GHENT UNIVERSITY

Course Specifications

Valid as from the academic year 2019-2020

Queueing Theory (E011320)

Due to Covid 19, the education and evaluation methods may vary from the information displayed in the schedules and course details. Any changes will be communicated on Ufora.

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

Credits	6.0	Study time	180 h	Contact hrs	60.0 h

Course offerings and teaching methods in academic year 2020-2021

A (semester 2)	Dutch	Gent	seminar: coached exercises	30.0 h
			self-reliant study activities	20.0 h
			lecture	30.0 h

Lecturers in academic year 2020-2021

Bruneel, Herwig	TW07	lecturer-in-charge

Offered in the following programmes in 2020-2021	crdts	offering
Master of Science in Teaching in Science and Technology (main subject Mathematics)	6	A
Bridging Programme Master of Science in Industrial Engineering and Operations Research	6	A
Bridging Programme Master of Science in Industrial Engineering and Operations Research	6	A
Master of Science in Business Engineering (main subject Data Analytics)	6	A
Master of Science in Electrical Engineering (main subject Electronic Circuits and Systems)	6	A
Master of Science in Business Engineering (main subject Operations Management)	6	A
Master of Science in Mathematics	6	A
Master of Science in Industrial Engineering and Operations Research	6	A
Master of Science in Electrical Engineering	6	A
Master of Science in Industrial Engineering and Operations Research	6	A

Teaching languages

Dutch

Keywords

queueing phenomena, stochastic modeling, system contents, waiting times, buffers, telecommunication networks

Position of the course

Basic concepts of classical elementary queueing theory in continuous time, as well as more advanced queueing theory in discrete time, useful for the performance evaluation of telecommunication systems and networks. 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

- Some concepts from probability theory
- Queueing systems: mathematical description, performance measures, utilisation factor
- Little's theorem
- Birth-death queueing systems in continuous time: M/M/1, M/M/infinity, M/M/m, M/M/1/K, M/M/m/m

- Markovian queueing systems in continuous time, method of stages, bulk arrivals
- Networks of queueing systems, Burke's theorem, Jackson's theorem
- Queueing theory and telecommunications
- Buffer analysis in discrete time: typical techniques and results
- Elementary buffer models in discrete time: GI-D-1, GI-D-c, study of buffer occupancy, delay and loss probability
- Interruptions in the service process

Initial competences

Mandatory: elementary probability theory (see e.g. course Probability and statistics); Useful: elements of stochastic processes in general, and Poisson processes and birth-death processes in particular (see e.g. course Discrete Systems or course Applied Probability)

Final competences

1 Be capable of probabilistic reasoning.
2 Have the reflex to use generating functions when solving probabilistic problems.
3 Understand the meaning of memorylessness.
4 Know and understand general structure and performance measures of a queueing system.
5 Know Little's theorem and have the reflex to use it in concrete situations.
6 Understand the concepts birth-death process, state-transition-rate diagram and balance equations.
7 Analyse birth-death queueing systems.
8 Establish and analyse more complicated state-transition-rate diagrams.
9 Analyse Markovian networks of queues.
10 Appreciate the purpose of buffers, multiplexers and switching systems in telecommunication networks.
11 Understand the rationale of buffer analysis techniques, such as analytical and numerical method, computer simulation and experiments.
12 Understand the usefulness and the results of buffer analysis.
13 Analyse simple discrete-time buffer systems.
14 Establish system equations, compute buffer occupancies and delays.
15 Understand the effect of output interruptions on buffer behaviour.

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, seminar: coached exercises

Learning materials and price

Course material: Flemish syllabus (10 euro) + occasional electronic slides (via the electronic learning platform)

References

- 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

Evaluation methods

end-of-term evaluation

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

Open book examination

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

Open book examination

Examination methods in case of permanent evaluation

Possibilities of retake in case of permanent evaluation

not applicable

Calculation of the examination mark

Evaluation during examination period. Special conditions: No direct questions about the theory in the syllabus, solving of exercises only