

(faculty stamp)

## COURSE DESCRIPTION

Z1-PU7

WYDANIE N1

Strona 1 z 1

<b>1. Course title: MEASUREMENTS OF ENERGY QUANTITIES</b>		<b>2. Course code</b>		
<b>3. Validity of course description: 2017/2018</b>				
<b>4. Level of studies: BA, BSc programme / MA, MSc programme or 1<sup>st</sup> cycle / 2<sup>nd</sup> cycle of higher education</b>				
<b>5. Mode of studies: <u>intramural studies</u> / extramural studies</b>				
<b>6. Field of study: POWER ENGINEERING</b>		<b>(FACULTY SYMBOL) RIE</b>		
<b>7. Profile of studies: academic</b>				
<b>8. Programme: PROCESSES AND ENERGY SYSTEMS</b>				
<b>9. Semester: 5</b>				
<b>10. Faculty teaching the course: Institute of Power Engineering and Turbomachinery</b>				
<b>11. Course instructor: dr inż. Daniel Węcel</b>				
<b>12. Course classification: specialty subjects</b>				
<b>13. Course status: <u>compulsory</u> / elective</b>				
<b>14. Language of instruction: English</b>				
<b>15. Pre-requisite qualifications: Fundamentals of metrology and experimental techniques, Fluid Mechanics, Thermodynamics</b>				
<b>16. Course objectives: Introducing students the methods of measuring the energy quantities, measurement devices and conditions of use. Develop the skills of basic energy measurement on the laboratory and determination the results of indirect measurements.</b>				
<b>17. Description of learning outcomes:</b>				
Nr	Learning outcomes description	Method of assessment	Teaching methods	Learning outcomes reference code
1.	Describes how to measure the energy quantities.	Final test	Lecture	K_W14
2.	Lists the types of measuring instruments used to measure: temperature, pressure, flow rate, humidity, power.	Final test	Lecture	K_W14
3.	List the main measuring transducers and output ranges of standard analog signals.	Final test	Lecture	K_W14
4.	Define the metrological terms	Final test	Lecture	K_W14
5.	Explain the principle of operation: resistance thermometers, thermocouples, differential pressure flow meters, psychrometers.	Final test	Lecture	K_W14
6.	He uses instruments to measure the energy quantities and continuously verifies obtained results.	Oral answer at the laboratory	Laboratory	K_W14
7.	Performs the calculation of measured values and prepare a report of the laboratory exercises.	Report	Laboratory	K_W14
8.				
<b>18. Teaching modes and hours</b>				
<b>15 Lecture / BA / MA Seminar / Class / Project / 30 Laboratory</b>				
<b>19. Syllabus description:</b>				
<b>Lecture:</b>				
Classification of measurements. The measuring process, uncertainties and errors. Measuring instruments and they construction. Measurement methods. Parameters characterizing the measured physical quantities. Measuring transducers and their properties. Measurement of energy quantities: temperature, level, flow rate, mechanical power, concentration and chemical composition of the substance, heating value, relative humidity.				
<b>Laboratory:</b>				
Laboratory exercises with the following topics::				
1. Power measurement		4. Chemical composition of the flue gas		7. Measurements of signal parameters

2. Water flow rate measurement	5. Heating value measurement	8. Measurement and standard transducers
3. Humidity measurement	6. Techniques for temperature measurement	9. Serial bus (RS, Profibus)
10. Air flow rate measurement		

**20. Examination: no**

**21. Primary sources:**

- Praca zbiorowa: Pomiary cieplne cz. I i II, WNT W-wa 2001
- Alexius J. Hebra: The Physics of Metrology. All about Instruments: From Trundle Wheels to Atomic Clocks. SpringerWienNewYork 2010
- Alexander von Beckerath, Anselm Eberlein, Hermann Julien, Peter Kersten, Jochem Kreutzer: WIKA-Handbook Pressure and Temperature Measurement. Germany 2008
- Zakrzewski Jan : Czujniki i przetworniki pomiarowe, Wyd.Pol.Śl., G-ce 2004
- Miłek Marian: Metrologia elektryczna wielkości nieelektrycznych, Oficyna Wydawnicza Uniwersytetu Zielonogórskiego, Zielona Góra 2006

**22. Secondary sources:**

- Chwaleba A., Poniński M., Siedlecki A.: Metrologia elektryczna, WNT W-wa 1996
- Praca zbiorowa: Wyrażanie niepewności pomiaru. Przewodnik. Główny Urząd Miar – W-wa, 1999
- Sydenham H.: Podręcznik metrologii cz.I i II, Wyd. Komunikacji i Łączności, W-wa 1988
- Łapiński Marian, Włodarski Wojciech: Miernictwo elektryczne wielkości nieelektrycznych, Czujniki pomiarowe. WNT, Warszawa 1970
- Frączek Jerzy: Laboratorium miernictwa przemysłowego wielkości nieelektrycznych. Skrypt 1226 Gliwice 1985

**23. Total workload required to achieve learning outcomes**

Lp.	Teaching mode :	Contact hours / Student workload hours
1	Lecture	15/10
2	Classes	/
3	Laboratory	30/25
4	Project	/
5	BA/ MA Seminar	/
6	Other	10/
	Total number of hours	55/35

**24. Total hours: 90**

**25. Number of ECTS credits: 3**

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

**27. Number of ECTS credits allocated for in-practice hours (laboratory classes, projects): 2**

**26. Comments:**

Approved:

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(date, Instructor's signature)

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(date , the Director of the Faculty Unit signature)