(*faculty stamp*)

COURSE DESCRIPTION

1. Course title: INDUSTRIAL MEASUREMENTS	**2. Course code**
3. Validity of course description: 2012/2013	
4. Level of studies: BA, BSc programme (1st cycle of higher education)	
5. Mode of studies: intramural studies	
6. Field of study: MAKROKIERUNEK	(FACULTY SYMBOL)
7. Profile of studies:	
8. Programme:	
9. Semester: 6	
10. Faculty teaching the course: Rau1	
11. Course instructor: Prof. Stanislaw Waluś	
12. Course classification:	
13. Course status: elective	
14. Language of instruction: English	
15. Pre-requisite qualifications: Physics, Mathematics, Fundamentals Metrology, Measurement Systems	
16. Course objectives: To acquaint the students with industrial measurements on the base of chosen values (flowrate, level, pH, conductivity), expressing of metrological properties, uncertainty calculations and using buses (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.	Students know demands for measuring system on the example of blast furnace process in purpose the proper measurement.	Colloquium	Lecture	
2.	They have knowledge In the scope of principle operation, construction and measurements of flow-rate with help various flow meters and know mathematical modeling of flow meters primary devices.	Colloquium	Lecture	
3.	Students know principles of operations of some level meters, influence values and possibilities of using in various measuring conditions.	Colloquium	Lecture	
4.	They have knowledge about ion selective measurement techniques in industry as well in medicine. They know how to use isotope radiation in industrial measurements and rules of radiation protection.	Colloquium	Lecture	
5.	Student know how to set up the simple measuring system on the base of Profibus system. They can estimate some errors resulting of influence quantities.	Colloquium	Lecture	
6.	They can estimate of uncertainty of measurement analyzing random errors (type A uncertainty) and with other methods (type B uncertainty) and know how to take account the correlation of measuring results.	Colloquium	Lecture	

7.	The students know how to choose measuring device in concrete conditions on the ex ample of choosing flow meter (on the base of medium, temperature, pressure, technical conditions and uncertainty demands – for normal conditions and in the situation, when the velocity distribution is not axisymmetric).	Colloquium	Lecture	
8.	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.	Exercise in Lab, Report	Laboratory	
9.	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 communication and programming smart sensor.	Exercise in Lab, Report	Laboratory	
10.	3. Conductometry Students learn about conductivity measurements. The ABB 4620 Industrial Conductivity Transmitter is used during laboratory. Students make some measurements for conductivity standards and samples and perform analysis of measurements and uncertainty of measurements.	Exercise in Lab, Report	Laboratory	
11.	4. Profibus Students task is to build up the software in LabVIEW via PROFIBUS RS-485 for: enumerating measured value, execute several measurements on line, estimating the response time of measuring device, warning banner after crossing alarm value of methane concentration in air, growth of concentration of carbon dioxide, fall of oxygen concentration, etc.	Exercise in Lab, Report	Laboratory	
12.	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.	Exercise in Lab, Report	Laboratory	
13.	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 in industry automatic laboratory measurements can be performed.	Exercise in Lab, Report	Laboratory	

18. Teaching modes and hours

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

Sem 6 - 15 h., Sem 6 - 15 h

19. Syllabus description:

Semester 6:

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

20. Examination: Colloquium at the end of the semester 6 from lecture and passing all of six laboratory reports

21. Primary sources:

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:

De Carlo J.P: Fundamentals of flow measurement, Instrument Society of America, Research Triangle Park, 1984.
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).
Flow Handbook. A Practical Guide: Measurement Technologies – Applications – Solutions, Endress+Hauser Flowtec AG, CH-4153 Reinach/BL, 2004.
Guide to the Expression of Uncertainty in Measurement, International Organization for Standardization, 1993.
http://www.profibus.com
Mc Ghee J., Korczyński M.J., Henderson I.A., Kulesza W.: Scientific Metrology,
Technical University of Łódź, Łódź 1996, ISBN 83-904299-9-3
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	15/5
2	Classes	0/0
3	Laboratory	15/20
4	Project	0/0
5	BA/ MA Seminar	0/0
6	Other	0/0
	Total number of hours	15/20

24. Total hours: 55

25. Number of ECTS credits: 2

26. Number of ECTS credits allocated for contact hours: 1

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

26. Comments:

Approved:

17th Jan. 2013 ……. ……
(date, Instructor's signature) (*date , the Director of the Faculty Unit signature)*