COURSE DESCRIPTION CARD - SYLLABUS

Course name
Monitoring and evaluation of ICT network performance [S2EiT1-SSiU>MiOWST]

Course

Field of study
Electronics and Telecommunications

Year/Semester
2/3

Area of study (specialization)
Networks, Systems and Services

Profile of study
general academic

Level of study
second-cycle

Course offered in
polish

Form of study
full-time

Requirements
elective

Number of hours

Lecture
30

Laboratory classes
15

Other (e.g. online)
0

Tutorials
0

Projects/seminars
15

Number of credit points

4,00

Coordinators

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Lecturers

Prerequisites

The student joining this course should know the basics of traffic engineering, queuing theory, network management systems, network protocols and telecommunications techniques that are used in telecommunications and computer networks. She/he should also be able to solve basic problems in the field of electronics and telecommunications with the use of a mathematical apparatus in the field of algebra and probability calculus. The students should also be aware of the need for a professional approach to solving technical problems and taking responsibility for the technical solutions they propose.

Course objective

To provide students with knowledge about advanced solutions in the field of traffic management in packet networks and methods of network design with differentiated quality of service. Developing students" skills in solving problems arising in the modeling, design and implementation of wide-area networks with differentiated service quality.

Course-related learning outcomes

Knowledge:
1. A student has systematic and mathematical knowledge in the field of theory and traffic engineering,

parameterization, dimensioning and optimization of networks and network systems.
2. A student has ordered practical knowledge in the field of designing ICT networks.
3. A student has in-depth knowledge of the construction and operation of telecommunications systems for the provision of multimedia services.

Skills:
1. A student can analyze and design packet networks, ensuring that the designed solutions achieve the required technical parameters.
2. A student can prepare a scientific study and present a presentation on the implementation of projects in the field of telecommunications, can discuss the presented problem.

Social competences:
1. A student knows the limitations of his own knowledge and skills, understands the need for further training.
2. A student is aware of the need for a professional approach to solving technical problems and taking responsibility for the proposed technical solutions.

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

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The knowledge acquired as part of the lecture is verified during the written and / or oral exam. The exam consists of answers to 3-5 problem questions. Questions are asked by the teacher (in the case of a written exam) or randomly drawn (in the case of an oral exam). Regardless of the form of the exam (oral, written), the questions come from a collection of 20 issues known to students and passed on during the lecture. Each answer to a given question is rated on a scale of 2 to 5, and the final result is the average of the scores for individual answers.
Completion of the project consists in assessing the documentation of the developed software (containing the results of calculations and their analysis), necessary to parameterize the network system with a given traffic control mechanism, as well as the presentation and defence of the completed project. Each of the above elements, i.e. documentation, presentation and defence, are rated on a scale of 2 to 5. To pass the project, it is necessary that each of the listed elements to be assessed is rated at least satisfactory (3.0). After this condition is met, the final grade for the project is the arithmetic average of the grades obtained for: documentation, presentation, and defence.
Skills acquired as part of the laboratory are verified on an ongoing basis. At the end of each laboratory class, the correctness of configuration of network devices is assessed on a scale of 2 to 5. The final grade is the average of grades obtained from individual laboratory classes.

Programme content

1. The lecture will cover the following issues:
- Network performance monitoring and testing objectives;
- Network performance metrics (packet level quality of service parameters - QoS, relationship of QoS and QoE parameters);
- Network types used in the analysis of packet network performance (real network, emulated network, network model);
- Network performance evaluation based on network model vs. network performance evaluation based on network measurements;
- Packet network analysis levels;
- Resource models in multi-service packet networks;
- Streaming, elastic and adaptive traffic;
- Advanced queuing systems and networks;
- Models of traffic flow and transfer management in packet networks;
- Load balancing models in packet networks;
- TE (Traffic Engineering) mechanisms for MPLS and Carrier Ethernet networks
- Introduction to the simulation of multi-service networks;
- Introduction to network measurements (measured elements, active and passive measurements, traffic generators, measurement tools);
- NetFlow (characteristics, implementations, range of applications; cooperation with MPLS, SCTP, BGP);
- Monitoring and fault localization in switched networks;

- Methods of monitoring and locating faults used in the field of routing and security;
- SLA parameters verification.
2. The laboratory classes include exercises on the following topics:
- Development of software for evaluating the performance of multi-service networks with streaming, elastic and adaptive traffic;
- Application of network performance evaluation techniques to assess Internet traffic properties;
- Application of network performance evaluation techniques to network modeling with traffic overflow;
- Network measurements using NetFLow;
- Troubleshooting of networks made of switches;
- Troubleshooting of routing protocols in ICT networks;
- Configuration of hardware traffic generators. Performance tests of network protocols with a controlled network load.
3. As part of the project, students prepare the software necessary for the parameterization of the network system with a given traffic management mechanism, and documentation with the results of calculations and their analysis.

Teaching methods

- a traditional lecture with elements of a problem lecture;
- a multi-phase project;
- laboratory exercises: practical exercises in groups using network devices.

Bibliography

Basic
1. Stasiak M., Głąbowski M., Zwierzykowski P.: Modelowanie i wymiarowanie ruchomych sieci bezprzewodowych. Wydawnictwo Komunikacji i Łączności, Warszawa 2009.
2. www.ietf.org (numery konkretnych RFC podawane na wykładach).
3. Oppenheimer, P. Top-Down Network Design, 3rd ed. Indianapolis, Indiana: Cisco Press, 2010.
Additional
1. Stasiak M., Głąbowski M., Zwierzykowski P.: Modeling and Dimensioning of Mobile Networks: from GSM to LTE, John Wiley and sons Ltd., January 2011
2. Iversen V.B., ed., Teletraffic Engineering, Handbook, ITU, Study Group 2,Question 16/2 Geneva, January 2005, published on-line.

Breakdown of average student's workload

	Hours	ECTS
Total workload	100	4,00
Classes requiring direct contact with the teacher	70	3,00
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	30	1,00