GHENT UNIVERSITY

Course Specifications

Valid in the academic year 2025-2026

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 2025-2026

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

Lecturers in academic year 2025-2026

Walraevens, Joris	TWO7	lecturer-in-charge
De Turck, Koen	TWO7	co-lecturer

Offered in the following programmes in 2025-2026	crdts	offering
Bridging Programme Master of Science in Electrical Engineering(main subject Communication and Information Technology)	6	A
Bridging Programme Master of Science in Computer Science 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 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	B
Master of Science in Computer Science Engineering	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 loss probabilities, blocking probabilities and delays in such queues.

Contents

- Introduction: Queues in communication networks and computers; Stochastic modelling; Terminology of queueing systems; Kendall notation.
- Birth-death queueing systems: Poisson arrivals see time averages; Global and detailed balance equations; Erlang's formulas.
- Waiting times: Little's law; Waiting time analysis of first-come-first-served birth-death queueing systems; Laplace-Stieltjes transform approach.
- Networks of queueing systems: Reversibility of Markov chains; Burke's theorem;

Product-form queueing networks.
- Beyond birth-death queues: Phase-type distribution; Markovian arrival process; quasi birth-death Markov chains, Numerical solution of quasi-birth-death Markov chains; Mean-value analysis of Queues with generally distributed service times.
- Overview and typology of simulation techniques.
- Generating random numbers: linear congruential generators; inversion method; accept/reject method.
- Monte Carlo estimation.
- Simulating trajectories of Poisson processes and Markov processes.
- Discrete-event systems: events, agenda, handlers.
- Variance reduction methods and confidence intervals: reduction by conditioning; reduction by control variables; importance sampling.
- Ergodicity, stationarity, transition period, regeneration.
- Simulation-based optimizations.

Initial competences

Basic probability theory and statistics; elements of stochastic processes

Final competences

1 To master mathematical solution techniques for queueing problems
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 queueing systems quantitatively and qualitatively
5 To know and apply general operational queueing-theoretic laws

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

Study material

Type: Syllabus

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

References

- M. Harchol-Balter, Performance Modeling and Design of Computer Systems: Queueing Theory in Action, Cambridge University Press, 2013.
- L. Kleinrock, "Queueing Systems, Volume 1, Theory" (Wiley, New York, 1975)

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, they present

their results for some of the assignments. The assignments count for 10 out of 20 points of the grade in total.
The exam is a written closed book exam.

Calculation of the examination mark

Final score = 50% score PE+50% score NPE
A student who does not gain at least 7/20 for each part (PE/NPE) cannot pass the course. If the calculated total score of such a student is a mark of ten or more out of twenty, then this is reduced to the highest failing mark (9/20).