COURSE DESCRIPTION CARD - SYLLABUS

Course name
Optoelectronics [S1MiKC1>OPTO]

Course

Field of study
Microelectronics and digital communications

Year/Semester
3/5

Area of study (specialization)
–

Profile of study
general academic

Level of study
first-cycle

Course offered in
Polish

Form of study
full-time

Requirements
compulsory

Number of hours

Lecture
15

Laboratory classes
15

Other
0

Tutorials
0

Projects/seminars
0

Number of credit points

2,00

Coordinators

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Lecturers

Prerequisites

Basic knowledge of mathematical analysis, algebra, basic areas of physics, basics of circuit theory necessary to understand, analyze, and evaluate the operation of electrical circuits.

Course objective

Deepening the knowledge about modern optoelectronics, the operation of various optical devices used in optical transmission systems and used to process optical signals.

Course-related learning outcomes

Knowledge:
Knows the properties and characteristics of optoelectronic components and the basic methods of design and analysis of optoelectronic circuits, including analog and digital circuits used in ICT. He knows the basic methods of designing optoelectronic systems and their application in telecommunications systems and the ICT industry. He has knowledge of the physical attitudes of passive and active optical elements. Understands the operation and construction of selected optical and optoelectronic components (directional couplers, modulators, photodiodes, lasers, optical filters). He knows the principles of operation of modern measuring equipment and sensors used in ICT systems.

Skills:
Can analyze requirements and specify optoelectronic system designs. Can select appropriate optoelectronic components based on catalogs and application notes, as well as design and implement optoelectronic systems. Can calculate the basic parameters of optoelectronic components. Has design skills to identify problems and limitations and propose solutions that meet specific requirements. Can carry out measurements of the basic properties of optoelectronic components.

Social competences:
They are aware of the need for a professional approach to the technical problems they solve and to take responsibility for the technical solutions they propose. Understands the role of otpoelectronics in next-generation systems for signal processing and transmission.

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Completion of the lecture content is in the form of a written and/or oral test.
Open, descriptive and calculation questions. Passing the laboratory material is based on reports created during the exercise.
Grading scale: <50% - 2.0 (ndst); 50% to 59% - 3.0 (dst); 60% to 69% - 3.5 (dst+) ; 70% to 79% - 4.0 (db); 80% to 89% - 4.5 (db+); 90% to 100% - 5.0 (bdb).

Programme content

The program provides knowledge of techniques used in optical communication and optoelectronic systems used in light-based communication systems.

Course topics

Wave-particle duality: rays, waves, electromagnetism, quanta. Light polarization. Electro-optical and acousto-optical effects. Selected elements of integrated optics: planar waveguides, directional coupler, electro-optical modulator, electro-absorbent modulator (Franz-Keldysh effect), Mach-Zehnder modulator, acousto-optic modulators. Photonic fibers. Optical resonators. Semiconductor optoelectronic materials, current carriers, band energy structure, straight and skewed bandgap semiconductors. Interaction of radiation with atoms. Light detection and generation in semiconductors. Emission spectrum of LED and laser diode. Optical amplifiers. Classification of lasers and their properties. Mod-sync lasers. Methods for realizing various formats of optical signal modulation. Wavelength conversion. All-optical signal regeneration. Optical commutation.
Laboratory exercises: selected LED/LASER spectral properties, LED/LASER operating characteristics, analog E/O converter, digital E/O converter, PIN/APD operating characteristics, analog O/E converter, digital O/E converter, electro-optical modulator, optical commutator.

Teaching methods

Lecture: multimedia presentation illustrated with examples with active participation and discussion of students. Laboratory: work with measuring sets - practical exercises carried out on the basis of instructions.

Bibliography

Basic:
Optoelektronika, B. Ziętek, UMK, Toruń, 2004 ,
Optical Electronics in Modern Communications, A. Yariv, Oxford University Press, N. York, 1998,
Fiber-optic communication systems, Govind P. Agrawal, John Wiley & Sons, 2021,
The RP Photonics Encyclopedia: http://www.rp-photonics.com/encyclopedia.html

Additional:
Optoelektronika, K. Booth, S. Hill, WKŁ, 2001

Breakdown of average student's workload

	Hours	ECTS
Total workload	60	2,00
Classes requiring direct contact with the teacher	30	1,00
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	30	1,00