STUDY MODULE DESCRIPTION FORM

Name of the module/subject		Code
Sensor technology and imaging of objects		**1010321271010325952**

Field of study	Profile of study (general academic, practical)	Year /Semester
Electrical Engineering	**(brak)**	**4 / 7**
Elective path/specialty	Subject offered in:	Course (compulsory, elective)
Measurement Systems in Industry and	**polish**	**obligatory**

Cycle of study:	Form of study (full-time,part-time)
First-cycle studies	**full-time**

No. of hours					No. of credits
Lecture: **2**	Classes: **-**	Laboratory: **3**	Project/seminars: **-**		**8**

Status of the course in the study program (Basic, major, other)	(university-wide, from another field)
(brak)	**(brak)**

Education areas and fields of science and art	ECTS distribution (number and %)
technical sciences	**8 100%**
Technical sciences	**8 100%**

Responsible for subject / lecturer:

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Responsible for subject / lecturer:

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Prerequisites in terms of knowledge, skills and social competencies:

1	**Knowledge**	Basic knowledge in the scope of electrotechnics, electronics, and metrology. Basic knowledge in the scope of electronic analog systems and digital technique.
2	**Skills**	Ability of the efficient self-education in the area concerned with the sensor technology and object imaging
3	**Social competencies**	Awareness of the necessity of the competence broadening and ability to show the readiness to cooperate as a team

Assumptions and objectives of the course:

- Konwledge of interdisciplinary achievements in the area of application of sensors and measuring systems in industry, everyday life, and biomedical engineering.
- Knowledge of the modern systems to measure nonelectrical quantities, including the quantities to be measured in biophysical investigations.
- Knowledge of the modern techniques of the acquisition, processing and presentation of measurement data.

Study outcomes and reference to the educational results for a field of study

Knowledge:

1. Ability to characterize the importance and application possibilities of the modern measuring systems. - [K_W05 +, K_W14 +]
2. Ability to explain the principles and techniques of the measuring signals acquisition for applications in industry and biomedical engineering. - [K_W03 +]

Skills:

1. Ability to work independently and as a team in the design and construction companies, research laboratories, industrial centres, and medical facilities - [K_U05 +, K_U23 ++]

Social competencies:

1. Ability to think and act interprisingly in the area of measuring systems to be used in industry and biomedical engineering - [K_K01 +]
2. Understanding the necessity of broad popularization of the knowledge in the scope of simple and complex measuring systems - [K_K05 +]

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

- 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 student's workload

Activity	Time (working hours)
1. Participation in lectures	30
2. Participation in laboratory exercises	45
3. Participation in consulting with lecturers	35
4. Preparation to laboratory exercises and preparation of the reports	60
5. Preparation to the exam	43

Student's workload

Source of workload	hours	ECTS
Total workload	213	8
Contact hours	110	4
Practical activities	105	4