GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

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|---|---|---|---|
| Subject name and code | Elements of modern physics, PG_00061199 | | |
| Field of study | Mechanical Engineering | | |
| Date of commencement of studies | October 2023 | Academic year of realisation of subject | 2025/2026 |
| Education level | first-cycle studies | Subject group | Obligatory subject group 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 | 5 | ECTS credits | 5.0 |
| Learning profile | general academic profile | Assessment form | exam |
| Conducting unit | Institute of Physics and Applied Computer Science -> Faculty of Applied Physics and Mathematics -> Wydziały Politechniki Gdańskiej | | |
| Name and surname of lecturer (lecturers) | Subject supervisor | dr inż. Marcin Dampc | |
| | Teachers | dr inż. Marcin Dampc<br>dr inż. Łukasz Haryński<br>dr Piotr Weber | |

**Lesson types and methods of instruction**

| Lesson type | Lecture | Tutorial | Laboratory | Project | Seminar | SUM |
|---|---|---|---|---|---|---|
| Number of study hours | 30.0 | 15.0 | 15.0 | 0.0 | 0.0 | 60 |

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 | 60 | 5.0 | 60.0 | 125 |

**Subject objectives**

During the course, students are to become familiar with the basic phenomena and theories of modern physics and the modern technologies used in science and industry based on them.

**Learning outcomes**

| Course outcome | Subject outcome | Method of verification |
|---|---|---|
| [K6_U01] is able to acquire information from specialized literary sources, databases and other resources, essential for solving engineering tasks; is able to compile the obtained information pieces and to interpret them, additionally is able to form conclusions and present justified opinion | The student is able to use literature and databases when preparing laboratory studies and solving theoretical problems. | [SU2] Assessment of ability to analyse information<br>[SU4] Assessment of ability to use methods and tools<br>[SU3] Assessment of ability to use knowledge gained from the subject |
| [K6_W02] possesses an organized knowledge on physics, including classic mechanics, acoustics, optics, electricity and magnetism, shows knowledge of the elements of quantum physics | The student becomes familiar with phenomena and learns theories in the field of mechanics, wave physics, electricity and magnetism, and quantum mechanics. | [SW1] Assessment of factual knowledge |

<table>
<tr><td>Subject contents</td><td>Lecture<br>1. Classical Mechanics<br>2. Wave Physics: Wave Description, Wave Equations, Wave Propagation, Interference, Acoustics, Ultra-Long Waves<br>3. Geometric Optics: Laws of Reflection and Refraction, Dispersion, Optical Atmospheric Phenomena<br>4. Wave Optics: Explanation of the Laws of Optics Using the Wave Model, Diffraction, Modern Optical Spectroscopy<br>5. Electricity and Magnetism: Electric and Magnetic Fields, Field Sources, Field Interactions with Charges, Energy of Electromagnetic Fields<br>6. Electromagnetic Waves: Dipole and Dipole Radiation, Propagation of Electromagnetic Waves Through Matte, Lasers<br>7. Quantum Physics: Crisis of Classical Physics, Blackbody, Emission Spectra of Gases, Photoelectric Effect, Bohr's Model, Quantum Description of the Atom, Quantum Numbers<br>8. Wave Quantum Theory: Matter Waves, Wave Equations and Their Interpretation, Uncertainty Principle, Quantum Cryptography, Quantum Computers.<br>Exercises:<br>1. Kinematics, two-dimensional motion in a gravitational field, dynamics of a material point<br>2. Kinematics of oscillatory motion, mechanical waves, acoustics<br>3. Wave optics: interference and diffraction, diffraction gratings.<br>4. Determining electric field strength and magnetic field induction, motion of the charged particles in electromagnetic fields, polarization of electromagnetic waves<br>5. Blackbody emission, Wien's law, Planck's distribution, the photoelectric effect, Balmer's formula, Bohr's model<br>6. The uncertainty principle, diffraction of matter waves<br>Lab:<br>1. Wave Physics: Relationship of the Speed of Sound in Solids to Young's Modulus, Propagation of Sound in Air.<br>2. Optics: Newton's Rings, Diffraction Gratings, Determining the Size of Slits and Obstacles Through Diffraction and Interference.<br>3. Electricity and Magnetism: Electric Field, Electron Charge-to-Mass Ratio<br>4. Quantum Physics: Photoelectric Effect, Blackbody Emission, Spectroscopy of Gas Emission Spectra.</td></tr>
<tr><td>Prerequisites and co-requisites</td><td>Knowledge of classical mechanics</td></tr>
<tr><td>Assessment methods and criteria</td><td><table>
<tr><th>Subject passing criteria</th><th>Passing threshold</th><th>Percentage of the final grade</th></tr>
<tr><td>Passing the labs</td><td>100.0%</td><td>25.0%</td></tr>
<tr><td>Colloquium</td><td>50.0%</td><td>25.0%</td></tr>
<tr><td>Exam</td><td>50.0%</td><td>50.0%</td></tr>
</table></td></tr>
<tr><td>Recommended reading</td><td><table>
<tr><td>Basic literature</td><td>1. David Halliday, Robert Resnick, Jearl Walker, Fundamentals of Physics, vol 2-5, PWN, 2015</td></tr>
<tr><td>Supplementary literature</td><td>1. Hermann Haken, Hans Christoph Wolf, The physics of atoms and quanta, PWN 2012<br><br>2. Hugh D. Young, University Physics with Modern Physics, 15th Ed. Pearson, Addispn-Wesley, 2019</td></tr>
<tr><td>eResources addresses</td><td></td></tr>
</table></td></tr>
<tr><td>Example issues/ example questions/ tasks being completed</td><td>Exam: Describe and explain the photoelectric effect. Sketch the dependence of the photocurrent on the stopping voltage for several different values of the following parameters: wavelength of incident radiation, radiation intensity, and work function.<br><br>Exercises: Calculate the energy emitted per second by a 1 m2 blackbody if its emission maximum falls at 550 nm.<br><br>Lab: Based on the hydrogen emission spectrum, determine the Rydberg constant and state the uncertainty of the result.</td></tr>
<tr><td>Work placement</td><td>Not applicable</td></tr>
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