



## COURSE DESCRIPTION CARD - SYLLABUS

Course name

Heat and fluid flow measurements

### Course

Field of study

Industrial and Renewable Energy

Area of study (specialization)

Thermal Engineering and Renewable Energy

Level of study

Second-cycle studies

Form of study

part-time

Year/Semester

1/1

Profile of study

general academic

Course offered in

Polish

Requirements

compulsory

### Number of hours

Lecture

9

Tutorials

Laboratory classes

9

Projects/seminars

9

Other (e.g. online)

### Number of credit points

3

### Lecturers

Responsible for the course/lecturer:

Dr inż Robert Kłosowiak

Responsible for the course/lecturer:

Email : robert.klosowiak@put.poznan.pl

Faculty of Environmental Engineering and Energetic

ul. Piotrowo 3, 60-965 Poznań

### Prerequisites

The student has a basic knowledge of thermodynamics and fluid mechanics. Has knowledge of physics in relation to the basic phenomena used in measurement



### Course objective

Acquaintance with the latest measuring technologies. Discussion of the measuring point issues. Teaching how to carry out measurements of thermodynamic quantities and error analysis of these measurements. The student has a basic knowledge of thermodynamics and fluid mechanics. Has knowledge of physics in relation to the basic phenomena used in the measurement. The student is able to cooperate in a group, taking on different roles in it to solve the tasks set before him. The student demonstrates independence in solving problems, acquiring and improving acquired knowledge and skills.

### Course-related learning outcomes

#### Knowledge

Has knowledge of the latest constructions of measuring machines and devices used in the energy industry

Knows and understands the fundamental aspects related to the design, construction, implementation and maintenance of control and measurement systems in industrial energy.

Has knowledge of the negative impact of energy technologies on the environment

#### Skills

Is able to design - in accordance with the given specification - and make simple devices, objects, systems or implement processes for industrial and renewable energy, using appropriately selected research methods, measuring techniques, tools and materials.

Is able to solve research and engineering tasks requiring the use of engineering standards and norms and the use of measurement technologies appropriate for industrial and renewable energy, using experience gained in an environment professionally engaged in engineering activities.

Is able to use the experience gained in the construction of control and measurement systems related to the maintenance of devices, facilities and systems of industrial and renewable energy

#### Social competences

Student is ready to critically assess knowledge and received information

Student is ready to recognize the importance of knowledge in solving cognitive and practical problems and to seek expert opinions in case of difficulties in solving the problems

Student is ready to think and act in an entrepreneurial way

### Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Written exam from the lecture, minimum to pass – 51% of total available points

passing the project and laboratory



## Programme content

Error analysis, ways of presenting results, ways of preparing research reports. Basic physical phenomena on which modern measuring systems used in industry are based. Analysis of measuring tracks adapted to the testing of heat-flow machines occurring in thermal energy. The principles of balancing and determining the efficiency (effectiveness) of heat and flow machines.

## Teaching methods

lecture

## Bibliography

Basic

Pomiary cieplne. Praca zbiorowa pod redakcją prof. dr inż. Tadeusza R. Fodemskiego. WNT Warszawa 2001.

J. Wojciechowski, Pomiary w elektrowniach cieplnych, PWT, Warszawa 1958.

K. Bakinowska, Pomiary cieplne, cz. I, WNT, Warszawa 1995

W. Minkina, Pomiary termowizyjne : przyrządy i metody; Politechnika Częstochowska, 2004

H. Madura, Pomiary termowizyjne w praktyce , Agenda Wydawnicza PAKu, Warszawa, 2004

Additional

Pomiary temperatury w badaniach silników i urządzeń cieplnych. Stefan Wiśniewski. WNT Warszawa 1983

W. Kołodziejczyk, Pomiary zużycia ciepła w budynkach, Centralny Ośrodek Informacji Budownictwa, Warszawa, 1993

W. Minkina, S. Chudzik ,Pomiary parametrów cieplnych materiałów termoizolacyjnych : przyrządy i metody; Politechnika Częstochowska, 2004

## Breakdown of average student's workload

	Hours	ECTS
Total workload	90	3,0
Classes requiring direct contact with the teacher	30	1,0
Student's own work (literature studies, preparation for laboratory classes/tutorials, preparation for tests/exam, project preparation) <sup>1</sup>	60	2,0

<sup>1</sup> delete or add other activities as appropriate