COURSE DESCRIPTION CARD - SYLLABUS

Course name
Passive Optical Networks [S1Teleinf1>OSD]

Course

Field of study
Teleinformatics

Year/Semester
3/6

Area of study (specialization)
–

Profile of study
general academic

Level of study
first-cycle

Course offered in
Polish

Form of study
full-time

Requirements
elective

Number of hours

Lecture
15

Laboratory classes
15

Other
0

Tutorials
0

Projects/seminars
0

Number of credit points

3,00

Coordinators

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Lecturers

Prerequisites

Knowledge in the field of fiber optic technology. Knowledge of fiber optic ICT networks. Ability to work with English-language technical literature.

Course objective

Provide students with basic knowledge of passive optical network technology. Developing students' skills in solving basic and design problems in the field of PON networks. Shaping students' skills in acquiring knowledge about ICT networks.

Course-related learning outcomes

Knowledge:
Has knowledge of the properties and operation of passive and active elements used in passive optical networks
Has knowledge of fiber optic systems and technology
Has ordered and theoretically founded knowledge of the PON network

Skills:

He can make a multi-variant selection of the type and architecture of a fiber optic PON network that meets the design assumptions
Can, in accordance with the assumptions, carry out the selection of the elements of the designed PON network
Can analyze the transmission properties of the photonic layer of the PON network

Social competences:
Is aware of the responsibility for their own work and is able to comply with the rules of teamwork

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

The knowledge acquired during the lecture is verified on a written test or oral form.
The set of final problems is sent to students by e-mail and / or posted on the didactic platform.
The written form is carried out as a test containing about 20 questions or may consist of an individual conceptual and design case study problem covering most of the lecture topics.
The test threshold is: 50% of the points.
The practical part is assessed on the basis of reports. The final grade is the average of the grades obtained.

Programme content

Introduction to passive optical networks - PON.
Optical networks. Architecture of telecommunications networks. Optical layer. All-optical networks.
The evolution of fiber optic networks.
Basics of fiber optic telecommunications.
Definitions and units. Optical waveguides. Fiber attenuation. Optical information capacity - dispersion effects. Nonlinear effects.
Power budget. System dynamics.
Network optical passive components.
Optical splitters. Optical filters. WDM Multiplexers. OADM. Optical connectors. Optical isolators.
Cables for optical networks.
Active elements of the PON network.
Photodiodes and optical receivers. Transmitters, semiconductor lasers, modulators. Wavelength converters.
Modulation and detection of optical signals.
Direct modulation. Intensity modulators: electroabsorption, MZM. Direct detection.
Architecture of PON networks.
Designing a PON network.
Requirements specification. Link power budget. System capacity - rise time budget.
PON network installation and testing.

Course topics

Lectures:
Introduction to optical access networks.
Basics of fiber optic telecommunications.
Characteristics and transmission parameters of the optical channel.
Selected non-linear effects.
Power penalties.
Information capacity of optical fiber.
Specificity and standards of optical fibers for subscriber applications - inside buildings.
Application of nonlinear Raman scattering.
Selected optical passive devices used in access networks.
Directional coupler. Fiber splitters.
Controlled directional coupler: modulator, electro-optical commutator.
Electro-absorption modulator. Modulator in the Mach-Zehnder interferometer configuration.
Optical detection. Semiconductor photodiodes PiN and APD – structure, properties, parameters and spectral characteristics. Coherent detection.
Semiconductor light sources. Light-emitting diodes. Semiconductor optical amplifier. Semiconductor lasers.

Optical transmitters with direct modulation and external modulators.
Light intensity modulation. Phase modulation. Selected advanced modulation formats.
Basics of the architecture of passive fiber optic networks.
PON alternatives: BPON, EPON, GPON.
FTTX networks. FTTX network architecture. WDM FTTX PON.
Prospects for the development of access networks using advanced optical technologies.
FTTH network design.
Choosing a network architecture. Requirements definition. FTTH network power budget analysis. Analysis of loss limited system. Equivalent losses of the fiber optic system. System throughput. Methods for reducing limitations caused by dispersion effects.
Installation and testing of FTTH networks.

Practical classes / simulation projects:
Definitions and units.
Fiber-optic splitters.
Fiber and bulk Bragg gratings. Optical filters. Optical multiplexers. OADM.
PON network power budget. Power budget optimization.
Dynamics of the PON system. Methods for optimizing system capacity.
Link simulation - maximum fiber length.
Simulation of advanced passive networks (GPON, NGPON - SOA, RA).

Teaching methods

Lecture: multimedia presentation.
Practical exercises: calculation examples and computer simulations.

Bibliography

Basic:
R Ramaswami,_KSivarajan, G Sasaki Optical Networks, A Practical Perspective, Elsevier, 2010
J. Prat, Next-Generation FTTH Passive Optical Networks, Springer, 2008
G. Keiser, FTTX concepts and applications, John Wiley & Sons, 2006
N. Kashima, Passive Optical Components for Optical Fiber Transmission, Artech House, 2005

Additional:
J. Siuzdak, Systemy i sieci fotoniczne, WKŁ,2009
C. Palais, Fiber optic Communications, Pearson Prentice Hall, 2005
Breakdown of average student's workload
Hours ECTS
Total workload 56 3.0
Classes requiring direct contact with the teacher 30 2.0
Student’s own work (preparation for tests, preparation for laboratory 26 1.0
classes, literature studies)

Breakdown of average student's workload

	Hours	ECTS
Total workload	56	3,00
Classes requiring direct contact with the teacher	30	2,00
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	26	1,00