Z1-PU7	WYDANIE N1	Strona 1 z 4

(*faculty stamp*)

COURSE DESCRIPTION

1. Course title: **INDUSTRIAL MEASUREMENTS**	**2. Course code**
3. Validity of course description: 2016/2017	
4. Level of studies: BSc programme / ~~MSc programme~~	
5. Mode of studies: intramural studies	
6. Field of study: MACROCOURSE	(FACULTY SYMBOL) AEII
7. Profile of studies: general	
8. Programme: Automatic	
9. Semester: 6	
10. Faculty teaching the course: Institute of Automatic Control, Rau1	
11. Course instructor: dr inż. Andrzej Kozyra	
12. Course classification: programme courses	
13. Course status: ~~compulsory~~ /elective	
14. Language of instruction: English	
15. Pre-requisite qualifications: Physics, Mathematics, Fundamentals Metrology, Measurement Systems	
16. Course objectives: To acquaint students with industrial measurements problems on the base of chosen values (e.g. flowrate, level, pH, conductivity), expressing of metrological properties, uncertainty calculations and usage of industrial networks (for example - Profibus) for communication and data processing.	

17. Description of learning outcomes:

Nr	Learning outcomes description	Method of assessment	Teaching methods	Learning outcomes reference code
1.	She/He knows based on the selected examples, what may be the requirements for the measurement system to ensure proper process control.	SP, CL, PS, OS	WT, L	K_W07 K_W22 K_K01
2.	She/He has knowledge of construction, operating principles, limitations of fluid flow measurement, level measurement, ion-selective measurement and measurement of gas concentrations.	SP, CL, PS, OS	WM, L	K_W18 K_U14
3.	He knows risk associated with industrial processes that use ionizing radiation. He has basic knowledge of radiological protection. He is aware of the risks associated with working in explosive atmospheres.	SP	WM	K_W22 K_U25 K_U26
4.	Can design and set up a simple measuring system and estimate sources of uncertainty.	CL, PS, OS	WT, L	K_W07 K_U07 K_U14 K_K03
5.	He is able to estimate the uncertainty of the measurement taking into account both the errors estimated by statistical methods (type A) and other methods (type B) and to take into account the correlation between measurement results.	SP, CL, PS, OS	WT, L	K_W07 K_U07

6.	She/He has the ability to select a measuring instrument for specific measurement conditions, such as a flow meter or a level meter, paying attention to the type of medium, thermal and pressure conditions, and the accuracy requirements of both the normal instrument and the normal deviation.	CL, PS, OS	WT, L	K_W07 K_U14
7.	It is able to collaborate in a group while performing measurements, taking different roles: the planner, the coordinator, the person performing measurements, the report maker.	CL, PS, OS	L	K_U02 K_U03 K_U05 K_K03
8.	He is aware of the need to take into account the measurement conditions for various industrial objects and the ability to choose the apparatus.	CL, PS, OS	WT, L	K_W07 K_W18 K_U03
	He understands the need to distinguish between different measures of measured quantity and the use of various physical phenomena to build a measurement system that allows required selectivity.	SP, CL, PS, OS	WT, L	K_W07 K_W18 K_U03 K_U26

18. Teaching modes and hours

Lecture / BA /MA Seminar / Class / Project / Laboratory

Sem 5 - 30 h., Sem 6 - 30 h

19. Syllabus description:

Semester 5 :

Lectures

Introduction to industrial measurements. Evaluation of measuring instruments for steel works process – as an example of typical difficulties in measuring and controlling industrial process.
Practical advices and recommendations for one who can control a process.
Calculation and treatment of measurement errors: classification of errors, uncertainty, statistics in measurement, calculation of measurement error for no correlated and correlated values. Accuracy rating. Linearity (independent, terminal-based, zero-based).

Flowmeters: role of the sensor in flow measurement, classification of flowmeter sensors, full-bore and sampling flowmeters, mathematical models of flowmeter primary device for various sensors (point, surface, segment, whole flow area).
Level measurement: classification of level measurement techniques, mechanical based level measurement, ultrasonic level sensors, nucleonic in level measurement.
Measuring instruments selection and evaluation on the example of flowmeter or level selection procedure.
Ionselective (ISE) measurements, pH measurements and conductivity measurements: concentration measures, dissociation, membrane potential, Nernst equation, potentiometric measuring circuit, ISE electrode; reference electrode;
Troubleshooting checklist for potentiometric measurements; limit of detection; interference ions; Nikolsky-Eisnemnan equation;
Measurement methods: direct potentiometry, know addition methods, flow injection analysis, titration; industrial and medical applications).
Modbus and HART overview: the main advantages and disadvantages of fieldbus system, the Modbus family applicable at all levels of automation, Modbus protocol, operation including device addressing, station types and network configuration. HART protocol principles.

Laboratories

1. Level measurements
Students will familiarize with level measuring techniques. There are two level transducers on the stand: FMD78 (the differential pressure transducer which can be programmed to level measurement mode) and FMP40 (the guided
level radar). During laboratory students learn how to configure industrial level transducers. Students perform also different calibration procedures, check advantages and disadvantages of both level measurements methods.

2. Open channel flow measurements
Exercise is made on the open channel flow measurement laboratory stand.
On this stand ultrasonic level meter is investigated. Students will learn about flow measurement with help of weirs and methods of HART communication and programming smart sensor.

3. Conductometry
Students learn about conductivity measurements. The ABB 4620 Industrial Conductivity Transsmiter is used during laboratory.
Students make some conductivity standards and measurements for standards and samples in different conditions. Perform analysis of measurements and uncertainty of measurements.

4. Modbus
Students task is to build up the software in LabVIEW via Modbus RS-485 for: enumerating measured value, execute several measurements on line, estimating the response time of measuring device. Student learn how to configure connection with devices, how to test bus connection.

5. HART
During laboratory students get acquaint with fundamental features of HART technology. Students use example of industrial HART intelligent transmitter to learn how to configure transmitter with the assistance of HART protocol and dedicated configuration software. Students learn how to create commissioning documentation - configuration control – element of meeting ISO9000 requirements.

6. Ion-selective measurements
Students get acquaint with ionselective measurement techniques: direct potentiometry, know addition methods and automatic determination of ionselective electrode's parameters. Students using laboratory Orion 930 Ionanalizer learn how automatic laboratory measurements can be performed in industry.

20. Examination: NO. The test after the lectures, completion laboratory exercises.

21. Primary sources:

1. Instrument Engineers' Handbook, Process Measurement and Analysis, Vol. I, Lipták B. G. Editor-in-chief, ISA-The Instrumentation, Systems, and Automation Society, CRC Press, Boca Raton London New York Washington, D.C. 2003.

22. Secondary sources:

1. De Carlo J.P: Fundamentals of flow measurement, Instrument Society of America, Research Triangle Park, 1984.
2. EN 61298-2 Process measurement and control device – General methods and procedure for evaluating performance Part 2: Test under reference conditions (IEC 1298-2: 1995).
3. Flow Handbook. A Practical Guide: Measurement Technologies – Applications – Solutions, Endress+Hauser Flowtec AG, CH-4153 Reinach/BL, 2004.
4. Guide to the Expression of Uncertainty in Measurement, International Organization for Standardization, 1993.
5. http://www.profibus.com
6. Mc Ghee J., Korczyński M.J., Henderson I.A., Kulesza W.: Scientific Metrology, Technical University of Łódź, Łódź 1996, ISBN 83-904299-9-3
7. Waluś S.: The Mathematical Modelling of Flowmeter Sensors, Akustyka Molekularna i Kwantowa, tom 19, Oddział Górnośląski PTA, Instytut Fizyki Politechniki Śląskiej, Sekcja Akustyki Molekularnej i Kwantowej PTA, Sekcja Akustyki Fizycznej Komitetu Akustyki PAN, Gliwice 1996, s. 275-286.

23. Total workload required to achieve learning outcomes

Lp.	Teaching mode :	Contact hours / Student workload hours
1	Lecture	15/10
2	Classes	0/0
3	Laboratory	15/15
4	Project	0/0
5	BA/ MA Seminar	0/0
6	Other	0/0
	Total number of hours	30/25

24. Total hours:55

25. Number of ECTS credits: 2

26. Number of ECTS credits allocated for contact hours: 2

27. Number of ECTS credits allocated for in-practice hours (laboratory classes, projects):1

26. Comments:

Approved:

…………………………….
(date, Instructor's signature)

…………………………………………………
(*date , the Director of the Faculty Unit signature)*