COURSE DESCRIPTION CARD - SYLLABUS

Course name

Audyting and Energy Management

Course

Field of study

Environmental Engineering Second-cycle Studies

Year/Semester

1/2

Area of study (specialization)

Heating, Air Conditioning and Air Protection

Profile of study

general academic

Level of study

Second-cycle studies

Course offered in

polish

Form of study

full-time

Requirements

compulsory

Number of hours

Lecture

30

Laboratory classes

Other (e.g. online)

Tutorials

15

Projects/seminars

Number of credit points

3

Lecturers

Responsible for the course/lecturer:

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Faculty of Environmental Engineering and Energy

ul. Berdychowo 4, 61-131 Poznań

Responsible for the course/lecturer:

Prerequisites

1.Knowledge:

Classification of renewable and non-renewable primary energy sources, evaluation of energy capacity of demand and supply side of energy market; ,

Principles of energy balancing, economic and ecological evaluation of energy systems in built environment.

2.Skills :

Application of energy balance equation in evaluation of energy systems in built environment;

Calculation of coefficients of energy, economic and ecolgic efficiency of energy systems in built environment;

3.Social competencies:

Awareness of the need to constantly update and supplement knowledge and skills.

Course objective

Widening by the students the knowledge and skills in energy management necessary to solve complex tasks of energy flows occurring in the built and natural environment

Course-related learning outcomes

Knowledge

1. The student has a theoretical and practical knowledge on the energy and energy balancing of complex energy systems in built environment

2. The student knows and understands the causes of irreversibility of real energy systems in built environment

3. The student knows principles of reducing the causes of irreversibility of real energy systems in built environment

4. The student knows dynamic methods of economic evaluation in energy management

5. The student knows the principles of energy auditing of buildings and technical equipment of buildings and knows the principles of multicriteria evaluation of energy systems in built environment

Skills

1. The student can construct evaluation model and energy and exergy balance equations for simple and complex energy systems in built environment

2. The student can calculate energy efficiency of simple and complex energy systems used in built environment

3. The student can calculate exergy efficiency and identify causes of irreversibility of simple and complex energy systems used in built environment

4. The student can calculate net present value (NPV) and internal rate of return (IRR) for elements and energy systems used in built environment

5. The student is able to choose on the basis of multicriteria analysis the recommended scenario of energy management in built environment

Social competences

1. The student understands the need for teamwork in solving theoretical and practical problems

2. The student is aware of the need to sustainable development in energy management

3. The student sees the need for systematic increasing his skills and competences]

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Lectures

Written test of competences (10 questions based on case study calculations)

Continuous assessment during lectures (rewarding activity of the students).

Tutorials

Final written colloquium - 3 examples on energy, exergy and economic analysis

Continuous assessment of the students (rewarding students activity

Programme content

Lectures:

Basic knowledge on auditing and energy management: definition of energy management, non-renewable primary energy sources, renewable primary energy sources, upgraded fuels, energy chain, gross and net energy efficiency, coefficient of non-renewable primary energy consumption, coefficient of carbon dioxide emission.

Principles of energy balancing of simple and complex energy systems in built environment, calculation of energy efficiency of complex energy systems in built environment;

Irreversibility of real thermodynamic processes. Gouya-Stodoli Law; the causes of irreversibility of real thermodynamic processes; exergy balance of thermodynamically open system; physical and chemical exergy of substance; exergy efficiency of thermodynamically open system; the measures of limitation of irreversibility of real thermodynamic processes;

Static and dynamic methods of economical evaluation of energy systems in built environment: simple payback time (SPBT), net present value (NPV), internal rate of return (IRR), total operation cost (TOC);

Principles of energy auditing: evaluation of energy use in buildings and technical systems of buildings; identification of technically acceptable scenarios of building?s retrofitting process, evaluation of chosen scenarios using energy, economy and ecological criteria;

Multicriteria methods in evaluation of energy projects in built environment: weighted sum method, outranking method (ELECTRE III/IV);

Tutorials:

1. Energy balancing of complex energy systems in built environment

2. Exergy balancing of complex energy systems in built environment

3. Calculation of economic efficiency of Energy systems in built environment

4. Multicriteria evaluation of energy systems in built environment

Teaching methods

Lecture: lecture based on a multimedia presentation, interactive analysis of case studies, discussion

Tutorials: interactive solving of computational examples

Bibliography

Basic

1. Szargut J., Ziębik A.: Termodynamika techniczna. Warszawa, WNT 2001.

2. Marecki J.: Podstawy przemian energetycznych. Warszawa, WNT 2000.

3. Chmielniak T: Technologie energetyczne. Warszawa, WNT 2008.

4. Szargut J., Guzik J.: Programowany zbiór zadań z termodynamiki technicznej. Warszawa, WNT 1980.

5. Rocznik statystyczny Rzeczpospolitej Polskiej 2010. Warszawa, ZWS 2011.

6. Mróz, T.M.: Planowanie modernizacji i rozwoju komunalnych systemów zaopatrzenia w ciepło. Wydawnictwo Politechniki Poznańskiej, seria rozprawy Nr 400, 2006.

7. Mróz, T.M.: Energy Management in Built Environment. Tools and Evaluation Procedures. Wydawnictwo Politechniki Poznańskiej, 2013.

Additional

1. Kreith, F., West, R.E.: CRC Handbook of Energy Efficiency. CRC Press Inc. 1997

Breakdown of average student's workload

	Hours	ECTS
Total workload	75	3,0
Classes requiring direct contact with the teacher	45	2,0
Student's own work (literature studies, preparation for /tutorials, preparation for tests/exam) [1]	30	1,0

[1] delete or add other activities as appropriate