GHENT UNIVERSITY

Course Specifications

Valid as from the academic year 2026-2027

Queueing Analysis and Simulation (E011322)

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 2026-2027

A (semester 1)	English	Gent	lecture seminar
B (semester 1)	Dutch	Gent	

Lecturers in academic year 2026-2027

Wittevrongel, Sabine	TW07	lecturer-in-charge
De Turck, Koen	TW07	co-lecturer

Offered in the following programmes in 2026-2027	crdts	offering
Bridging Programme Master of Science in Electrical Engineering(main subject Communication and Information Technology)	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 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 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 Computer Science Engineering	6	A
Master of Science in Mathematics	6	A

Teaching languages

English, Dutch

Keywords

Queueing systems; Stochastic modelling; Performance evaluation of computer and communication systems; Markov chains; Simulation.

Position of the course

This course introduces basic concepts of queueing analysis and simulation for assessing the performance of computer and communication systems. Specifically, the course discusses techniques for dimensioning queues and buffers and for the estimation of buffer occupancies, loss probabilities and delays in such queues.

Contents

· Introduction: discrete-time queueing models and telecommunications; terminology for queueing systems; general queueing-theoretic laws (equilibrium condition, Little's law)
· Elementary buffer analysis in discrete time: typical techniques and results; balance equations; approach via probability generating functions
· Analysis of more general buffer models in discrete time (with a more-dimensional state description): correlated arrival processes; variable transmission times; output interruptions; priority systems

· Generation of random numbers: linear congruential generators, shift-register generators, jump-ahead algorithms; inversion method; rejection method; ratio method.
· Monte Carlo estimators, confidence intervals, bootstrapping, and resampling.
· Quasi–Monte Carlo.
· Simulation of spatial and spatio-temporal processes.
· Discrete-event systems: events, event list (agenda), handlers.
· Importance weighting and other variance reduction techniques.
· Rare events: importance weighting, splitting, cross-entropy method.
· Ergodicity, stationarity, burn-in period, regeneration, perfect simulation.
· Optimization and sensitivity analysis

Initial competences

Basic probability theory and statistics; elements of stochastic processes

Final competences

1 To master mathematical techniques for queueing analysis in discrete time and to apply them creatively
2 To construct a simulation program and to process simulation results
3 To select the most suitable models, methods and techniques for specific queueing problems
4 To assess the performance of buffer systems quantitatively and qualitatively
5 To have insight into results of buffer analysis and to understand the influence of model parameters on the buffer behavior

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

Group work, Seminar, Lecture, Independent work

Extra information on the teaching methods

Seminar, Lecture, Independent work

Study material

Type: Syllabus

Name: Queueing Analysis and Simulation
Indicative price: € 10
Optional: no
Available on Ufora : Yes
Available through Student Association : Yes

References

H. Bruneel, B.G. Kim, "Discrete-time models for communication systems including ATM" (Kluwer Academic Publishers, Boston, 1993)
S. M. Ross, *Simulation*, 5th ed. New York: Academic Press, 2012.
B. L. Nelson and L. Pei, *Foundations and Methods of Stochastic Simulation: A First Course*, 2nd ed. Cham, Switzerland: Springer, 2021.

Course content-related study coaching

Assessment moments

end-of-term and continuous assessment

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

Written assessment with open-ended questions

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

Written assessment with open-ended questions

Examination methods in case of permanent assessment

Presentation, Assignment

Possibilities of retake in case of permanent assessment

examination during the second examination period is possible in modified form

Extra information on the examination methods

During the semester, the students are asked to write reports for a number of assignments (individually or in group). At the end of the semester, there is an oral defense of these assignments. The assignments count for 2 out of 20 points of the grade in total. The exam is a written closed book exam.

Calculation of the examination mark

Final score = 10% score PE+90% score NPE
A student who does not obtain at least 8/20 for each component (PE/NPE) cannot pass the course.
If the calculated total score of such a student amounts to 10/20 or higher, it will be reduced to the highest failing grade (9/20).