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[K_K01 +] 2. Understanding the necessity of broad popularization of the knowledge in the scope of simple and complex measuring	Socia	l competencies:					
			rprisingly in the area of measuring	systems to be used in indust	ry and biomedical engineering -		
			ity of broad popularization of the k	nowledge in the scope of sim	ple and complex measuring		

Assessment methods of study outcomes

Lectures:

- evaluation of the knowledge with a written exam related to the content of lectures (test, computational and problem questions), awarding marks in laboratory exercises)

- continuous estimation in all classes (awarding attendance in lectures, activity and quality of perception).

Laboratory exercises:

- continuous estimating with the tests,

- awarding the skill increase,

- the evaluation of knowledge and skills connected with the measuring tasks and prepared reports

Course description

Updating 2017:

Methods of education are orientated to students to motivate them to participate actively in education process by discussion and reports.

Lectures:

Multimedia presentations expanded by examples shown on a board. Activity of students is taken into consideration in final students evaluation. Theoretical questions are presented in the exact reference to the practice.

Laboratory:

Detailed reviewing of particular exercises reports. Realization of laboratory tasks in teams, taking into account the specific computational experiments covering:

- Measuring transducer with electrical output signal basic statical and dynamical properties.
- Measurement of electrical signals.
- Standard analog signals.
- Power supply of measuring transducers.
- Attenuation of electromagnetic disturbances.
- Determination of the coefficient of the processing of the transducer.
- Bridge sternal Measurement of the resistance by the use of a bridge circuit.
- Thermography.
- Laser and ultrasonic sensor of the distance.
- Examples of measuring transducers.

- Metrological attributes and testing of the selected equipment for measurements and recording used in physical and biophysical applications.

- Modern methods of imaging used in technology and medicine: thermovision, thermography, ultrasonography, computer tomography (CT), magnetic resonance (MRI), X-ray imaging (RTG), fiberoscopy and endoscopy.

- Devices for acquiring images with visible radiation (CMOS and CCD cameras).

- Configuration of vision systems for image acquisition with analog and digital cameras.
- Selecting the camera optical systems.
- Formats of graphical files and methods of data compression.
- Methods of image digital processing.

Basic bibliography:

1. Biocybernetyka i inżynieria biomedyczna, red. M. Nałęcz, Akademicka Oficyna Wyd. EXIT, Warszawa 2001-2002 S. Bolkowski Elektrotechnika, Wyd. Szkolne i Pedagogiczne, Warszawa 2009

- 2. A. Cysewska-Sobusiak, Podstawy metrologii i inżynierii pomiarowej, Wyd. Politechniki Poznańskiej, Poznań 2010
- 3. R. Jóźwicki, Technika laserowa i jej zastosowania, Oficyna Wyd. Politechniki Warszawskiej, Warszawa 2009
- 4. Z. Kaczmarek, Światłowodowe czujniki i przetworniki pomiarowe, Agenda Wydawnicza PAK, Warszawa 2006
- 5. M. Rząsa, B. Kiczma, Elektryczne i elektroniczne czujniki temperatury, WKŁ, Warszawa, 2005

6. J. Zakrzewski, Czujniki i przetworniki pomiarowe, Wyd. Politechniki Śląskiej, Gliwice 2004

Additional bibliography:

1. H. Madura, Pomiary termowizyjne w praktyce, Agenda Wyd. PAK, Warszawa, 2004

2. W. Malina, S. Ablameyko, W. Pawlak, Podstawy cyfrowego przetwarzania obrazów, Akademicka Oficyna Wyd. EXIT, Warszawa 2002

3. A. Michalski, S. Tumański, B. Żyła, Laboratorium miernictwa wielkości nieelektrycznych, Oficyna Wyd. Politechniki Warszawskiej, Warszawa 1996

4. J. Moczko, L. Kramer, Cyfrowe metody przetwarzania sygnałów biomedycznych, Wyd. UAM, Poznań 2001

Result of average stud	dent's workload			
Activity	Time (working hours)			
1. Participation in lectures		18		
2. Participation in laboratory exercises	27			
3. Participation in consulting with lecturers	5			
4. Preparation to laboratory exercises and preparation of the reports	41			
5. Preparation to the exam	33			
Student's workload				
Source of workload	hours	ECTS		
Total workload	124	5		
Contact hours	50	2		
Practical activities	68	3		