COURSE DESCRIPTION CARD - SYLLABUS

Course name
Laser optics [S1FT1>OL]

Course

Field of study
Technical Physics

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 (e.g. online)
0

Tutorials
0

Projects/seminars
0

Number of credit points

3,00

Coordinators

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Lecturers

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:

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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. Jóźwicki, "Fundamentals of photonic engineering", WNT, Warsaw 2008
4. F. Ratajczyk, "Optics of Anisotropic Centers", Oficyna Wydawnicza Politechniki Wrocławskiej, Wroclaw 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 Technology7, Warsaw 1999
3. R. Jóźwicki, "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	3,00
Classes requiring direct contact with the teacher	35	1,00
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	35	1,00