GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

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| Subject name and code | Laser Technology, PG_00048086 | | |
| Field of study | Electronics and Telecommunications | | |
| Date of commencement of studies | October 2022 | Academic year of realisation of subject | 2024/2025 |
| Education level | first-cycle studies | Subject group | Optional subject group<br>Subject group related to scientific research in the field of study |
| Mode of study | Full-time studies | Mode of delivery | at the university |
| Year of study | 3 | Language of instruction | Polish |
| Semester of study | 6 | ECTS credits | 2.0 |
| Learning profile | general academic profile | Assessment form | assessment |
| Conducting unit | Department of Metrology and Optoelectronics -> Faculty of Electronics, Telecommunications and Informatics | | |
| Name and surname of lecturer (lecturers) | Subject supervisor | dr hab. inż. Jerzy Pluciński | |
| | Teachers | dr hab. inż. Jerzy Pluciński | |

| Lesson types and methods of instruction | Lesson type | Lecture | Tutorial | Laboratory | Project | Seminar | SUM |
|---|---|---|---|---|---|---|---|
| | Number of study hours | 15.0 | 0.0 | 15.0 | 0.0 | 0.0 | 30 |
| | E-learning hours included: 0.0 | | | | | | |

| Learning activity and number of study hours | Learning activity | Participation in didactic classes included in study plan | Participation in consultation hours | Self-study | SUM |
|---|---|---|---|---|---|
| | Number of study hours | 30 | 2.0 | 18.0 | 50 |

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| Subject objectives | The aim of the course is to acquaint students with the principle of the construction and operation of lasers, with their types and parameters and the rules of their safe use, as well as skills in measurement of laser beam parameters. |

## Learning outcomes

| Course outcome | Subject outcome | Method of verification |
|---|---|---|
| [K6_W03] knows and understands, to an advanced extent, the construction and operating principles of components and systems related to the field of study, including theories, methods and complex relationships between them and selected specific issues - appropriate for the curriculum | He compares the properties of the laser beam with optical radiation from other sources, explains the structure and operation of continuous and pulsed lasers, explains the methods of tuning lasers, describes the factors destabilizing the operation of lasers and discusses the principles of their stabilization. He lists the basic types of lasers and their typical parameters, presents laser safety classes. | [SW1] Assessment of factual knowledge |
| [K6_W02] knows and understands, to an advanced extent, selected laws of physics and physical phenomena as well as methods and theories explaining the complex relationships between them, constituting the basic general knowledge in the field of technical sciences related to the field of study | He explains the phenomenon of absorption, emission and stimulated emission, knows the Einstein equations describing these phenomena, knows the concept of population inversion. | [SW1] Assessment of factual knowledge |
| [K6_U06] can analyse the operation of components, circuits and systems related to the field of study, measure their parameters and examine technical specifications | He measures the parameters of optical modulators used in laser technology, analyzes the operation of optical elements using the phenomenon of laser beam diffraction, makes measurements using lasers, including the optical properties of selected media. | [SU1] Assessment of task fulfilment |
| [K6_U05] can plan and conduct experiments related to the field of study, including computer simulations and measurements; interpret obtained results and draw conclusions | He performs light interference experiments. | [SU1] Assessment of task fulfilment |

## Subject contents

1. Introduction, historical background.
2. Properties of laser beam.
3. Temporal coherence of laser beam; coherence length, coherence time.
4. Spatial coherence of laser beam; laser beam divergence, beam focusing.
5. Main elements of lasers: optical amplifier, optical resonator; optical feedback.
6. Absorption, spontaneous emission, stimulated emission Einstein's coefficients.
7. Laser pumping: optical pumping, atom collisions, carrier injection into p-n junction, chemical reactions.
8. Light amplification in laser.
9. Setups of optical resonators configurations and applications.
10. Stability of optical resonators.
11. Longitudinal laser modes.
12. Transverse laser modes.
13. Tunable lasers.
14. Sources of laser beam fluctuations.
15. Passive methods of laser stabilization.
16. Laser frequency stabilization using maximum of amplification curve or Lamb dip.
17. Laser frequency stabilization using intrinsic or extrinsic absorption cell.
18. Laser frequency stabilization using Zeeman effect.
19. Lasers with switchable gain.
20. Q-switching lasers.
21. Mode-locking lasers.
22. Frequency sweep lasers.
23. Soliton lasers.
24. Type of lasers and its parameters.

## Prerequisites and co-requisites

No requirements

## Assessment methods and criteria

| Subject passing criteria | Passing threshold | Percentage of the final grade |
|---|---|---|
| Midterm colloquium | 50.0% | 60.0% |
| Practical exercise | 50.0% | 40.0% |

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| Recommended reading | Basic literature | 1. O. Svelto: Principles of Lasers, 4th Edition. Plenum Press, New York, 1998.<br>2. B. Ziętek: Lasery. Wyd. 2., Wydawnictwo Naukowe UMK. Toruń, 2015.<br>3. K. Barat: Laser Safety Management, CRC, Boca Raton, 2006.<br>4. B. E. A. Saleh, M. C. Teich: Fundamentals of Photonics, 2nd Edition. John Wiley & Sons, New York, 2007.<br>5. Control of Hazards to Health from Laser Radiation, Technical Bulletin Medical 254, Headquarters, Department of The Army, Washington, DC, 2006.<br>6. F. Täger: Springer Handbook of Lasers and Optics, Springer, Berlin, 2007. |
| | Supplementary literature | No requirements |
| | eResources addresses | Adresy na platformie eNauczanie: |
| Example issues/ example questions/ tasks being completed | | |
| Work placement | Not applicable | |

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