RTU Course "Hybrid Optical Fibre-Wireless Communication and Networking"

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General data

Code	RDE717
Course title	Hybrid Optical Fibre-Wireless Communication and Networking
Course status in the programme	Compulsory/Courses of Limited Choice; Courses of Free Choice
Responsible instructor	Sandis Spolītis
Academic staff	Vjačeslavs Bobrovs Oskars Ozoliņš
Volume of the course: parts and credits points	1 part, 4.0 Credit Points, 6.0 ECTS credits
Language of instruction	LV, EN
Annotation	The study course is meant to obtain knowledge about the modern optical access and radio access networking architectures and their basic building blocks for system convergence. This knowledge will enable students not only to understand the specifics of new signal transmission techniques, but also to develop and apply effective modelling and characterization methods for designing a new generation of hybrid fibre-wireless communication systems.
Goals and objectives of the course in terms of competences and skills	The aim of the study course is to provide knowledge about broadband signal modulation, transmission, and detection methods for next-generation fibre-wireless systems and networking convergence. Tasks of the study course: * to provide basic knowledge and experience about analogue and digital radio-over-fibre systems; * to teach to design and apply modulation and demodulation techniques to realize seamless convergence between the fibre-optic and radio access networks; * to develop skills to analyse and optimise the hybrid optical fibre-wireless convergence architecture.
Structure and tasks of independent studies	Within the study course, students' independent work will be organized as follows: - to solve the tasks defined by the academic personnel, showing the use of the knowledge acquired in the lectures; - applying the acquired knowledge in developing simple numerical models of hybrid optical fibre-wireless systems; - analyse the state-of-the-art from latest published research works on optical fibre-wireless systems; - a hybrid optical fibre-wireless transmission system should be developed based on the equipment available in the laboratory.
Recommended literature	Obligātā/Obligatory: 1. J. Yu, X. Li, and X. Pang, Optical Fiber Telecommunications VII, A. E. Willner Ed.: Academic Press, 2020. 2. S. Pan and J. Yao, "Photonics-Based Broadband Microwave Measurement," J. Lightwave Technol., vol. 35, no. 16, pp. 3498-3513, 2017. 3. X. Pang et al., "100 Gbit/s hybrid optical fiber-wireless link in the W-band (75–110 GHz)," Optics Express, vol. 19, no. 25, pp. 24944-24949, 2011. Papildu/Additional: 1. T. Nagatsuma, G. Ducournau, and C. C. Renaud, "Advances in terahertz communications accelerated by photonics," Nature Photonics, vol. 10, no. 6, pp. 371-379, 2016. 2. S. Jia, X. Pang, O. Ozolins, X. Yu, H. Hu, J. Yu, P. Guan, F. Da Ros, S. Popov, G. Jacobsen, M. Galili, T. Morioka, D. Zibar, and L. K. Oxenlowe, "0.4 THz Photonic-Wireless Link With 106 Gb/s Single Channel Bitrate," J. Lightwave Technol., vol. 36, no. 2, pp. 610-616, 2018.
Course prerequisites	Telecommunication theory, transmission systems, fibre optic transmission systems, physics of optical information processing.

Course contents

Content	Full- and part-time intramural studies		Part time extramural studies	
	Contact Hours	Indep. work	Contact Hours	Indep. work
Introduction to architectures of optical access and radio access networks (OAN and RAN).	4	6	0	0
Common Public Radio Interface (CPRI) and Enhanced CPRI (eCPRI).	4	6	0	0
Advanced signal modulation techniques.	8	12	0	0
High-frequency radio signal generation with photomixing.	8	12	0	0
Envelope detection and coherent heterodyne detection.	8	12	0	0
Spurious-free dynamic range (SFDR).	4	6	0	0
Static and adaptive equalization methods with digital signal processing.	8	12	0	0
Influence of laser phase noise in the hybrid optical fibre-wireless systems.	8	14	0	0
Characterization and transmission performance evaluation of hybrid fibre-wireless systems.	12	16	0	0
Total:	64	96	0	0

Learning outcomes and assessment

Learning outcomes	Assessment methods
Able to competently understand the networking architectures of modern optical access and radio access networks, understand the principles and specifications of CPRI and eCPRI.	Test, exam.
Able to model CPRI-equivalent systems and analyse the transmission performance.	Practical works, exam.
Able to understand the key system metrics and perform characterization of optoelectronic transceivers, digital and analogue subsystems, and hybrid fibre-wireless systems.	Test, laboratory and practical works, exam.
Able to design and implement several commonly used digital signal processing techniques to mitigate transmission impairments.	Laboratory and practical works, exam.

Evaluation criteria of study results

Criterion	%
Tests	30
Laboratory and practical works	40
Exam	30
Total:	100

Study subject structure

Part	CP	Hours per Week			Tests			Tests (free choice)		
		Lectures	Practical	Lab.	Test	Exam	Work	Test	Exam	Work
1.	4.0	2.0	1.0	1.0		*			*	