RTU Course "Optical Transmission Lines"

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General data

Code	RDE603
Course title	Optical Transmission Lines
Course status in the programme	Courses of Free Choice
Responsible instructor	Jurģis Poriņš
Academic staff	Ģirts Ivanovs Vjačeslavs Bobrovs
Volume of the course: parts and credits points	1 part, 5.0 Credit Points, 7.5 ECTS credits
Language of instruction	LV, EN, DE
Annotation	The course consists of three basic blocks – general guidelines; analysis of optical transmitters, receivers and regenerators, using modelling methods; and noise analysis of optical channels. Basic blocks cover the following topics: in-depth analysis of optical transmission systems, signal propagation in optical fibres, noise in optical channels, optical receivers, amplifiers and regenerators, the types and structures, coherent and non-coherent reception, types of modulation, as well as features and characteristics of optical networking.
Goals and objectives of the course in terms of competences and skills	The goal of the course: to acquire theoretical knowledge about optical transmission lines. The objectives: 1. to develop skills to be able to use independently the latest technical and scientific literature; 2. to plan a research project in optical transmission systems; 3. to develop students' initiative and creative skills, understanding of innovations, and critical thinking necessary for presenting the results of research; 4. to promote understanding of optical transmission systems.
Structure and tasks of independent studies	Study methods: interactive lectures, research and case studies – workshops on research topics. The aim of interactive lectures is to discuss specific problems within the framework of the course. Research process aims to develop necessary skills, and workshops are intended for presentation and defence of research papers.
Recommended literature	1. Agraval P. Nonlinear Fiber Optics. New York:. Academic press, 2001. 445 p. 2. Francis T. Entropy and Information Optics. NEW YORK, BASEL, 2002. 325 p. 3. Michael Bass. Handbook of Optics. Vol. 4. Fiber Optics and Nonlinear Optics. McGRAW-HILL, 2009. 657 p. 4. Headley C. Agrawal G.P. Raman Amplification in Fiber Optical Communication Systems. UK: Elsevier Inc, 2005, 389 p. 5. Garrett, I, Bond, D. J., Waite, J. B., Lettis, D. S. L., and Jacobsen, G. 'Impact of Phase Noise in Weakly Coherent Systems: A New and Accurate Approach. Lightwave Tech., 1990. vol. 8, p. 329-337. 5. Thiele H.J., Nebeling M. Coarse Wavelength Division Multiplexing Technologies and Applications. USA: CRC Press, 2007, 378 p.
Course prerequisites	Students are expected to have knowledge of electrodynamics, signal transmission, optical processing and transmission of information.

Course contents

Content	Full- and part-time intramural studies		Part time extramural studies	
	Contact Hours	Indep. work	Contact Hours	Indep. work
General concepts of optical information processing and transmission. Optical signal detection theory.	4	0	0	0
The ideal receiver. Filter-based receivers. Optical receivers.	4	0	0	0
Photodetector. Real photodetector. Photon counting receivers.	4	0	0	0
Noise and noise models.	4	0	0	0
Thermal noise and the models, Gaussian approximation.	4	0	0	0
Power-limited optical channels. Minimal power necessary for optical information reception	6	0	0	0
Intersymbol interference. Poisson channels. Receivers for Poisson channels.	6	0	0	0
The maximum SNR receivers. Saddle point approximation. NBS receivers.	6	0	0	0
Error rate. Error rate limits.	4	0	0	0
Frequency manipulation. Homodyne and heterodyne systems. Simultaneous reception.	6	0	0	0
Ideal coherent systems. PDM-QPSK and FDM PDM-QPSK. Coherent radiation in erbium-doped fibre systems.	10	0	0	0
Non-coherent systems. OPFDM RZ-DQPSK and PDM-DQPSK.	10	0	0	0
Laboratory works.	12	0	0	0

Total:	80	0	0	0

Learning outcomes and assessment

Learning outcomes	Assessment methods
Students are able to identify and analyze the main operating principles, architectures and parameters of optical transmission systems.	To define problems precisely and correctly and identify their causes. Evaluation of a research project – defence of the paper.
Students are able to analyze and classify the theoretical and practical concepts by forming models and configurations of optical communication systems.	An oral examination, evaluation of a research project.
Students are able to identify, analyze, classify and describe mathematically optical receiving elements and their functioning in accordance with NOE.	An oral examination, evaluation of a research project.
Students are able to identify, analyze and evaluate research opportunities within the framework of the course.	An oral examination, evaluation of a research project.
Students are able to conduct relevant research at the doctoral level independently.	An oral examination, evaluation of a research project.

Study subject structure

Part	CP	Hours per Week			Tests			Tests (free choice)		
		Lectures	Practical	Lab.	Test	Exam	Work	Test	Exam	Work
1.	5.0	5.0	0.0	0.0		*				