RTU Course "Fibre Optic Transmission Systems"

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General data

Code	RDE419
Course title	Fibre Optic Transmission Systems
Course status in the programme	Compulsory/Courses of Limited Choice
Responsible instructor	Vjačeslavs Bobrovs
Academic staff	Ģirts Ivanovs Sandis Spolītis Jurģis Poriņš Uģis Seņkāns
Volume of the course: parts and credits points	1 part, 5.0 Credit Points, 7.5 ECTS credits
Language of instruction	LV, EN
Annotation	The study course is meant to obtain knowledge about fibre optic transmission systems (FOTS), their elements, optical loss mechanisms, and electrodynamic equations that describe signal propagation in a specific environment. International standards in the design of FOTS will be discussed with a view to future technological solutions, which will enable students not only to understand the development process of communication systems but also to create and apply modern methods in the development of the new generation of FOTS.
Goals and objectives of the course in terms of competences and skills	The aim of the study course is to provide knowledge about fibre optic transmission systems and their application in next-generation telecommunications networks. Tasks of the study course: * to provide basic knowledge and experience about fibre optic communication systems; * to teach to develop and apply different types of FOTS solutions in accordance with international recommendations; * to develop skills to analyse the existing architectures of fibre optic communication systems and possibilities to modernize them by engineering.
Structure and tasks of independent studies	Students will have to solve the tasks set by the lecturer, demonstrating the acquired knowledge in the lectures. Students are expected to independently research the latest results in published scientific articles. Applying the modeling tools, it will be necessary to develop and test different types of FOTS solutions in an experimental laboratory.
Recommended literature	Obligātā/Obligatory: 1. Govind P. Agrawal. Fiber-Optic Communication Systems, 5th Edition. Wiley, 2021. 2. Rongqing Hui. Introduction to Fiber-Optics Communications. Elsevier, 2020. 3. Govind P. Agrawal. Nonlinear Fiber Optics, 6th Edition. Elsevier, 2019. 4. Reinhold Noe. Essentials of Modern Optical Fiber Communication. Second edition. Springer, 2016. Papildu/Additional: 1. Spolītis, S., Mūrnieks, R., Skladova, L., Salgals, T., V. Andrianov, A., P. Marisova, M., Leuchs, G., A. Anashkina, E., Bobrovs, V. IM/DD WDM-PON Communication System based on Optical Frequency Comb Generated in Silica Whispering Gallery Mode Resonator. IEEE Access, 2021, Vol. 9, 1.-11.lpp. 2. Salgals, T., Alnis, J., Mūrnieks, R., Brice, I., Poriņš, J., Andrianov, A., Anashkina, E., Spolītis, S., Bobrovs, V. Demonstration of a Fiber Optical Communication System Employing a Silica Microsphere-Based OFC Source. Optics Express, 2021, Vol. 29, No. 7, pp.10903-10913. 3. Pang, X., Udaļcovs, A., Schatz, R., Bobrovs, V., Jacobsen, G., Popov, S., Ozoliņš, O. Short Reach Communication Technologies for Client-side Optics beyond 400 Gbps. IEEE Photonics Technology Letters, 2021, Vol. 33, No. 18, 66335.-66345.lpp.
Course prerequisites	Telecommunication theory, transmission systems, transmission media.

Course contents

Content	Full- and part-time intramural studies		Part time extramural studies	
	Contact Hours	Indep. work	Contact Hours	Indep. work
Introduction to FOTS, development history and trends.	2	4	0	0
Peculiarities of FOTS structure and main components.	6	10	0	0
Light propagation in optical waveguides. Light propagation in the fibre. Maxwell's equations.	6	10	0	0
Losses in optical waveguides and their mechanism. Absorption, linear and nonlinear scattering. Optimal wave mode.	6	10	0	0
Optical cable constructions and their features. Fibre production technologies and materials.	6	10	0	0
Light emission sources, their characteristics and parameters.	4	6	0	0
Photo receivers, their characteristics and parameters.	6	10	0	0
Optical amplifiers.	4	6	0	0
Classification of fibre optic communication systems. WDM systems.	8	12	0	0

Fibre optic sensors. Measurement of FOTS element parameters.	6	10	0	0
Modelling and development of FOTS systems.	26	32	0	0
Total:	80	120	0	0

Learning outcomes and assessment

Learning outcomes	Assessment methods
Able to competently understand the structures of fibre optical transmission systems, know the basic parameters of the main elements. Can model communication system transmitters with DSP.	Laboratory and practical works, test, exam.
Able to create an optical transmission channel by analysing the effects of phase noise and equalization enhanced phase noise. Is able to evaluate and reduce the linear and nonlinear disturbances in the communication systems with different optical signal amplifier techniques.	Laboratory and practical works, test, exam.
Able to choose the necessary elements for the development of FOTS, evaluate the main parameters, and explain the quality of the received signal.	Laboratory and practical works, test, exam.
Able to design and implement a newer generation of FOTS, using different modulation, optical signal amplification techniques, and accumulated dispersion compensation elements. Able to incorporate the signal performance improvement techniques in communication systems and comment on them.	Laboratory and practical works, test, exam.

Evaluation criteria of study results

Criterion	%
Tests	40
Laboratory and practical works	20
Exam	40
Total:	100

Study subject structure

Part	CP	Hours per Week			Tests		
		Lectures	Practical	Lab.	Test	Exam	Work
1.	5.0	4.0	0.0	1.0		*	