UNIWERSYTET JAGIELLOŃSKI
COLLEGIUM MEDICUM

Faculty of Medicine
EDUCATIONAL SUBJECT DESCRIPTION SHEET
Basics of medical imaging

Subject Basics of medical imaging			
Examination graded credit		**Block** obligatory for passing in the course of studies	
Field of study Medical and Dental Program		**Didactic cycle** 2019/20	**Period** Semester 4
Lecture languages English		**Education profile** general academic	**Mandatory** elective
Hours lecture: 30		**Number of ECTS points** 2	
Study level long-cycle master's degree program	**Study form** full-time	**Disciplines** Medical science	
Subject coordinator	Eugeniusz Rokita		
Lecturer	Eugeniusz Rokita		
Standard group B. Scientific basis for medicine			

Entry requirements

Completing the course on biophysics or medical physics at the academic level. Ability to self-prepare an essay by using the internet and specific books.

Goals

G1	The aim of the module is to familiarize a student with, in terms of knowledge with: (1) the concepts enabling the biophysical description of the medical imaging techniques, (2) the effects of physical factors on the human body, (3) the basics of physical methods used in the diagnosis, with particular emphasis on diagnostic imaging, (4) image processing techniques and (5) methods of estimating the risk of performing a diagnostic test.
G2	To make students aware of the limitations associated with diagnostic imaging methods and side effects associated with the use of different imaging methods. In particular, familiarization with: (1) restrictions various imaging diagnostics methods, (2) characteristic artifacts for various imaging methods, (3) assessment of the harmfulness of ionizing and non-ionizing radiation used in a given diagnostic method as well as standards in this area for both patients and staff.
G3	To develop skills in optimizing the procedure to achieve a specific diagnostic purpose and preparation for the use of imaging apparatus in clinical practice. In particular, familiarization with: (1) how to choose the optimal diagnostic procedure to solve a specific problem, (2) effective using basic diagnostic imaging devices, (3) explaining the course to the patient the test that awaits him, (4) cooperation with the team operating the imaging equipment and (5) use of the literature.

Subject's learning outcomes

Code	Outcomes in terms of	Effects

Knowledge – Student knows and understands:		
W1	issues in the field of medicine and natural sciences – in the basic scope	O.W1
W2	tissue and organ imaging methods and principles of operation of diagnostic devices for this purpose	B.W9
W3	operating principles of ultrasonic devices	B.W10
W4	principles of photometry and optical fibers and the use of light sources in dentistry	B.W11
W5	principles of lasers in dentistry	B.W12
W6	principles of dental equipment operation	B.W13
Skills – Student can:		
U1	carry out diagnostics of the most common diseases, assess and describe the patient's somatic and mental state	O.U1
U2	interpret physical phenomena occurring in the masticatory organ	B.U2
U3	use the physical processes appropriate to the work of a dentist	B.U3
Social competences – Student is ready to:		
K1	use objective sources of information	O.K7
K2	formulate conclusions from own measurements or observations	O.K8

Study content

No.	Course content	Subject's learning outcomes	Activities
1.	Image representation, processing and analysis methods in medicine - digital image, image algebra, geometric transformations, image histograms, image filtration, Fourier transformation, operations on series of images. Image data recording standards - DICOM, archiving and sending of images - PACS, information systems in radiology - RIS. Optical imaging - lasers and optical fibers, endoscopic techniques, wireless endoscopy and virtual endoscopy.	W1, W2, W4, W5, W6, U1, K1	lecture
2.	Classical radiology - physical basics, X-ray tube, X-ray image detectors in radiology, optimization of parameters in radiological examination, calculation of ionizing radiation doses, radiation protection, mammography, contrast radiology, vascular examinations in radiology, coronary angiography, retrograde chol-angio-pactreatography, digital subtractive angiography, layered radiology and pantomography, densitometry. Computed tomography - construction and tomograph operation principle, image reconstruction methods, quantitative computed tomography (bone density determination), image quality assessment, artifacts, spiral tomography and multi-row modern systems, three-dimensional tomography, the use of contrast media, static and and dynamic tomography in cardiology.	W1, W2, U1, U2, K1, K2	lecture

3.	Ultrasonography - characteristics of acoustic waves, interaction with biological systems, structure and principle of ultrasound machine operation, image presentation methods, 3D and 4D ultrasound, endoscopic and intraoperative systems, Doppler ultrasound, special ultrasound techniques, elastography, higher harmonics, intravascular ultrasound, studies of tissue movement, contrast media in ultrasound, artifacts.	W1, W3, U3, K1, K2	lecture
4.	Magnetic resonance tomography - magnetic tissue properties, magnetization vector, effect of nuclear magnetic resonance, Larmor frequency, relaxation times, measuring techniques, induction law, free induction decay, excitation pulses, spin echo and gradient echo methods, construction of magnetic resonance tomograph, superconducting magnet, permanent magnet, gradient coils and RF coils, image reconstruction methods, fast imaging techniques, selection of parameters in the magnetic resonance examination, sequence of pulses, PD, T1 and T2 images, imaging of blood flow, diffusion measurements, chemical shift, magnetic resonance spectroscopy, special imaging techniques in magnetic resonance tomography, noise sources, resolving power, artifacts, contrast agents in magnetic resonance tomography, biological effects of electromagnetic fields.	W1, W2, U1, U2, K1, K2	lecture
5.	Scintigraphy and emission tomography - construction and principle of gamma camera gamma, isotope characteristics, basics of radiochemistry, single photon emission tomography (SPECT), positron emission tomography (PET).	W1, W2, U1, U2, K1, K2	lecture
6.	New imaging diagnostics techniques - thermography, impedance tomography, tomography based on infrared radiation, optical coherence tomography.	W1, W2, K1, K2	lecture

Literature

Obligatory

1. P. Suetens, Fundamentals of Medical Imaging, Cambridge University Press, Cambridge, 2017.
2. J.T. Bushberg, J.A. Seibert, E.M. Leidholdt, J.M. Boone, The Essential Physics of Medical Imaging. Wolters Kluwer, Philadelphia, 2012.
3. W.R. Hedrick, D.L. Hykes, D.E. Strachman, Ultrasound Physics and Instrumentation, Mosby, St. Louis, 2006.
4. A. Oppelt (Ed.), Imaging Systems for Medical Diagnosis, Publicis Corporate Publishing, Erlangen, 2005.

Optional

1. J. Zamorano, J.J. Bax, F.E. Rademarkers, J. Knuuti, The ESC Textbook of Cardiovalcular Imaging, NewYork, 2010.
2. P. Rogalla, J. T. van Scheltinga, B. Hamm (eds), Virtual Endoscopy and Related 3D Techniques, Springer, Berlin, 2002.

Course advanced

Teaching methods:

lecture, lecture with multimedia presentation

Activities	Examination methods	Credit conditions

Activities	Examination methods	Credit conditions
lecture	oral examination, essay	The condition of passing the course is a positive essay grade prepared by the student and passing an oral exam covering mainly problems related to the topic of the essay. Knowledge of the issues presented in lectures can also be checked.

Additional info

The essay should be prepared according to the given template. Essays that do not meet this condition will not be reviewed.

Calculation of ECTS points

Activity form	Activity hours*
lecture	30
preparation for examination	10
preparation of a report	20
Student workload	**Hours** 60
Workload involving teacher	**Hours** 30

* hour means 45 minutes

Methods of evaluating the learning outcomes

Learning-outcome code	Method of evaluation	
	oral examination	essay
W1	x	
W2		x
W3	x	x
W4	x	x
W5	x	x
W6	x	
U1	x	
U2	x	
U3	x	
K1		x
K2	x	

Standard effects

Code	Content
B.U2	interpret physical phenomena occurring in the masticatory organ
B.U3	use the physical processes appropriate to the work of a dentist
B.W9	tissue and organ imaging methods and principles of operation of diagnostic devices for this purpose
B.W10	operating principles of ultrasonic devices
B.W11	principles of photometry and optical fibers and the use of light sources in dentistry
B.W12	principles of lasers in dentistry
B.W13	principles of dental equipment operation
O.K7	use objective sources of information
O.K8	formulate conclusions from own measurements or observations
O.U1	carry out diagnostics of the most common diseases, assess and describe the patient's somatic and mental state
O.W1	issues in the field of medicine and natural sciences – in the basic scope

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