GHENT UNIVERSITY

Course Specifications

Valid in the academic year 2022-2023

Queueing Theory (E011320)

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

Credits 6.0	**Study time 180 h**	**Contact hrs** 60.0h

Course offerings and teaching methods in academic year 2022-2023

A (semester 2)	Dutch	Gent		
B (semester 1)	English	Gent	lecture	30.0h
			seminar: coached exercises	30.0h

Lecturers in academic year 2022-2023

Walraevens, Joris	TW07	lecturer-in-charge
Wittevrongel, Sabine	TW07	co-lecturer

Offered in the following programmes in 2022-2023	**crdts**	**offering**
Master of Science in Teaching in Science and Technology(main subject Mathematics)	6	B
Bridging Programme Master of Science in Industrial Engineering and Operations Research	6	B
Master of Science in Business Engineering(main subject Data Analytics)	6	B
Master of Science in Industrial Engineering and Operations Research(main subject Manufacturing and Supply Chain Engineering)	6	B
Master of Science in Business Engineering(main subject Operations Management)	6	B
Master of Science in Industrial Engineering and Operations Research(main subject Transport and Mobility Engineering)	6	B
Master of Science in Industrial Engineering and Operations Research	6	B
Master of Science in Mathematics	6	B

Teaching languages

English, Dutch

Keywords

Queueing systems; Stochastic modeling; Continuous-time and discrete-time models; Performance measures

Position of the course

This course introduces basic concepts of classical elementary queueing theory in continuous time, as well as more advanced queueing theory in discrete time. Specifically, the course discusses techniques for the dimensioning of waiting rooms and buffers and for the estimation of loss probabilities, blocking probabilities and delays.

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.
- Quasi-birth-death queueing systems: Phase-type distribution; Markovian arrival process; Numerical solution of quasi-birth-death Markov chains.
- Queues with generally distributed service times: Mean-value analysis; Transform analysis; Calculation/approximation of performance measures from transforms.
- Networks of queueing systems: Reversibility of Markov chains; Burke's theorem; Jackson networks.
- Discrete-time queueing models and telecommunications

- Elementary buffer analysis in discrete time: typical techniques and results
- Analysis of more advanced buffer models in discrete time (with a more-dimensional state description): correlated arrival processes, variable transmission times, output interruptions

Initial competences

Basic probability theory and statistics; elements of stochastic processes

Final competences

1 To master mathematical solution techniques for queueing problems
2 To select the most suitable models, methods and techniques for specific queueing problems
3 To assess the performance of queueing systems quantitatively and qualitatively
4 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

Lecture, Self-reliant study activities, Project, Seminar: coached exercises

Learning materials and price

Syllabus that is made available in PDF-form on the electronic learning platform and that can be purchased from VTK in paper form (5-10 euros).

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)
- H. Bruneel, B.G. Kim, "Discrete-time models for communication systems including ATM" (Kluwer Academic Publishers, Boston, 1993)

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 examination with open questions

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

Written examination with open questions

Examination methods in case of permanent assessment

Report

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 brief reports for a small number of assignments. These assignments count for 4 of the 20 points of the grade in total.
The exam is a written closed book exam.

Calculation of the examination mark

Final score = 80% score PE+20% score NPE