



## COURSE DESCRIPTION CARD - SYLLABUS

Course name

PO 2.1.1. Techniki modulacji i przetwarzania sygnałów optycznych - EC 2.1.1 Optical signal modulation and processing techniques

### Course

Field of study  
Teleinformatics

Year/Semester  
1/2

Area of study (specialization)

Profile of study  
general academic

Level of study  
second-cycle studies

Course offered in  
Polish

Form of study  
full-time

Requirements  
elective

### Number of hours

Lecture  
30

Laboratory classes  
30

Other (e.g. online)

Tutorials  
0

Projects/seminars  
0/0

### Number of credit points

4

### Lecturers

Responsible for the course/lecturer:

Responsible for the course/lecturer:

Dr inż. Jan Lamperski  
e-mail: jan.lamperski@put.poznan.pl

### Prerequisites

Basic knowledge of mathematics  
Basic knowledge of optics, optoelectronics, photonics  
Basic knowledge of fiber optic technology



## Course objective

Provide theoretical and practical knowledge on advanced modulation and optical signal processing methods. Preparation for the design and implementation of functional optical modules.

## Course-related learning outcomes

### Knowledge

Has extensive knowledge of photonics and fiber optic technology, including the knowledge necessary to understand the operation of fiber optic links and optical telecommunications systems  
Has an established knowledge of the essential properties and understanding of the operation of optical elements and all-optical methods of signal processing used in optical fiber technology  
Understands system limitations resulting from undesirable effects occurring in optical fiber systems  
Is aware of the trends in the development of optical methods of information transmission and processing

### Skills

Can define the requirements and architecture of a fiber optic link  
He can choose the architecture, configuration, technology and elements of a fiber optic link  
He can evaluate the existing realizations of fiber optic systems and is prepared to propose and implement innovative technological solutions  
He can design a link that meets the requirements from the point of view of the power budget and system dynamics

### Social competences

Is aware of the need for a professional approach to solved technical problems and taking responsibility for the proposed technical solutions  
Can formulate opinions on the basic challenges faced by photonics and telecommunications of the 21st century

## Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

The knowledge acquired during the lecture is verified during an written test and / or oral part.

The exam topics list are sent to students via e-mail or using the university's platform.

The written form is carried out in the form of a test containing from 20 to 40 questions. The test may be accompanied by an oral part verifying the level of understanding of the material covered by the test.

The test passing threshold is: 50% of the points. Final grade includes the oral part and activity during the semester showing knowledge and the ability to solve problems independently.

The practical part is assessed on the basis of reports. The final grade is the average of the grades obtained.



### Programme content

- 1 Selected elements of photonics and quantum mechanics
- 2 Teletransmission properties of optical fibers: linear effects, non-linear effects. The importance of nonlinear effects for all-optical modulation and signal processing methods
- 3 Optical amplification technology
- 4 Optical methods of multiplication
- 5 Intensity modulation and direct detection. Ways of implementing intensity modulation. Limitations of modulators using intensity modulation. Problems and limitations of receivers with direct detection.
- 6 Advanced modulation formats of optical signals. Coherent detection, modulation formats, implementation problems, quantum limit of optical noise. Optical signal modulation formats. Techniques of phase modulation implementation. Comparison of OOK PSK tolerance to dispersion and nonlinear effects. Multilevel modulation of optical signals.
- 7 All-optical methods of signal processing  
Ultrafast all-optical optical gates / switches  
Wavelength conversion systems  
All-optical OTDM multiplexers and demultiplexers  
Optical regenerators
- 8 Selected elements of quantum information processing methods

### Teaching methods

- Lecture: multimedia presentation.  
Practical exercises: analysis of experimental results and computer simulations.

### Bibliography

#### Basic

- Optical Fiber Communications: Principles and Practice, J. M. Senior, Prentice Hall, N. York, 1994
- Fiber-optic Communication Systems, G. P. Agrawal, Wiley-Interscience; 3rd edition, 2002
- Zarys telekomunikacji światłowodowej, J. C. Paliás, WKŁ, 1991 (Fiber Optic Communications, Prentice Hall, Pearson Education, Inc., New Jersey 2005
- Applications of Nonlinear Fiber Optics, G. P. Agrawal, Academic Press 2001

#### Additional

- J. Siudak, Sieci fotoniczne, WKŁ, 2009

### Breakdown of average student's workload

	Hours	ECTS
Total workload	120	4.0



	Hours	ECTS
Classes requiring direct contact with the teacher	64	3.0
Student's own work (preparation for tests, preparation for laboratory classes, preparation for exam, literature studies)	56	1.0