GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Medical Imaging Methods, PG_00067989						
Field of study	Biomedical Engineering						
Date of commencement of studies	October 2025		Academic year of realisation of subject	2026/2027			
Education level	first-cycle studies		Subject group	Obligatory subject group in the field of study 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	2		Language of instruction	Polish			
Semester of study	4		ECTS credits	3.0			
Learning profile	general academic profile		Assessment form	exam			
Conducting unit	Department of Biomedical Engineering -> Faculty of Electronics Telecommunications and Informatics -> Faculties of Gdańsk University of Technology						
Name and surname of lecturer (lecturers)	Subject supervisor		dr hab. Marcin Gruszecki				
	Teachers						
Lesson types	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		43.0	75
Subject objectives	The aim of the course is to familiarize students with the structure and principles of operation of selected devices used for imaging in medicine.						

Learning outcomes

Course outcome	Subject outcome	Method of verification
[K6_U09] can carry out a critical analysis of the functioning of existing technical solutions and assess these solutions, as well as apply experience related to the maintenance of technical systems, devices and facilities typical for the field of studies, gained in the professional engineering environment	The student is able to evaluate the selected imaging method	[SU1] Assessment of task fulfilment
[K6_W51] Knows and understands, to an advanced extent, selected aspects of biomedical diagnostics and human anatomy and physiology, constituting general knowledge related to the field of study	The student acquires knowledge about various forms of energy and their impact on living organisms.	[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	The student knows selected physical phenomena related to selected medical imaging methods.	[SW1] Assessment of factual knowledge
[K6_W04] knows and understands, to an advanced extent, the principles, methods and techniques of programming and the principles of computer software development or programming devices or controllers using microprocessors or programmable elements or systems specific to the field of study, and organisation of systems using computers or such devices	The student knows the basics of software development	[SW1] Assessment of factual knowledge

Subject contents	Course content – lecture 1. Introduction to medical imaging The importance of imaging in diagnostics, therapy and disease monitoring The advantages of imaging methods over other techniques (e.g. laboratory, functional) Division according to the source of the physical signal: Ionizing radiation: X-ray, CT, PET, SPECT Magnetic fields and radio waves: MRI Mechanical waves: ultrasound Thermal radiation: thermography Functional division: structural vs. functional imaging 2. X-ray equipment - construction, principle of operation, purpose Radiation source: X-ray tube - cathode/anode, voltage and current control. Principle of operation: interaction of X-ray radiation with tissues - absorption, scattering, transmission. Image formation mechanisms: exposure of film, phosphor plates, digital detectors (CCD/DR). Safety standards: exposure, protective shields, monitoring of doses for personnel. Diagnostic X-ray machines 3. Computed tomography (CT) Principle of spiral tomography: lamp and table movement; multi-row detectors. Data reconstruction Diagnostic features: layer resolution, examination time, radiation dose. Artifacts and methods of their correction. 4. Magnetic resonance imaging (MRI) Physics of the technique: nuclear resonance, gradients and coil sensitivity. Imaging sequences: T1, T2 selection of sequences depending on the purpose of the examination. Image quality parameters: echo time (TE), repetition time (TR) MR safety: compatibility with metals, implant disturbances, contrast agents. 5. Single photon emission computed tomography (SPECT) Signal source: radioisotopes (Tc-99m, I-123); isotope characteristics. Gamma camera detectors: collimator, scintillator, photomultipliers. Applications: cerebral/cardiac perfusion, bone examination; patient safety. 6. Positron emission tomography (PET) Mechanism of action: positron emission annihilation and detection of 511 keV. PET detectors: block scintillators Connection with CT/MRI Clinical applications: oncology, neurology, cardiology. 7. Ultrasonography (USG) Principle of operation: ultrasonic waves generation/measurement, tissue impedance. Imaging modes: A-mode, B-mode, Doppler (color, continuous, pulsed), elastography. USG artifacts: shadows, false echoes; Applications: fetal diagnostics, cardiovascular system 8. Thermography Technology: thermal imaging cameras - infrared range, thermal sensitivity. Medical applications: detection of inflammation, ulcers, blood circulation. 9. Equipment for modern diagnostic imaging

	Fusion of modalities: PET/CT, SPECT/CT, PET/MRI systems Laboratory Source imaging Ultrasound Tomography Microscopy Endoscopy Thermography
Prerequisites and co-requisites	

Assessment methods and criteria

Subject passing criteria	Passing threshold	Percentage of the final grade
lecture	50.0%	40.0%
laboratory	50.0%	60.0%

Recommended reading

Basic literature	J.Moore, G. Zouridakis, Biomedical Technology and devices, CRC Press, 2004 M. Nałęcz [red.] Biocybernetyka i Inżynieria Biomedyczna, t.8. Obrazowanie biomedyczne, Exit 2003 S. Webb, The physics of medical imaging, IOP 1988
Supplementary literature	B.N. Feinberg, Applied clinical engineering, Prentice-Hall, 1986 Enderle [red}, Introduction to biomedical engineering, Elsevier, 2005 Z.-H. Cho, J.P. Jones, M.Singh, Foundations of medical imaging, J.Wiley&Sons, 1993
eResources addresses	

Example issues/ example questions/ tasks being completed	
Practical activites within the subject	Not applicable

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