Study programme: Master studies – Mathematics

Course name: Stochastic Models in Operations Research

Lecturer: Lenka Glavaš

Status: Optional for the module Statistics, actuarial and financial mathematics

ECTS: 8

Attendance prerequisites: Theory of probability, Stochastic processes, Mathematical statistics

Course aims: Learning objectives are: developing theoretical framework from parts of the theory of stochastics processes, necessary for studying the queueing theory, as well as getting acquainted with various queueing systems and their modelling and analysis using previously introduced stochastic models.

Course outcome: Student has expanded knowledge of the theory of stochastics processes, necessary for studying the queueing theory. Therefore, student understands underlying concepts and properties associated with Markov chains, birth and death processes, renewal processes, Poisson process, and student is capable of applying skills and transforming the knowledge into actual implementation of methods to solve practical problems concerning operations research.

Course content: Stream of homogeneous events, simple stream. Derivation of equations for simple streams. The probability generating function. Laplace-Stieltjes transform. Poisson process. Markov chains. Higher order transition probabilities. Classification of states. Continuous time Markov chains, infinitesimal generator, distribution of time that the chain stays in the given state before making a transition into a different state, differentiability of transition probabilities. Pure birth processes, the classical regularity condition of a pure birth process. Birth and death processes. Renewal processes. The homogeneous Poisson process as a renewal process. Classification of queues. The queue M|M|m, performance measures, probability distributions of waiting time and sojourn time. Queues with losses. Finite capacity systems – the queue M|M|m|K, average number of busy servers, probability distribution of waiting time, blocking probability. Queues with limited delay time. The queue M|G|1, Pollaczek-Khinchin formula, probability distribution of waiting time. The queue G|M|1. Priority queueing. Introduction to Jackson networks of queues.

Literature:

1. Ленка Главаш, Слободанка Јанковић: *Стохастички модели у операционим истраживањима*, Математички факултет, Београд 2016.
2. Sidney Resnick: *Adventures in Stochastic Processes*, Birkhäuser Boston 1992.
3. B.V. Gnedenko, I. N. Kovalenko: *Introduction to queueing theory*, Birkhäuser Boston 1989.
4. Søren Asmussen: *Applied probability and queues*, Springer-Verlag New York 2003.

Number of hours: 7	**Lectures:** 3	**Exercises**: 4

Teaching and learning methods: Lectures (frontal). Classes and exercises (interactive).

Assessment (maximal 100 points)			
Course assignments	**Number of points**	**Final exam**	**Number of points**
Lectures	-	Written exam	-
Exercises / Tutorials	10	Oral exam	40
Colloquia	40	Written-oral exam	-
Tests	-		
Essay / Project	10		