POZNAN UNIVERSITY OF TECHNOLOGY

EUROPEAN CREDIT TRANSFER AND ACCUMULATION SYSTEM (ECTS)

COURSE DESCRIPTION CARD - SYLLABUS

Course name
Laser Optics [S1FT2>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 general physics. Basic knowledge in mathematical analysis and algebra at the level of mathematics lectures. Ability to perform simple physical experiments and process measurement results at the level of the First Physics Laboratory. Understanding the need to expand one's competencies and readiness for teamwork.

Course objective

1. To provide students with basic knowledge on the properties, description methods, and calculations of operational parameters for simple and complex laser optics systems, as well as the principles of laser construction. 2. To develop skills in configuring simple optical experimental systems, operating them, performing measurements, and interpreting the obtained results. 3. To enhance teamwork skills among students.

Course-related learning outcomes

Knowledge:
The student will possess knowledge in the following areas:
1. Understands quantum processes resulting in laser radiation

2. Knows the basic components of lasers and can determine their impact on the operation of the laser and the properties of the generated radiation

Skills:
The student will be able to:
1. Operate low-power lasers and build simple experimental setups using optical elements
2. Perform measurements of quantities characterizing laser light and interpret the results

Social competences:
The student will acquire the following social competences:
1. Can work responsibly in a laboratory, both individually and in a team
2. Can think and act in a creative and entrepreneurial manner

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Written Exam; Laboratory Report Assessment; Activity in Solving Example Problems during Lectures
50.1%-70.0% (grade 3); 70.1%-90.0% (grade 4), rom 90.1% (grade 5)

Programme content

1. Matrix formalism for calculating optical systems. Matrix description of polarized light.
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 fibers, components of the optical path, materials and technology of fiber construction.
5. Conditions for obtaining laser action. Population inversion. Three-level and four-level systems.
6. Types of laser resonators. Stability condition. Parameters of the Gaussian beam. Beam invariant. Kogelnik's law and the application of matrix formalism to the Gaussian beam.
7. Concept of cavity Q-factor. Its impact on laser generation. Methods for changing Q-factor. Transverse and longitudinal modes. Modes selection methods.
8. Properties of solid-state and gas laser media. Laser examples. Pumping methods.
9. Methods of light modulation. Types of modulators and basic parameters.
10. Obtaining ultrashort laser pulses. Giant pulses. Mode-locking.
11. Tunable lasers. Methods for controlling wavelength and linewidth.

Course topics

none

Teaching methods

Lecture: Multimedia presentation, presentation illustrated with examples given on the board.
Laboratory Exercises: Practical exercises, conducting experiments, making measurements, discussion, teamwork.

Bibliography

Basic:
1. B. Ziętek, „Optoelektronika”, Wydawnictwo Uniwersytetu Mikołaja Kopernika, Toruń 2004
2. B. Ziętek, „Lasery”, Wydawnictwo Uniwersytetu Mikołaja Kopernika, Toruń 2008
3. R. Jóźwicki, „Podstawy inżynierii fotonicznej”, WNT, Warszawa 2008
4. F. Ratajczyk, „Optyka ośrodków anizotropowych”, Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław 2005

Additional:
1. N. W. Karłow, „Wykłady z fizyki laserów”, WNT Warszawa 1989
2. A. Kujawski, P. Szczepański, „Lasery Podstawy fizyczne”, Oficyna Wydawnicza Politechniki Warszawskiej, Warszawa 1999
3. R. Jóźwicki, „Optyka laserów”, WNT, Warszawa 1981
4. F. Kaczmarek, „Podstawy działania laserów”, WNT Warszawa 1983

5. F. Kaczmarek, „Wstęp do fizyki laserów", PWN Warszawa 1978
6. K. Shimoda, „Wstęp do fizyki laserów", PWN Warszawa 1993

Breakdown of average student's workload

	Hours	ECTS
Total workload	75	3,00
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)	45	2,00