RTU Course "Signalling Systems and Protocols"

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General data

Code	RAE553
Course title	Signalling Systems and Protocols
Course status in the programme	Compulsory/Courses of Limited Choice
Responsible instructor	Andris Skrastiņš
Academic staff	Ingrīda Lavrinoviča
Volume of the course: parts and credits points	1 part, 3.0 Credit Points, 4.5 ECTS credits
Language of instruction	LV, EN
Annotation	The rapid development of telecommunications branches required specialists, who would be able to analyse the current situation, forecast development directions, make long-term responsible solutions about favourable signalling/protocol system selection The study course provides students with the necessary skills for working in the sphere of signalling and communications protocols. Aspects of compatibility, scalability and security are emphasized. Message formats, time and state diagrams of protocols are analysed. Working with protocol analysers in an emulation environment provides students with the necessary skills for solving problems and preparing for changes in configuration. Within the framework of the study course, students are acquainted with fundamental telecommunications signalling and protocols, analyse its historical development with some essential drawbacks, expand their personal vision for future task solutions in future.
Goals and objectives of the course in terms of competences and skills	The goal of the study course is to prepare specialists for work with telecommunication protocols and signalling. The objectives of the study course: 1. To provide knowledge and independently navigate the rapidly changing industry standards, recommendations and hardware tools. 2. To develop the skills to deal with the protocols, as well as the implementation and interoperability issues independently. 3. To provide knowledge of signalling network alignment and modification.
Structure and tasks of independent studies	In some of the laboratory work, students use virtual network environments that can be implemented on personal computers. In other laboratory works, students perform tasks on the emulated network environment prepared in the RTU data center. As part of this work, the student performs configurations and analyzes the operation of the transmitted traffic and protocols by connecting to the appropriate router remotely. The second part of the work is done independently at home, analyzing the obtained traffic trace in the context of a specific task. The student has the opportunity to access the laboratory network infrastructure remotely and make additional measurements or configuration corrections.
Recommended literature	Obligātā/Obligatory: 1.Michael G. Solomon, David Kim. Fundamentals of Communications and Networking, 3rd Edition, 2021, Jones & Bartlett Learning 2.Chwan-Hwa Wu, J. David Irwin. Introduction to Computer Networks and Cybersecurity. 2016. CRC Press. 3.Vinit Jain, Brad Edgeworth. Troubleshooting BGP: A Practical Guide to Understanding and Troubleshooting BGP. Cisco Press. 2016. 4.A. Singh, A. Mallick, A Survey on Virtual Private Network, National Conference On Contemporary Research and Innovations in Computer Science (NCCRICS), decembris 2017. DOI: 10.29126/23951303/NCCRICS-105. Papildu/Additional: 5.Luc De Ghein. MPLS Fundamentals: A Comprehensive Introduction to MPLS Theory and Practice. Cisco Systems Inc., 2007 6.J. F. Kurose, K. W. Ross “Computer Networks: A Top-down Approach 7th Ed.”, Pearson Education Limited, 2017. - 853 p. 7.Hwaiyu Geng, Data Center Handbook: Plan, Design, Build, And Operations Of A Smart Data Center. Wiley Publishing Inc,, 2021- 755 p. 8.H. Geng, Data Center Handbook, Wiley Publishing Inc, 2015. - 715 p. 9.Perez A., Network security, Hoboken, NJ: ISTE Ltd/John Wiley and Sons Inc, 2014 10. All materials available on the Internet on the topics of this course.IETF un ITU-T documents.
Course prerequisites	Skills in Linux. The principal activity Cisco IOS environment.

Course contents

Content	Full- and part-time intramural studies		Part time extramural studies	
	Contact Hours	Indep. work	Contact Hours	Indep. work
Introduction to the study course. Introductory lecture. The aim, tasks and methodology of the study course.	2	0	0	0
Signaling tasks and types. SS7 sublayers and their functions. The main types of message blocks and their subfields. Network services part (MTP, SCCP). SCCP via IP (SIGTRAN).	2	2	0	0

Telecommunication protocols, definitions, structure and working principles. Standardization.	2	2	0	0
ICMP Protocol. Its implementation for management and diagnosis of IP networks.	2	2	0	0
Telnet and SSH. Structure, fields, procedures, encryption, authentification and authorization.	2	2	0	0
FTP and TFTP. Remote bootup of telecommunications infrastructure and boot file transmission.	2	4	0	0
Multipath TCP (MPTCP) protocol, additional options, realization, effective flow management.	4	2	0	0
Inter-operator routing of BGPv4, protocol working principles, methods and security.	6	6	0	0
Virtual private network (VPN) types, application use cases, comparison, utilization of integrated protocols.	6	6	0	0
MPLS VPN functions and use cases.	2	4	0	0
Web services, methodology of resource and service access.	2	2	0	0
HTTP protocol, work principle, methods and application. Comparison of HTTP/1, HTTP/2 and QUIC protocols.	6	4	0	0
QUIC protocol, work principle, evaluation.	2	2	0	0
TLS protocol – enforcement of security for transport layer. Authentication, integrity and encryption.	4	2	0	0
SMTP protocol, realization and common problems. E-mail access protocols - POP3, IMAP, Web.	2	2	0	0
Wi-Fi standard and protocols. Realization of wireless LAN. Wireless network controllers.	4	6	0	0
Data network protection. Tasks and functions of firewall.	4	4	0	0
Network vulnerability scanning and identification tools. Types of network attacks and vulnerabilities.	4	8	0	0
Data center architecture and it’s evolvement tendencies.	2	0	0	0
Total:	60	60	0	0

Learning outcomes and assessment

Learning outcomes	Assessment methods
Students are able to select conformable protocol/ signalling after analysis of standards, recommendations and technical documentation. Is able to document and reproduce protocol/ signalling state diagram and message formats.	Test, Exam
Students are able to analyse troubleshooting in protocol/signalling.	Test, Laboratory work.
Students are able to evaluate potential benefits and drawbacks on changing of protocol version.	Test, Laboratory work. Exam
Students are able to analyse and solve protocol compatibility problems draw reasonable conclusions about necessary configuration changes.	Test, Laboratory work. Exam
Students are able to use simulation and emulation tools (test environment) for configuration preparation and distribution	Test, Laboratory work. Exam
Students are able to plan network topologies and select the most appropriate protocols to ensure continuous network operation.	Test, Laboratory work.
Students are able to identify protocol of security requirements and understands possible protection options.	Test, Laboratory work. Exam

Evaluation criteria of study results

Criterion	%
Homework and tests	20
Laboratory works	50
Exam	30
Total:	100

Study subject structure

Part	CP	Hours per Week			Tests		
		Lectures	Practical	Lab.	Test	Exam	Work
1.	3.0	2.0	0.0	1.0		*	