

**Complex exam
minor subject**

Performance Modeling of Queueing Systems

Syllabus

Markov-type queueing systems, M/M/1, M/M/n/n, finite source systems. M/G/1 systems with transformation and mean value formulas. G/M/m, G/G/1 systems, derivation of their performance measures. Open and closed queueing networks, their main forms, different numerical procedures related their modeling. Network modeling tools. Investigating Non-Markov systems. Using Discrete Event Simulation. Computer tools for determining the performance characteristics. Using PEPSY tools, MOSEL-2 tool, and Riverbed Modeler© (former OPNet IT Guru) for analyzing queueing and infocommunication systems.

Renewal and Markovian Renewal processes. Phase Type Distributions. Birth and Death Processes. Quasi Birth and Death Processes. Spectral expansion, calculation of eigenvalues and eigenvectors. Complex Markovian queueing systems. Finite source systems, examples, applications.

Bibliography

1. Bolch, G., Greiner, S., Trivedi, K.: Queueing Networks and Markov Chains, J. Wiley, 1998, 2002
2. Gross, D., Harris, C. : Fundamentals of Queueing Theory, John Wiley, New York, 1985
3. Daigle, J.N.: Queueing Theory for Telecommunications, Addison-Wesley, 1992.
4. Lakatos, L., Szeidl, I., Telek, M.: Introduction to Queueing Systems with Telecommunication Applications, Springer, New York, 2013.
5. Begain K., Bolch G., and Herold H., Practical Performance Modeling, Application of the MOSEL Language, Kluwer Academic Publisher, Boston, 2001.
6. Sethi, A., S., Hnatyshin, V., Y., The Practical OPNET® User Guide for Computer Networks, CRC Press, (2013).
7. G. Latouche, V. Ramaswami: Introduction to Matrix Analytic Methods in Stochastic Modeling, Society for Industrial and Applied Mathematics, 1987.
8. Marcel F. Neuts: Matrix-Geometric Solutions in Stochastic Models An Algorithmic Approach, Johns Hopkins University Press, 1981

**Compulsory subjects for this
minor subject**

Stochastic Modeling of Informatics Systems

**Recommended subjects for this
minor subject**

Tools for Network Modeling
Analytic methods in stochastic modeling