform and interpret the discussed methods of industrial statistics and quality control
- 11 Have sufficient theoretical insight into the fundamental assumptions and objectives of statistical methods to assess their range of applicability and limitations

### Conditions for credit contract

Access to this course unit via a credit contract is determined after successful competences assessment

### Conditions for exam contract

This course unit cannot be taken via an exam contract

### Teaching methods

Seminar, Independent work

### Extra information on the teaching methods

The course is split up in a number of well-determined parts. Students must study the theory of each part by themselves, **before** a specific date, based on particular sections in the textbook, slides and other given references. After that, there is first a practical session with PC exercises and then a Questions & Answers session (Q&A) on the theory with further demonstrations concerning the study material. Students must submit their questions for the Q&A beforehand to the forum on the electronic learning environment.

### Study material

Type: Handbook

Name: Introduction to Statistical Quality Control

Indicative price: € 50

Optional: yes

Language : English

Author : Douglas C. Montgomery

ISBN : 978-1-11939-930-8

Number of Pages : 768

Oldest Usable Edition : 6

Online Available : No

Available in the Library : Yes

Available through Student Association : Yes

Usability and Lifetime within the Course Unit : regularly

Usability and Lifetime within the Study Programme : one-time

Usability and Lifetime after the Study Programme : occasionally

Additional information: In the course, we frequently refer to sections in this book. It explains some of the course material in a slower manner than in the lecture slides.

Type: Slides

Name: Quality engineering and industrial statistics

Indicative price: Free or paid by faculty

Optional: no

Language : English

Number of Slides : 700

Available on Ufora : Yes

Online Available : No

Available in the Library : No

Available through Student Association : No

### References

- <http://www.itl.nist.gov/div898/handbook/index.htm>
- <http://www.r-project.org/>
- Kennett R.S., Zacks S., Modern Industrial Statistics - Design and Control of Quality and Reliability, 1998, Thomson Publishing Inc.
- Cano E.L., Moguerza J.M., Redchuk A., Six Sigma with R, 2012, Springer.

### Course content-related study coaching

- e-mail
- the electronic learning environment (forums)
- appointment tutoring

### Assessment moments

end-of-term assessment

### Examination methods in case of periodic assessment during the first examination period

Written assessment with open-ended questions, Written assessment open-book

### Examination methods in case of periodic assessment during the second examination period

Written assessment with open-ended questions, Written assessment open-book

**Examination methods in case of permanent assessment**

**Possibilities of retake in case of permanent assessment**

not applicable

**Calculation of the examination mark**