GHENT UNIVERSITY

Course Specifications

Valid as from the academic year 2024-2025

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,

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 statistcs 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 interprete 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 asses their range of applicability and limitiations

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