COURSE DESCRIPTION CARD - SYLLABUS

Course name
Medical images processing [S2IBio1>POM]

Course

Field of study
Biomedical Engineering

Year/Semester
1/2

Area of study (specialization)
Bionics and Virtual Engineering

Profile of study
general academic

Level of study
second-cycle

Course offered in
Polish

Form of study
full-time

Requirements
compulsory

Number of hours

Lecture
15

Laboratory classes
15

Other
0

Tutorials
0

Projects/seminars
15

Number of credit points

3,00

Coordinators

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Lecturers

Prerequisites

Basic knowledge of mathematics, physics and computer science, consistent with the core curriculum for first-cycle studies. Ability to solve basic mathematical problems in based on possessed knowledge and ability to obtain information from indicated sources.

Course objective

Expanding knowledge of mathematics with elements of mathematical methods of processing medical digital images and knowledge of computer science with elements of algorithms used in the processing of digital medical images. Gaining skills in selected IT tools supporting medical image processing and analysis.

Course-related learning outcomes

Knowledge:
1. Knows the basic mathematical methods including the methods of linear algebra and transforms used in the processing of medical images.
2. Has theoretically founded knowledge of imaging techniques, their applications and image processing methods obtained from imaging diagnostics systems.

3. Has basic knowledge of devices used in clinical practice and diagnostics for obtaining digital medical images.

Skills:
1. Is able to use mathematical methods and algorithms used in the processing of medical images.
2. Is able to obtain the necessary information from the literature and data from available IT systems supporting the processing of medical images.
3. Is able to use knowledge of medical imaging techniques and medical image processing to assess the suitability of medical data to solve complex engineering tasks.

Social competences:
1. Understands the need for lifelong learning; can organize the learning process.
2. Can properly set priorities for the implementation of a specific task.

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Learning outcomes presented above are verified as follows:
Lectures: written exam in the form of a multiple-choice test, which consists of closed questions and open questions along with solving tasks.
Computer laboratory: credit based on short quizzes and a final test. The final test, consisting of theoretical part (knowledge of commands in MATLAB in the context of image processing) and practical part on the computer
(individual tasks to be performed in MATLAB).
Assessment rules: assessment based on points obtained using a linear scale: 0 ÷ 49% points - 2.0, 50% ÷ 59% of points - 3.0, 60 ÷ 69% points - 3.5, 70 ÷ 79% points - 4.0, 80 ÷ 89% points - 4.5, 90 ÷ 100% points - 5.0.

Programme content

Lecture:
- Basic concepts, types of medical imaging.
- Mathematical foundations of medical imaging.
- Point transformations of images.
- Contextual transformations.
- Global transformations.
- Basics of computer image analysis.
- Examples of applications of pre-processing and analysis of digital medical images.

Computer laboratory:
1. Introduction to MATLAB and Image Processing Toolbox.
2. Image histogram and point operations on the image.
3. Morphological operations.
4. Linear filtering of images.
5. Fourier transform.
6. Elements of image segmentation based on the Hounsfield scale.
All operations on laboratories are performed on individual examples of X-rays, CT, MRI.

Course topics

Lecture:
1. Basic concepts: definition, characteristics and classification of images.
2. Types of medical imaging: X-ray, RM, CT and others.
3. Mathematical foundations of medical imaging: digital image, image acquisition: quantification and discretization, arithmetic operations on images.
4. Point transformations of images: thresholding, histogram.
5. Contextual transformations: definition of filters and filtration, high-pass and low-pass filters, edge filters, filters with logical conditions.
6. Global transformations: Fourier transform and discrete cosine transform.
7. Basics of computer image analysis, morphometric and quantitative parameters of objects.

8. Examples of applications of pre-processing and analysis of digital medical images.
Computer laboratory:
1. Introduction to MATLAB and Image Processing Toolbox.
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Teaching methods

1. Lecture: presentation illustrated with examples given on the board, problem solving.
2. Laboratory exercises: conducting experiments, discussion.

Bibliography

Basic
1. I. Bankman: Handbook of Medical Image Processing and Analysis, Elsevier, 2nd ed, 2009
2. J. Cytowski, J. Gielecki, A. Gola: Cyfrowe przetwarzanie obrazów medycznych, EXIT, 2008
3. W. Malina, M. Smiatacz: Cyfrowe przetwarzanie obrazów, EXIT, 2008
4. R. C. Gonzalez, R. E. Woods: Digital Image Processing, Prentice Hall; 3rd ed., 2007
5. W. Malina, S. Ablameyko, W. Pawlak: Podstawy cyfrowego przetwarzania obrazów, EXIT, 2002
6. M. Nałęcz, L. Chmielewski, J. L. Kulikowski., A. Mowakowski: Obrazowanie biomedyczne, EXIT, 2003
Additional
1. R. Tadeusiewicz, P. Korohoda: Komputerowa analiza i przetwarzanie obrazów, Wydawnictwo Fundacji Postępu Telekomunikacji, 1997
2. R. Tadeusiewicz, M. Flasiński: Rozpoznawanie obrazów, PWN, 1991
3. Z. Wróbel, R. Koprowski: Praktyka przetwarzania obrazów z zadaniami w programie Matlab, EXIT, 2008

Breakdown of average student's workload

	Hours	ECTS
Total workload	75	3,00
Classes requiring direct contact with the teacher	47	2,00
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	28	1,00