Course name:		
Medical imaging techniques		
Field of study: **Biomedical engineering**	Type of study: ***Full-time***	Course code: **B10_14**
Course characteristics: **Mandatory**	Level: **First**	Year: **II** Semester: **IV**
Type of classes: **lectures, laboratories**	Hours per week: **2 lect^{E} , 2 lab**	ECTS points amount: **5 ECTS**

COURSE GUIDE

I. GENERAL INFORMATION OF THE COURSE

AIMS OF THE COURSE

A1. Obtaining knowledge about medical imaging techniques: fundamental physics, mathematical principles, medical image processing, medical applications.

A2. Practice by students the design a computer application realizing signal processing involved with a chosen medical imaging technique.

PRELIMINARY REQUIREMENTS FOR THE KNOWLEDGE, SKILLS AND OTHER COMPETENCIES

1. Basic knowledge about diagnostic methods in medicine.
2. Programming skills in chosen development environment.
3. Ability to chose a proper numerical method for problem solving given tasks.
4. Ability to perform mathematical operations to solve given problems.
5. Ability to work independently and in the group.
6. Ability to correct interpretation and to presentation of own action.

II. LEARNING 0UTCOMES

EE 1 – students will posses theoretical knowledge in the fields of medical imaging techniques,

EE 2 – students will be able to design independently computer systems which have implemented methods of signal processing involved with medical imaging techniques,

EE 3 – students will be able to prepare a report from a designing process of computer system.

CONTENT

Lectures	**Hours**
Lect. 1 – The role of medical imaging techniques. Systematics of medical imaging techniques.	**2**
Lect. 2,3 – X-ray technique: historical background, fundamental physics, construction of X-ray equipment.	**4**
Lect. 4,5 – Computed tomography: historical background, fundamental physics, technical concepts of computed tomography scanners, reconstruction algorithms.	**4**
Lect. 6,7 – Positron emission tomography: historical background, fundamental physics, construction of PET scanners.	**4**
Lect. 8,9 – Statistical reconstruction algorithms.	**4**
Lect. 10,11 – Magnetic resonance imaging: historical background, fundamental physics, construction of MRI scanners, imaging modalities.	**4**
Lect. 12 – Single positron emission computed tomography: historical background, fundamental physics, construction of SPECT scanners.	**2**
Lect. 13,14 – Ultrasonography: historical background, fundamental physics, construction of USG apparatus, imaging modalities.	**4**
Lect. 15 – Other imaging techniques: termography, radioisotope imaging, etc.	**2**
Laboratories	**Hours**
Lab. 1 – Introduction to the chosen programming environment. Design of a simple application.	**2**
Lab. 2,3 – Implementation of the simulation environment for acquisition of parallel x-ray beams.	**4**
Lab. 5 – Implementation of the simulation environment for acquisition of x-ray fan-beams.	**2**
Lab. 6,7 – Implementation of the simulation environment for acquisition of x-ray cone-beams.	**4**
Lab. 8,9 – Implementation of the convolution/back-projection reconstruction algorithm for parallel-beam scanner.	**4**
Lab. 10 – Implementation of the Fast Fourier Transfor for 1D and 2D.	**2**
Lab. 11 – Implementation of the filtration/back-projection reconstruction algorithm for parallel-beam scanner.	**2**
Lab. 12 – Implementation of the convolution/back-projection reconstruction algorithm for parallel-beam scanner.	**2**
Lab. 13,14 – Implementation of the FDK reconstruction algorithm for cone-beam spiral scanner.	**4**
Lab. 15 – Simulation of the Poisson noise for parallel x-ray beams.	**2**

TEACHING TOOLS

1. – lectures using multimedia presentations
2. – chosen programming environment
3. – computer stations with software
4. – laboratory instructions

Błąd! Nie można odnaleźć źródła odwołania.

1. A.C. Kak, M. Slanley, Principles of computerized tomographic imaging. IEEE Press, New York, 1988.
2. A.K. Jain, Fundamentals of digitals image processing, Prentice-Hall, 1989.
3. M. Sonka, J.M. Fitzpatrick, Handbook of medical imaging, vol. 2, Medical image processing and analyzing, SPIE- The international society for optical engineering, 2010.
4. P. Suetens, Fundamentals of medical imaging, Cambridge University Press, 2009.
5. R. Cierniak, X-Ray Computed Tomography in Biomedical Engineering, Springer, London, 2011.

COURSE COORDINATOR AND ACADEMIC TEACHER

1. dr hab. inż. Robert Cierniak, Prof. PCz cierniak@kik.pcz.pcz.pl