

RTU Course "Electronic Communications Services and Measurements"**33000 Faculty of Computer Science, Information Technology and Energy****General data**

Code	DE1021
Course title	Electronic Communications Services and Measurements
Course status in the programme	Compulsory/Courses of Limited Choice
Responsible instructor	Elmārs Lipenbergs
Academic staff	Inga Vagale
Volume of the course: parts and credits points	1 part, 9.0 credits
Language of instruction	LV, EN
Annotation	<p>The study course provides knowledge and skills on aspects of the provision, use and development of electronic communication services - starting with the structure and basic concepts of electronic communication networks, principles of service operation and quality indicators, measurements of electrical, network and service quality parameters, basic principles and technologies of mobile networks, the application possibilities of big data, artificial intelligence (AI) and machine learning (ML) in the telecommunications field to international recommendations, regulatory acts, aspects of regulation and supervision, and projects intended for the development and accessibility of electronic communications. The acquisition of knowledge about parameters to be measured in the field of electronic communications, measuring equipment and systems, as well as methods and algorithms for measuring the quality of electronic communications services is intended. The laboratory work is intended to acquire skills for connecting, configuring and using the measuring equipment used in the field of telecommunications for measurements in the fixed communication networks and wireless transmission environment, for linear and non-linear scale measurements of the signal level, for determining parameters of the time and frequency dimensions, as well as for evaluating service quality indicators for voice communications and Internet access service.</p> <p>The practical works include mathematical processing and analytical comparisons of measurement results, including service quality measurement data, using Internet access service quality evaluation tools, as well as comparison and evaluation of information provided by communication operators on quality indicators.</p>
Goals and objectives of the course in terms of competences and skills	<p>The goal of the study course is to provide knowledge about the telecommunications industry in relation to services and the measurement of their indicators.</p> <p>Tasks of the study course:</p> <ul style="list-style-type: none"> - to provide basic knowledge about the structure of telecommunication networks, operating principles, application of telecommunication technologies; - to provide practical knowledge of telemeasurements in communication technology and measurements of network and service quality parameters; - to explain the principles of quality assessment of telecommunication services; - to provide an overview of the use of the latest technologies for the telecommunications industry; - to provide information on the requirements and recommendations of the global and European regulatory and technical framework regarding telecommunications; - to teach to understand the influence of the quality assessment methodology of telecommunication services on the results of actual measurements, to navigate the application of the latest technologies such as big data, artificial intelligence (AI) and machine learning (ML) in telecommunications; - to teach the ability to analyse the compliance of telecommunication service providers with European regulations.
Structure and tasks of independent studies	<p>The independent work is organized in the form of online tasks and questionnaires, which evaluate the knowledge acquired in the lectures of the students. Learning the study course requires an independent study of educational literature, as well as viewing video materials of the used measuring devices and measurement methods and evaluating the results of measurements and mathematical processing.</p>

Recommended literature	<p>Obligātā/Obligatory:</p> <ol style="list-style-type: none"> 1. Elmārs Lipenbergs, Inga Vagale. Lekciju konspekts, prezentācijas un videomateriāli ORTUS. 2. Christoph Rauscher, Volker Janssen, Roland Minihold. "Fundamentals of Spectrum Analysis". 3. Rohde & Schwarz USA, Inc. ""dB or not dB?", 2019. 4. 2019 Toni Janevski. "QoS for Fixed and Mobile Ultra-Broadband" John Wiley & Sons Ltd (Wiley IEEE series), UK, April 2019. 5. Fritz Riehle, "Towards a redefinition of the second based on optical atomic clocks", 2015. 6. The International Bureau of Weights and Measures (BIPM), "SI Brochure: The International System of Units (SI)", (2019/2022). 7. FLUKE, "ABCs of Portable Oscilloscopes", 2024. 8. Tektronix, "XYZs of Oscilloscopes", www.tektronix.com/oscilloscopes, 2024. 9. Tektronix, "Fundamentals of Real-Time, Spectrum Analysis", 2024. 10. Rohde & Schwarz GmbH & Co., "Fundamentals of Vector Network Analysis", 2008. 11. International Telecommunication Union (ITU), "Quality of service regulation manual", 2017. 12. Kevin R. Fall, W. Richard Stevens, "TCP/IP Illustrated, Volume 1: The Protocols, 2nd Edition", 2011. 13. James F. Kurose, Keith W. Ross, "Computer Networking. A Top-Down Approach. Seventh Edition", 2017. 14. Dileeka Dias; Nihal Kularatna, Essentials of Modern Telecommunications Systems , Artech, 2004. 15. BEREC vadlīnijas "BEREC Guidelines detailing Quality of Service Parameters", 2020. 16. BEREC vadlīnijas "BEREC Guidelines on the Implementation of the Open Internet Regulation", 2022. 17. BEREC vadlīnijas "BEREC Guidelines to assist NRAs on the consistent application of Geographical surveys of network deployments", 2020. <p>Papildu/Additional:</p> <ol style="list-style-type: none"> 1. Eiropas pasta un telesakaru administrāciju konferences (CEPT) Elektronisko sakaru komitejas (ECC) pārskats ECC Report 195 "Minimum Set of Quality-of-Service Parameters and Measurement Methods for Retail Internet Access Services", 2013. 2. Eiropas pasta un telesakaru administrāciju konferences (CEPT) Elektronisko sakaru komitejas (ECC) pārskats ECC Report 312 "Measuring and evaluating Mobile Internet Access Service Quality", 2019. 3. Komisijas paziņojums Eiropas Parlamentam, Padomei, Eiropas Ekonomikas un sociālo lietu komitejai un Reģionu komitejai: "Konkurētspējīga digitālā vienotā tirgus savienojamība. Virzība uz Eiropas Gigabitu sabiedrību", COM(2016) 587, 2016. 4. "Komisijas paziņojums, ar ko nosaka digitālo mērķrādītāju Savienības līmeņa prognozētās trajektorijas", C(2023) 7500, 2023 5. The International Bureau of Weights and Measures (BIPM), "SI base unit: second (s)". 6. Barnett, J. E., «Time's Pendulum. From Sundials to Atomic Clocks, the Fascinating History of Timekeeping and How Our Discoveries Changed the World», San Diego, New York, London, A. Harvest Book, Harcourt Brace & Company, 1999. 7. Xiang Cheng, Luoyang Fang, Liuqing Yang , Shuguang Cui, "Mobile Big Data", 2018. <p>Citi informācijas avoti/Other sources of information:</p> <ol style="list-style-type: none"> 1. Interneta avots: https://www.etsi.org/ 2. Interneta avots: https://www.itu.int/ 3. Interneta avots: https://www.cept.org/ 4. Interneta avots: https://www.iso.org/ 5. Interneta avots: https://www.sprk.gov.lv/ 6. Interneta avots: https://vases.lv
Course prerequisites	Student are required to have knowledge of general electrical measurements and circuit theory, as well as knowledge about valuation methods of measurement errors, confidence intervals, and measurement uncertainties.

Course contents

Content	Full- and part-time intramural studies		Part time extramural studies	
	Contact Hours	Indep. work	Contact Hours	Indep. work
Introduction. Basic principles and basic concepts of electronic communication provision. Network structure, used technologies, physical properties of data transmission and electrical measurements, as well as the principles of processing measurement results.	16	16	0	0
Types, standards and technologies of electronic communication services. Network architecture and service provision methods. Historical and contemporary methods and technologies of providing electronic communication services.	16	16	0	0
Evaluation and measurement of signal levels on a linear and non-linear scale, measurement of signal attenuation, measurement of time intervals and frequencies, evaluation of the frequency spectrum - the most important parameters, measurement principles and methods, as well as the used measuring equipment.	18	18	0	0
Aspects of providing voice communications, text messages, television and other electronic communications services, technologies, their quality monitoring methods, as well as measurements of network and quality parameters.	14	14	0	0
Internet and computer networks. Internet Basics. Internet access technologies. OSI model layers, their protocols. End-to-end data transmission. Traffic management.	18	18	0	0
Internet service quality parameters and their evaluation methodology, covering the parameters range and measurement scope conditions, as well as measurement reference selection criteria.	14	14	0	0
The latest Internet technologies, services and their application. Insights into mobile network architecture. Internet technologies for IoT solutions.	8	8	0	0
Application of big data, artificial intelligence (AI) and machine learning (ML) in telecommunications.	6	6	0	0
Standards and regulatory aspects of the electronic communications industry. Responsible institutions, set requirements and monitoring mechanisms. Electronic communications industry development strategies and projects. Broadband mapping.	10	10	0	0

Total:	120	120	0	0
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Learning outcomes and assessment

Learning outcomes	Assessment methods
Able to explain the basic concepts and principles of the electronic communications industry. Understands electronic communication network stages, data transmission principles and technologies. Orients himself in the available literature and knows the purposes of technology application.	Test, exam.
Able to acquire skills with measuring devices used in the field of electronic communications for signal level, time and frequency dimension measurements, able to work independently with service quality measurement tools, competently explain the results of measurements of electrical and service indicators and their evaluation methods in communication technology, including in connection with the mathematical reliability of measurement results.	Test, practical work, exam.
Able to competently explain quality indicators of electronic communication services, their assessment principles and traffic management methods.	Test, practical work, exam.
Understands the principles of data transmission in mobile networks. Knows the latest Internet technologies, services and their application.	Test, exam.
Able to analyse and reasonably explain the compliance of the activities of electronic communication service providers with the requirements of European regulatory acts and standardization regulations.	Test, practical work, exam.
Familiar with European strategic goals, projects implemented to achieve them and regulations regarding the electronic communications industry.	Test, practical and laboratory work, exam.

Evaluation criteria of study results

Criterion	%
Tests	30
Practical and laboratory works	40
Exam	30
Total:	100

Study subject structure

Part	CP	Hours			Tests		
		Lectures	Practical	Lab.	Test	Exam	Work
1.	9.0	80.0	20.0	20.0		*	