COURSE UNIT (MODULE) DESCRIPTION

Course unit (module) title	Code
Fiber technology	

Lecturer(s)	Department(s) where the course unit (module) is delivered
Coordinator: doc. Rytis Butkus **Other(s):**	VU Faculty of Physics Department of Quantum Electronics

Study cycle	Type of the course unit (module)
First	Arbitrary

Mode of delivery	Period when the course unit (module) is delivered	Language(s) of instruction
Auditorium	6th semester (spring)	Lithuanian/English

Requirements for students	
Prerequisites: General physics (Optics)	**Additional requirements (if any):**

Course (module) volume in credits	Total student's workload	Contact hours	Self-study hours
5	129	51	78

Purpose of the course unit (module): programme competences to be developed
The lectures will start from propagation principles of light in fibers and waveguides, basis of fiber communication principles and architectures and will continue with main parameters of fibers,

manufacturing techniques, causes of losses, fiber components, sensors and lasers and main applications. The gained knowledge will help to recognize important physical processes and light transformations taking place in fibers.

Learning outcomes of the course unit (module)	**Teaching and learning methods**	**Assessment methods**
After this course the students will learn about different types of fibers and fiber components, the main fiber parameters and its importance for different applications. The students will also learn about possibilities of practical applications of fibers. Will be able to choose right optical fiber for his application (4.3)	Lectures + seminar + laboratory exercise + exam	Cumulative mark: evaluation of laboratory exercise, evaluation of presentation during seminar and moderating another seminar, exam evaluation.

Content: breakdown of the topics	**Contact hours**							**Self-study work: time and assignments**	
	Lectures	Tutorials	Seminars	Exercises	Laboratory work	Internship / work placement	**Contact hours**	**Self-study hours**	**Assignments**
1. Early optical communications. Development of fibers and their initial applications. The use of fiber in data transfer systems. The main parameters of fibers.	4		2				**6**	**6**	An exercise or task related to the subject of the lectures
2. Propagation of light in fibers: geometrical and wave optics approach. Numerical aperture. Modes in fibers. Types of fibers. Index profile and photonic crystal fibers. Doped fibers and fibers made from different materials. Testing techniques for different fiber features.	4		2				**6**	**6**	An exercise or task related to the subject of the lectures
3. Losses in fibers: physical origins and causes. Impact of impurities and lowest possible losses. Macro and micro bending losses, fiber connection types and their losses.	4		2				**6**	**6**	An exercise or task related to the subject of the lectures

Manufacturing techniques of fibers.									
4. Fiber optics communications cables and lines. Different types of dispersion and its impact on data transmission rate. Zero dispersion region dispersion parameter. Management of fiber dispersion. Principles of data coding and data bandwidth.	4		2				**6**	**6**	An exercise or task related to the subject of the lectures
5. Elements of integrated optics. Types of waveguides and their applications. Fiber couplers, multiplexers and demultiplexers, phase controllers and electro-optic modulators, polarizers and polarization controllers.	4		1				**5**	**6**	An exercise or task related to the subject of the lectures
6. Fiber sensors. Hybrid and intrinsic sensors based on intensity, phase, polarization and spectral change. Physical variables. Fiber sensor multiplexing. Examples of fiber sensor applications.	4		1				**5**	**6**	An exercise or task related to the subject of the lectures
7. Fiber lasers and amplifiers. Pumping schemes, double-clad fibers, large-mode-area fiber lasers and fiber-rods. CW and pulsed regimes, techniques of Q-switching and mode-locking. Lasers utilizing different glasses as host materials and different dopants. Fiber laser energy combining.	4		1				**5**	**6**	An exercise or task related to the subject of the lectures
8. Fiber nonlinear optics. Main nonlinear phenomena observed in fibers. Four-wave mixing, self-phase modulation, resonant scattering phenomena, supercontinuum generation.	4		1				**5**	**6**	An exercise or task related to the subject of the lectures
9. Laboratory exercise					4		**4**	**14**	Preparation for a laboratory exercise, processing the results and completing the report.
Exam	3						**3**	**16**	
Total	**32**		**12**		4		**51**	**78**	

Assessment strategy	**Weight,%**	**Deadline**	**Assessment criteria**
Laboratory exercise	10	End of semester	The assessment is based on the quality of performed tasks and whether or not all tasks are accomplished and on the correctness of the answers to questions

			related to theory of a subject. +1 mark (as absolute value in a 10 mark system) is given if the completed report is defended perfectly. If questions are not answered – no mark is given and if a laboratory exercise is not completed, -1 mark is given.
Seminar presentation moderation of another seminar	25	Semester	One presentation shall be given during the course of seminars related to the subject of the lectures. The assessment of the presentation is based on whether the depicted material is related to the selected topic of a presentation, whether or not the material is consistent and is explained clearly and are the questions of the attendees answered properly. Part of the assessment is related to quality of moderation of another seminar.
Exam	65	Session	Questions and exercises from any subject of the course. Assessment is based on the correctness of the answers.

Author	**Year of publication**	**Title**	**Issue of a periodical or volume of a publication**	**Publishing place and house or web link**
Compulsory reading				
1. F. Mitschke	2009	Fiber Optics		Springer, Heidelberg
2. D. Čiplys, A .Krotkus, V. Smilgevičius	2008	Šviesolaidžių optika		Vilniaus universiteto leidykla, Vilnius
Optional reading				
1. Joseph C. Palais	2004	Fiber Optic communications		Prentice Hall, New Jersey
2. G. P. Agrawal	2002	Fiber-optics Communication systems		John Wiley & Sons, New York