COURSE DESCRIPTION CARD - SYLLABUS

Course name
Stochastic processes and queueing systems: modeling and algorithms [S2TIIZM1E>PSiSK]

Course

Field of study
Information Technology for Smart and Sustainable Mobility

Year/Semester
1/2

Area of study (specialization)
–

Profile of study
general academic

Level of study
second-cycle

Course offered in
English

Form of study
full-time

Requirements
compulsory

Number of hours

Lecture
32

Laboratory classes
16

Other
0

Tutorials
0

Projects/seminars
0

Number of credit points

4,00

Coordinators

Lecturers

Prerequisites

Knowledge: Mathematics - including probability and statistics, linear algebra, exponential functions and limits, discrete mathematics / graph theory. Algorithms and Data Structures Skills: Problem-solving - especially in algorithmic and mathematical contexts. Basic programming - (e.g., in Python, C++, or Java).

Course objective

The course combines theoretical analysis with practical examples to equip students with tools for modeling, analyzing, and optimizing systems in transport, logistics, and computer networks. The aim of the course is to equip students with theoretical and practical knowledge in queueing theory and network optimization.

Course-related learning outcomes

Knowledge:
he student has advanced and in-depth knowledge of selected mathematical and computer science topics, in particular, is familiar with queueing theory and the principles of queueing system analysis, network optimization issues, Markov processes, and Markov chains
The student demonstrates knowledge of advanced methods, techniques, and tools used for solving complex engineering tasks and conducting research in a selected area of transport engineering

Skills:
The student is able to use information and communication technologies applied in the implementation of transport system projects, including the ability to apply queueing theory, shortest path problems, and flow optimization methods in tools used for network optimization.
The student is able - when formulating and solving engineering tasks - to integrate knowledge from various areas of transport, computer science and mathematics, and to apply a systems approach that also takes non-technical aspects into account

Social competences:
The student understands the importance of using the latest knowledge in computer science to solve research and practical problems

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Written exam
Practical exam

Programme content

Queueing theory and exploration of queues , Network optimization, Markov processes and Markov chains

Course topics

1. Basic queueing theory.
2. Markov Processes and Markov Chains
3. Birth-Death Processes
4. Equilibrium Solutions for M/M/-/- Queues
5. Analysis of the M/G/1 queue: Priorities in a M/G/1
6. Network of queues
7. Queueing theory in practice: traffic descriptors, delay and rate guarantees
8. Network optimization

o The shortest path problem: The Dijkstra Algorithm, The Ford Algorithm, The Floyd Algorithm
o Flow optimization: The maximum flow problem, The Ford-Fulkerson Algorithm, The minimum-cost maximum-flow problem

Teaching methods

The course is conducted remotely (online) in a synchronous format. Classes may also be held in person.
Interactive lectures with multimedia presentations
Case studies and practical examples

Bibliography

Basic:
Bose, S. (2002), An Introduction to Queueing Systems, Kluwer Academic/Plenum Publishers

Additional:
-

Breakdown of average student's workload

	Hours	ECTS
Total workload	100	4,00
Classes requiring direct contact with the teacher	48	2,00
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	52	2,00