COURSE DESCRIPTION CARD - SYLLABUS

Course name
Thermal measurement [S1Energ2>MC]

Course

Field of study
Power Engineering

Year/Semester
3/6

Area of study (specialization)
–

Profile of study
general academic

Level of study
first-cycle

Course offered in
Polish

Form of study
full-time

Requirements
elective

Number of hours

Lecture
15

Laboratory classes
15

Other
0

Tutorials
0

Projects/seminars
15

Number of credit points

3,00

Coordinators

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Lecturers

Prerequisites

- Knowledge of the thermodynamics, fluid mechanics - Basic knowledge of the basics of temperature and pressure measurement - The student should also be able to obtain information from specified sources and be willing to cooperate as part of a team.

Course objective

Acquainting with measuring instruments of basic physical quantities in thermal energy. Elements of mathematical statistics, theory of measurement errors in relation to measuring systems in energy systems. This applies to devices such as boilers, turbines, compressors, heat exchangers.

Course-related learning outcomes

Knowledge:
1. Has structured knowledge of the basics of thermodynamic technological processes in the energy industry, knows and understands the construction, principles of operation, use and design of thermal devices (including specialized ones)
2. Has structured knowledge of the theory of thermodynamic cycles and flow machines, knows and understands the connections between theoretical issues and real objects, knows and understands the

need to use standardized symbols in engineering graphics
3. Has systematic knowledge of the basics of control and automation of technological processes in the energy sector; understands the problems of stability in dynamic systems and knows the methods of their description.

Skills:
1. Is able to develop documentation regarding the implementation of an engineering task using appropriate methods and tools, including advanced information and communication techniques (ICT); is able to prepare a text discussing the results of this task.
2. Is able to use properly selected methods and devices enabling measurement of basic quantities characterizing energy elements and systems.
3. Is able to use known analytical, simulation and experimental methods and mathematical models to analyze and evaluate the operation of energy elements and systems.

Social competences:
1. Understands the need and knows the possibilities of continuous training, raising professional, personal and social competences (e.g. through second and third cycle studies, postgraduate studies, courses); and is ready to critically assess knowledge, recognizes its importance in solving cognitive and practical problems.

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

The knowledge acquired during the lecture is verified by a written final exam consisting of 5 questions scored differently depending on their level of difficulty. After the written part, there will be a short oral part. Passing threshold: 60% of points. Assessment issues, on the basis of which questions are developed, will be sent to students by e-mail using the university e-mail system.
The skills acquired during laboratory classes are verified on the basis of a short entrance test and reports from classes. Passing threshold: 60% of points, with all laboratory exercises must be passed with a minimum grade of 3.0. The issues are first discussed on the board and then carried out in groups - practical exercises.
In the initial part of design classes, issues are first discussed on the board and then carried out in groups - practical exercises. The skills acquired during project classes are verified on the basis of short presentations during the semester, questions from the teacher and on the basis of the final project. Passing threshold: 60% of points.

Programme content

Types and ranges of measurements in the energy sector. Classification of instruments and measuring methods. Types of measuring instruments used. Construction and operation of the most commonly used instruments. Pressure, temperature, volumetric and mass flow measurements. Selection of measuring instruments, methods of mounting measuring sensors. Measuring transducers - classification, principle of operation, selection methods, measuring systems. Fundamentals of error account and processing of measurement results. Tests of selected power devices - pump, fan.

Course topics

Types and ranges of measurements in the energy sector. Classification of instruments and measuring methods. Types of measuring instruments used. Construction and operation of the most commonly used instruments. Pressure, temperature, volumetric and mass flow measurements. Selection of measuring instruments, methods of mounting measuring sensors. Measuring transducers - classification, principle of operation, selection methods, measuring systems. Fundamentals of error account and processing of measurement results. Tests of selected power devices - pump, fan.

Teaching methods

1. Lecture: blackboard with multimedia presentation.
2. Laboratory classes: discussing the theory and assumptions for classes on the board and performing tasks given by the teacher.
3. Design classes: discussing theory and assumptions for classes on the board and performing tasks given by the teacher, independent work on the design task.

Bibliography

Basic:
Fodemski T.R. i inni: Pomiary cieplne, cz. I i II, WNT, Warszawa 2001.
Kulesza J. i inni: Pomiary cieplne, cz. I i II, WNT, Warszawa 1993.
Jaworski J. i inni: Wstęp do metrologii i techniki eksperymentu, WNT, Warszawa, 1992.

Additional:
PN-93/M-53950/01
Heat Transfer Analysis of 3D Printed Wax Injection Mold Used in Investment Casting / Bartłomiej Burlaga (WIM), Arkadiusz Kroma (WIM), Przemysław Poszwa (WIM), Robert Kłosowiak (WIŚiE), Paweł Popielarski (WIM), Tomasz Stręk (WIM) // Materials - 2022, vol. 15, iss. 19, s. 6545-1-6545-25
Portable Heat Pump Testing Device / Robert Kłosowiak (WMRiT), Jarosław Bartoszewicz (WMRiT), Rafał Urbaniak (WMRiT) // International Journal of Applied Mechanics and Engineering - 2015, vol. 20, no. 3, s. 657-662

Breakdown of average student's workload

	Hours	ECTS
Total workload	75	3,00
Classes requiring direct contact with the teacher	45	2,00
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	30	1,00