



COURSE DESCRIPTION CARD - SYLLABUS

Course name

Fundamentals of Wide Area Networks (WANs) [S1Cybez1>PRSK]

Course

Field of study
Cybersecurity

Year/Semester
2/3

Area of study (specialization)
–

Profile of study
general academic

Level of study
first-cycle

Course offered in
Polish

Form of study
full-time

Requirements
compulsory

Number of hours

Lecture
30

Laboratory classes
30

Other
0

Tutorials
0

Projects/seminars
0

Number of credit points

4,00

Coordinators

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Lecturers

Prerequisites

Knowledge of the fundamentals of local area networks (LANs) and an introduction to teleinformatics.

Course objective

The course "Fundamentals of Wide Area Networks (WANs)" introduces students to advanced topics in the design, configuration, and management of wide area networks. It covers routing protocols, traffic flow management, the design of secure virtual private networks (VPNs), as well as MPLS and GMPLS techniques. Students will learn engineering methods for designing and building networks and develop skills in configuring network devices, including automated configuration processes. This course builds upon the knowledge and skills acquired in "Fundamentals of Local Area Networks" and "Introduction to Teleinformatics."

Course-related learning outcomes

Knowledge:

- A student is familiar with advanced routing protocols (OSPF, BGP, ISIS) and traffic management mechanisms in WAN networks.
- Understands the techniques for designing and implementing secure virtual private networks (VPNs).

- Possesses knowledge of MPLS, GMPLS, and quality of service (QoS) management in IP networks.

Skills:

- Can configure routing protocols and optimize the performance of WAN networks.
- Is able to design and implement VPNs in various architectures.
- Applies automation techniques for network device configuration.

Social competences:

- Understands the importance of continuous skill development in the field of wide area networks (WANs).
- Is aware of the responsibility for designing and managing secure networks in a business environment.

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

1. Knowledge: A written exam with questions on routing protocols, VPNs, and MPLS/GMPLS techniques.

2. Skills: Ongoing assessment of laboratory tasks and final evaluation of the group project.

In each form of the course assessment, the grade depends on the number of points the student earns relative to the maximum number of required points. Earning at least 50% of the possible points is a prerequisite for passing. The relationship between the grade and the number of points is defined by the Study Regulations. Additionally, the course completion rules and the exact passing thresholds will be communicated to students at the beginning of the semester through the university's electronic systems and during the first class meeting (in each form of classes).

Programme content

The course "Fundamentals of Wide Area Networks (WANs)" introduces students to advanced topics in the design, configuration, and management of wide area networks. It covers routing protocols, traffic flow management, the design of secure virtual private networks (VPNs), as well as MPLS and GMPLS techniques. Students will learn engineering methods for designing and building networks and develop skills in configuring network devices, including automated configuration processes. This course builds upon the knowledge and skills acquired in "Fundamentals of Local Area Networks" and "Introduction to Teleinformatics."

Course topics

I. Fundamentals of Wide Area Networks (WANs) (10x45)

1. Protocols and Mechanisms of the TCP/IP Stack

- Overview of key TCP/IPv4/IPv6 protocols.
- Packet flow management using Access Control Lists (ACL).

2. Routing Protocols

- Single-area and multi-area OSPF protocol.
- ISIS protocol - fundamentals and applications.
- Basics of BGP protocol and inter-autonomous system routing management.
- Optimization of routing protocols and strategic routing.

II. MPLS, GMPLS, Carrier Ethernet, and VPN Technologies (12x45)

1. MPLS

- Fundamentals of MPLS.
- MPLS mechanisms for optimizing network traffic flow.

2. Advanced MPLS Techniques

- GMPLS networks.
- TP-MPLS networks.

3. Virtual Private Networks (VPNs)

- Overlay architecture in VPNs.
- Layer 3 VPNs in peer-to-peer architecture.
- Layer 2 VPNs using MPLS and Carrier Ethernet techniques.

III. Quality of Service (QoS) and Network Automation in IP Networks (8x45)

1. Introduction to Quality of Service (QoS)

- Basic concepts and mechanisms of QoS, QoE, and GoS in IP networks with differentiated service

quality.

- Relationship between QoS and QoE for typical packet network services (VoIP, IPTV, video conferencing, VoD, gaming).

- Traffic supervision, classification, and marking mechanisms.

- Queue management and packet scheduling mechanisms.

2. Automation of Configuration Processes

- Tools and techniques for automating network device configuration.

- Introduction to network automation systems (Ansible, Netconf, Restconf).

IV. Laboratory: Practical Aspects of WAN Management

1. Routing Protocol Configuration

- Implementation and optimization of OSPF and ISIS protocols.

- Configuration of inter-autonomous system routing.

2. VPN Design and Configuration

- Implementation of VPNs in overlay and peer-to-peer architectures.

- MPLS and Carrier Ethernet configuration for Layer 2 and Layer 3 networks.

3. Quality of Service (QoS) Management

- Implementation of QoS mechanisms in IP networks.

- Traffic analysis and priority management in practice.

4. Network Configuration Automation

- Deployment of scripts for automating configuration processes.

- Testing and evaluating the effectiveness of automated solutions.

Teaching methods

- Lectures online using multimedia presentations and practical examples.

- Laboratory sessions with hands-on exercises, including network device configuration and the implementation of QoS and VPN mechanisms.

Bibliography

Basic:

1. Doyle, J., & Carroll, J. D. (2005). Routing TCP/IP (Vol. 1, 2nd ed.). Cisco Press. ISBN: 978-1587052026 (or 1-58705-202-4).

2. de Ghein, L. (2006). MPLS Fundamentals. Cisco Press. ISBN: 978-1587051975 (or 1-58705-197-4).

3. Network protocol documentation (RFC), available at RFC Editor.

Additional:

1. Educational materials prepared by the instructors.

Breakdown of average student's workload

	Hours	ECTS
Total workload	105	4,00
Classes requiring direct contact with the teacher	60	2,50
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	45	1,50