RTU Course "Digital Switching Systems"

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General data

Code	RAE306
Course title	Digital Switching Systems
Course status in the programme	Compulsory/Courses of Limited Choice
Responsible instructor	Andris Skrastiņš
Volume of the course: parts and credits points	1 part, 4.0 Credit Points, 6.0 ECTS credits
Language of instruction	LV, EN
Annotation	In this study course students are introduced with digital switching systems that are reviewed from the perspective of circuit and packet switched networks. Study course provides students with an in-depth understanding of telecommunication network operational principles, hence increasing students' professional and theoretical knowledge in the telecommunication industry. In this course students study types of communication network nodes, their structure and operational principles. A study course covers architecture of public network (Internet), its division in Autonomous Systems (AS) and routing among and within them as well as Multiprotocol Label Switching (MPLS), Traffic Engineering (TE) and its capabilities. Virtualization in computer networks is reviewed as well - virtual routing instances, virtual private networks, their types and advantages. An introduction in network security. Software defined network (SDN) structure, functions and advantages. Network management and automation. Overview of Next Generation Networks (NGN) - architecture, elements, topologies and ITU-T vision of NGN.
Goals and objectives of the course in terms of competences and skills	The aim of this course is a continuation to introduction of students with the operation principle of telecommunications and computer networks. Course is for students who have acquired basic knowledge of information and communication technologies, or they have studied the course Telecommunications and Computer Networks (1) (RAE348). Study course tasks: Obtain knowledge and skills in telecommunication and computer networks and their structure and operation, introducing students with packet and circuit switching principles. To provide knowledge about the concepts of public network (Internet) architecture and communication protocols Provide knowledge about network resource management in software defined networks and a concept of next generation network architecture.
Structure and tasks of independent studies	It is intended for this course to be implemented as lessons, that includes lectures, online demonstrations, discussion and practice (lab) works. Students must acquire topics covered in lectures, prepare for online tests, as well as perform lab works, prepare a review of the lab and submit a review before the deadline. In lab work students complete the assigned tasks, create reports of results, and are able to explain and demonstrate them.
Recommended literature	Obligāta/Obligatory 1. Kurose James F., Computer networking: a top-down approach 7th ed, Boston: Pearson, 2017 2. Sandberg B., Networking: the complete reference 3rd ed, New York: McGraw-Hill, 2015 3. A.Kavacis, G.Lauks. Daudz-protokolu iezīmju komutēšana, MPLS. RTU TI, 2008. Papildu/Additional: 4. Perez A., Network security, Hoboken, NJ: ISTE Ltd/John Wiley and Sons Inc, 2014 5. Luc De Ghein. MPLS Fundamentals: A Comprehensive Introduction to MPLS Theory and Practice. Cisco Systems Inc., 2007 6. Odom W., CCIE routing and switching certification guide 4th ed., Indianapolis, IN: Cisco Press, 2010 7. Morreale P., Software defined networking: design and deployment, Boca Raton: CRC Press, 2015 8. Stallings W., Foundations of modern networking: SDN, NFV, QoE, IoT, and Cloud, Indianapolis, IN: Addison-Wesley Professional, 2015 9. Plevyak T., Next generation telecommunications networks, services, and management, Hoboken, N.J.: Wiley, 2010 10. Oļģerts Belmanis. Pakešu komutācija. RTU TI, 2006. 11. James Macfafarlane. Network Routing Basics. Wiley Publishing Inc, 2006. 12. Oļģerts Belmanis. Ciparu kanālu komutācija. RTU TI, 2005. Citi informācijas avoti/Other sources of information: 13. All materials available on the Internet on the topics of this course.
Course prerequisites	Basic knowledge about information and communication technologies or knowledge gained in course Telecommunications and computer networks (1) (RAE348).

Course contents

Content	Full- and part-time intramural studies		Part time extramural studies	
	Contact Hours	Indep. work	Contact Hours	Indep. work
Introduction to digital switching systems. Fundamentals of circuit switching. Analog and digital signals. Signaling system. Fundamentals of packet switching and packet switched networks.	6	4	0	0

Router structure and operational principles. Switching fabric in routers. Modular switches and routers.	4	4	0	0
Architecture of public network (Internet). Autonomous systems. Routing protocols and metrics. Routing among autonomous systems. GNS3 network emulation tool.	6	4	0	0
Lab: Network services, routing protocols	2	6	0	0
Multiprotocol Label Switching (MPLS) in packet networks. LDP protocol. MPLS services: MPLS VPN, AToM, VPLS.	8	4	0	0
Lab: Introduction to MPLS technology – labeled packet switching	2	6	0	0
Traffic engineering, Integrated services (IntServ), Differentiated services (DiffServ). MPLS traffic engineering. Resource Reservation Protocol (RSVP), RSVP-TE.	6	4	0	0
Lab: Introduction to MPLS-TE technology	2	6	0	0
Virtualization in computer networks. Channel and interface virtualization. Virtual routing and forwarding (VRFs). VXLAN technology. Network function virtualization.	6	4	0	0
Lab: Virtualization in computer networks. Virtual routing and forwarding	6	6	0	0
VPN networks, types and advantages. Tunneling in IP networks (GRE, IPIP, EoIP). Introduction to Network Security. Firewalls. Public key cryptography. Symmetric and asymmetric encryption. Key exchange	8	6	0	0
Software-Defined Network (SDN) their architecture, functions and interfaces. OpenFlow protocol. Mininet network emulation tool.	4	4	0	0
Lab: Software-Defined Network. Mininet tool	4	8	0	0
Network management and automation. Data serialization languages: JSON, YAML, XML. Ansible. Python language. Web-based free access test environments for automation: e.g., Cisco DEVNET Sandbox	8	4	0	0
Lab: Network management, automation	2	6	0	0
Next Generation Networks (NGN), architecture, elements, topologies, vision of ITU-T.	6	4	0	0
Total:	80	80	0	0

Learning outcomes and assessment

Learning outcomes	Assessment methods
Students are able to describe the main switching node structure and functions and can explain advantages and disadvantages as well as differences of various switching nodes.	Test, practical exercises during seminar. Exam.
Students are able to distinguish and define the differences between circuit and packet switching. Can describe structure and functions of switch and router.	Test, practical exercises during seminar. Exam.
Students are able to plan network topology according to desired target and individually plan network addressing and required network functions.	Test, practical exercises, laboratory works. Exam.
Students understand operation principles of Multiprotocol Label Switching (MPLS) and its capabilities and advantages. Understands traffic engineering capabilities and can evaluate the necessity of them.	Test, practical exercises, laboratory works. Exam.
Students understand WAN network architecture and involved protocols, Understand capabilities of virtualization in data transmission networks.	Test, practical exercises, laboratory works. Exam.
Understands the basic principles of data network security and knows several basic solutions.	Test, practical exercises during seminar.
Students have acquired knowledge about network management, capabilities of automatization and understand software defined network structure and capabilities.	Test, practical exercises, laboratory works. Exam.

Evaluation criteria of study results

Criterion	%
Tests and exercises (4)	20
Labs works (8 labs/practical works)	50
Exam	30
Total:	100

Study subject structure

Part	CP	Hours per Week			Tests		
		Lectures	Practical	Lab.	Test	Exam	Work
1.	4.0	3.0	0.0	1.0		*	