



COURSE DESCRIPTION CARD - SYLLABUS

Course name

Laser optics

Course

Field of study

Technical Physics

Area of study (specialization)

Level of study

First-cycle studies

Form of study

full-time

Year/Semester

3/5

Profile of study

general academic

Course offered in

Polish

Requirements

compulsory

Number of hours

Lecture

15

Laboratory classes

15

Other (e.g. online)

Tutorials

Projects/seminars

Number of credit points

3

Lecturers

Responsible for the course/lecturer:

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Physics

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Responsible for the course/lecturer:

Prerequisites

Basic knowledge of physics within the scope of the lecture in general physics. Basic knowledge of mathematical analysis and algebra in the field of mathematics lectures. The ability to perform simple physical experiments and the development of measurement results in the scope covering I. Physical Laboratory. Understanding the necessity to expand one's competences, readiness to undertake cooperation within the team.

Course objective

1. To provide students with basic knowledge about the properties, description and calculations operational parameters of simple and complex laser optics systems and construction bases lasers.



2. Developing the ability to configure simple optical experimental systems starting them, taking measurements and interpreting the obtained results 3. Developing teamwork skills in students.

Course-related learning outcomes

Knowledge

As a result of the conducted classes, the student will have knowledge in the following areas:

1. knows and understands the quantum processes which generate laser radiation. [K1_W04]
2. knows the basic laser components and knows how to determine their influence on laser performance and properties generated radiation, [K1_W10].

Skills

As a result of the course, the student will acquire the following skills:

1. can handle low-power lasers and build simple optical elements experimental systems [K1_U15]
2. is able to measure quantities characterizing laser light and interpret measurement results [K1_U17].

Social competences

As a result of the conducted classes, the student will acquire the following social competences:

1. is able to work responsibly in the laboratory individually and in a team [K1_K01]
2. can think and act in a creative and enterprising way K1_K08

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Effect	Form of evaluation	Assessment criteria
W01, W02,	Final test	50.1% -70.0% (3)
	Assessment of reports on the implementation of laboratory exercises	70.1% -90.0% (4)
	Activity in solving sample tasks during the lecture from	90.1% (5)
U01, U02	Final test	50.1% -70.0% (3)
	Assessment of reports on the implementation of laboratory exercises	70.1% -90.0% (4)
	Activity in solving sample tasks during the lecture from	90.1% (5)
K01, K02	Final test	50.1% -70.0% (3)
	Assessment of reports on the implementation of laboratory exercises	70.1% -90.0% (4)
	Activity in solving sample tasks during the lecture from	90.1% (5)

Programme content



1. Matrix formalism applied to the calculation of optical systems. Polarized light matrix description
2. Types and applications of interferometers. Physical quantities characterizing interferometers.
3. Polarizing prisms. Circular and elliptical polarization. Operation of phase plates.
4. Light propagation in optical fibers, types of optical fibers. Track elements fiber optic. Materials and technology of optical fibers construction.
5. Conditions for receiving a laser action. Inversion of the levels population. Three-level and four-level systems.
6. Types of laser resonators. Stability condition. Gaussian beam parameters. Invariant beams. Kogelnik's law and the application of matrix formalism to a Gaussian beams.
7. The concept of quality factor of the resonator. Impact Q on laser generation. Methods of changing Q. Transverse and longitudinal modes. Mode selection methods
8. Properties of laser centers on solid and gas. Examples of lasers. Methods pumping
9. Ways of light modulation. Types of modulators and basic parameters.
10. Obtaining ultra-short laser pulses. Giant impulses. Mode-Locking.
12. Tunable lasers. Wavelength and line width control methods

Teaching methods

1. Lecture: multimedia presentation, presentation illustrated with examples given on the blackboard.
2. Laboratory exercises: practical exercises, conducting experiments, making measurements, discussion, team work.

Bibliography

Basic

1. B. Ziętek, "Optoelectronics", Nicolaus Copernicus University Publishing House, Toruń 2004
2. B. Ziętek, "Lasers", Nicolaus Copernicus University Publishing House, Toruń 2008
3. R. Józwicki, "Fundamentals of photonic engineering", WNT, Warsaw 2008
4. F. Ratajczyk, "Optics of Anisotropic Centers", Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław 2005

Additional

1. N. W. Karłow, "Lectures on the physics of lasers", WNT Warsaw 1989
2. A. Kujawski, P. Szczepański, "Lasers Physical basics", Publishing House of the University of Technology, Warsaw 1999



3. R. Józwicki, "Optics of lasers", WNT, Warsaw 1981
4. F. Kaczmarek, "Fundamentals of lasers", WNT Warsaw 1983
5. F. Kaczmarek, "Introduction to the physics of lasers", PWN Warsaw 1978
6. K. Shimoda, "Introduction to the physics of lasers", PWN Warsaw 1993

Breakdown of average student's workload

	Hours	ECTS
Total workload	70	3,0
Classes requiring direct contact with the teacher	35	1,0
Student's own work (literature studies, preparation for laboratory classes/tutorials, preparation for tests/exam, project preparation) ¹	35	1,0

¹ delete or add other activities as appropriate