University of Gdańsk

Subject card

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| Subject name and code | Medical Imaging, PG_00210344 | | | | | | |
| Field of study | Medical Physics | | | | | | |
| Date of commencement of studies | October 2025 | | Academic year of realisation of subject | 2026/2027 | | | |
| Education level | Master's studies | | Subject group | Optional subject group | | | |
| Mode of study | full-time studies | | Mode of delivery | at the university | | | |
| Year of study | 2 | | Language of instruction | Polish | | | |
| Semester of study | 4 | | ECTS credits | 3.0 | | | |
| Learning profile | academic | | Assessment form | credit | | | |
| Conducting unit | | | | | | | |
| Name and surname of lecturer (lecturers) | Subject supervisor | | dr Justyna Strankowska | | | | |
| | Teachers | | | | | | |
| Lesson types | Lesson type | Lecture | Tutorial | Laboratory | Project | Seminar | SUM |
| | Number of study hours | 45.0 | 0.0 | 0.0 | 0.0 | 0.0 | 45 |
| | 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 | 45 | | 0.0 | | 30.0 | 75 |
| Subject objectives | The aim of the course is to familiarize students with medical imaging methods, as well as the design, operating principles, and clinical applications of medical equipment used in diagnostic imaging. The course covers topics that provide an understanding of the physical principles underlying medical imaging techniques and the acquisition and analysis of biomedical signals. It also enables students to develop the ability to independently select appropriate imaging modalities and analyze diagnostic findings in specific clinical cases. | | | | | | |

Learning outcomes

| Course outcome | Subject outcome | Method of verification |
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| [FIZMEDMU2_U05] Can present research results (experimental, theoretical, numerical, medical) in writing, orally, in a multimedia presentation or poster, using specialist terminology. | The student develops a comparative analysis of physical imaging parameters across various diagnostic techniques, utilizing strict terminology from the field of medical physics, synthesizes data from medical literature regarding the clinical advantages and disadvantages of using hybrid techniques in patient diagnostics; and critically analyzes and interprets sample registrations of bioelectric signals (ECG, EEG, EMG) as well as diagnostic images (CT, MRI, USG), subsequently formulating and substantiating conclusions regarding the quality of the acquired measurement data. | [SU2] presentation/project/paper/ report |
| [FIZMEDMU2_W06] Knows and understands the current directions of development of physics and medical sciences, especially in the field of medical physics, and the fundamental dilemmas of modern civilisation. | The student identifies current technological trends in hybrid techniques (e.g., PET/CT, PET/ MRI) and directions for radiation dose optimization in modern tomography, critically evaluates the advantages and disadvantages of individual diagnostic modalities based on criteria such as spatial and temporal resolution, invasiveness (ionizing vs. non-ionizing radiation), and procedural availability; and discusses the physical and technological limitations of contemporary structural and functional imaging methods in the context of early diagnostics challenges. | [SW4] test/exam - oral or written |
| [FIZMEDMU2_W04] Knows and understands in depth the theoretical foundations and principles of operation of measurement systems and research, diagnostic and therapeutic equipment specific to the field of physics and medicine. | The student provides a detailed description of the design and operating principles of X-ray equipment and the image reconstruction process in computed tomography (CT), defines the functions of individual components of an MRI scanner (main magnet, gradient coils, RF coils) and their role in spatial signal encoding; analyzes the architecture of detection systems used in emission tomography (scintillation crystals, photomultiplier tubes in PET and SPECT) and the technical requirements for electrographic signal registration; and distinguishes the operating modes of modern ultrasonography devices (A-scan, B-scan, Doppler) along with the subcomponents responsible for beamforming and echo reception. | [SW4] test/exam - oral or written |
| [FIZMEDMU2_W01] Knows and understands in depth selected issues in the field of physics and medicine, the complex relationships between them, and development trends in the exact and natural sciences, health sciences, and others. | The student explains the physical mechanisms of bioelectric signal generation within the human body and their representation in electrographic modalities (ECG, EEG, EMG), describes the physical phenomena of ultrasonic wave interaction (reflection, refraction, attenuation, the Doppler effect) and infrared radiation interaction with biological tissues; clarifies the relationship between the acquired image and tissue-specific magnetic relaxation parameters ($T_1$, $T_2$); and characterizes the physical processes (positron annihilation, gamma photon emission) that govern image formation in nuclear medicine (PET, SPECT). | [SW4] test/exam - oral or written |

<table>
<tr><td>Subject contents</td><td>1. Electrography (ECG, EEG, and EMG techniques).<br>2. Conventional Radiography and Computed Tomography (CT).<br>3. Magnetic Resonance Imaging (MRI).<br>4. Ultrasonography (Ultrasound Imaging, US).<br>5. Medical Thermography.<br>6. Nuclear Medicine Imaging Techniques (PET and SPECT).<br>7. Comparison of diagnostic techniques: advantages and limitations of diagnostic methods used in patient evaluation.</td></tr>
<tr><td>Prerequisites and co-requisites</td><td></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>Presentation / Written report</td><td>51.0%</td><td>30.0%</td></tr>
<tr><td>Open-ended questions test</td><td>51.0%</td><td>70.0%</td></tr>
</table></td></tr>
<tr><td>Recommended reading</td><td><table>
<tr><td>Basic literature</td><td>1] Rezonans Magnetyczny i Tomografia Komputerowa w praktyce klinicznej red. J. Walecki, A. Ziemiański, Springer PWN, Warszawa 1998.<br>[2] NMR w biologii i medycynie K.H. Hausser, H.R. Kalbitzer, Wydawnictwo Naukowe UAM, Poznań 1993.<br>[3] Fizyczne metody diagnostyki medycznej i terapii red. A. Z. Hrynkiewicz, E. Rokita, Wydawnictwo Naukowe PWN, Warszawa 2000.<br>[4] Fizyczne metody badań w biologii, medycynie i ochronie środowiska red. A. Z. Hrynkiewicz, E. Rokita, Wydawnictwo Naukowe PWN, Warszawa<br>1999.<br>[5] Biocybernetyka i inżynieria biomedyczna 2000 t. 8 red. Maciej Nałęcz, Akademicka Oficyna Wydawnicza EXIT, Warszawa 2003.<br>[6] Podstawy inżynierii medycznej G. Pawlicki, Oficyna Wydawnicza Politechniki Warszawskiej, Warszawa 1997.<br>[7] Postępy Termografii Aplikacje Medyczne A. Nowakowski, M. Kaczmarek, J. Rumiński, M. Hryciuk, Wydawnictwa Gdańskie, Gdańsk 2001.<br>[8] The Physical Principles of Medical Imaging, 2nd Ed. P. Sprawls, Resources for Learning and Teaching http:// www.sprawls.org/resources</td></tr>
<tr><td>Supplementary literature</td><td>[1] Podstawy spektroskopii molekularnej Z. Kęcki, Wydawnictwo Naukowe PWN, Warszawa 1992.<br>[2] Biofizyka molekularna G. Ślósarek, Wydawnictwo Naukowe PWN, Warszawa</td></tr>
<tr><td>eResources addresses</td><td></td></tr>
</table></td></tr>
<tr><td>Example issues/ example questions/ tasks being completed</td><td></td></tr>
<tr><td>Work placement</td><td>Not applicable</td></tr>
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