STUDY MODULE DESCRIPTION FORM

Name of the module/subject **Heating**		Code **1010101241010130187**
Field of study **Environmental Engineering First-cycle Studies**	Profile of study (general academic, practical) **general academic**	Year /Semester **2 / 4**
Elective path/specialty **-**	Subject offered in: **Polish**	Course (compulsory, elective) **obligatory**
Cycle of study: **First-cycle studies**	Form of study (full-time,part-time) **full-time**	
No. of hours Lecture: **45** Classes: **15** Laboratory: **-** Project/seminars: **30**		No. of credits **7**
Status of the course in the study program (Basic, major, other) **other**	(university-wide, from another field) **university-wide**	
Education areas and fields of science and art **technical sciences** **Technical sciences**		ECTS distribution (number and %) **7 100%** **7 100%**

Responsible for subject / lecturer:

prof. dr hab. inż. Halina Koczyk
email: halina.koczyk@put.poznan.pl
tel. (61) 6652532
Faculty of Civil and Environmental Engineering
ul. Piotrowo 5 60-965 Poznań

Prerequisites in terms of knowledge, skills and social competencies:

1	**Knowledge**	The student has knowledge in the following areas: mathematics, building physics, basics of thermal engineering and fluid mechanics, needed to formulate and solve simple tasks. The student is familiar with applicable building envelopes solutions.
2	**Skills**	The student is able to solve the problems of fluid mechanics and thermal engineering, and can draw and read construction drawings.
3	**Social competencies**	The student is aware of the need to constantly update and supplement knowledge and skills.

Assumptions and objectives of the course:

Acquiring by students basic knowledge and skills in the scope of the basics of water heating design.

Study outcomes and reference to the educational results for a field of study

Knowledge:

1. The student has theoretically underpinned, organized general knowledge of issues related to the installation of central heating. - [-]
2. The student has knowledge of thermal parameters of the internal environment associated with heating systems. - [-]
3. The student knows the basic solutions of heating installations of buildings and their components. - [-]
4. The student has structured knowledge on the developments in the field of heating systems. - [-]
5. The student knows the requirements for thermal protection and energy ratings of heating systems as well as the building regulations related to heating systems. - [-]
6. The student has the knowlegde of the calculation of heat transfer coefficients for building envelopes, designed heat load for individual rooms and the building, selection of radiators and protection of the system. - [-]
7. The student knows the calculation methods, design techniques, tools and materials used in solving engineering tasks related to heating systems design. - [-]
8. The student knows and understands the flow phenomena occurring in gravity circulation and pump circulation heating systems. - [-]
9. The student has knowledge of hydraulic calculations of water heating installations, including the determination of circulation pressure, pressure losses in circuits and installation characteristics. - [-]

Skills:

1. The student can propose a concept solution for the heating system in a small building with a single utility function as well as a developed view of central heating system. He is able to use and convert units of physical quantities used in fluid mechanics. - [-]

2. The student can calculate the designed heat load for individual rooms and the buildingas well as assess the heating, ventilation and hot water systems in terms of energy use. - [-]

3. The student can design a central heating installation, configure a small heat source for the purposes of heating and hot water systems and justify the choice of individual components in terms of computation. - [-]

Social competencies:

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

2. The student is aware of the importance and understand the non-technical consequences of engineering activities, including the impact on the environment. - [-]

3. The student sees the need for extending their competence systematically. - [-]

Assessment methods of study outcomes

Lectures

Written examination followed, in case of doubt, by an oral examination.

Final evaluation of the exam takes into account the result of the test and grades earned for the recitation and design exercises

Recitation classes

? are credited on the basis of successful completion of the final test tasks.

Class Projects

? are credited on the basis of the project design of the heating system for a small building made in traditional technique and an oral defence of the project.

Course description

Factors of external climate and their effect on the heat balance of the building. Thermal comfort. The external climate factors and their impact on the building energy balance. Calculation of heat and moisture transfer for building envelopes. Thermal protection requirements according to building regulations. Calculations of heat transfer coefficients for the envelopes consisting of homogeneous and heterogenous layers. Thermal bridges, their effects and how they can be included in the design calculations. The heat balance of buildings under design conditions and during the heating season. Calculations of the design heat load. Calculations of the energy needs, delivered energy and primary energy for heating, ventilation and domestic hot water purposes - basic computational methodology based on energy certificates. Tasks and classification of heating systems. Schemes of modern heating solutions for housing levels. Expansion facilities in heating systems. Diagrams of solutions of the levels of housing in modern hesting systems. Protection of heating systems (diagrams and calculation formulas).Principles of pipe dimensioning in water heating. Circulation pressure. Pressure losses of circuits. The definition of pipe section and circuit. Heat sources. Principles of design, selection of boilers and requirements for small boiler rooms for heating and hot water purposes. Waste gas disposal systems. Chimney classification. Examples of solutions for modern boilers. Gas supply installations for boiler rooms for the gas lighter and heavier than air. Oil fuel storage. Oil supply installations. Requirements for oil fuel storage rooms in the building. Control of boiler for the needs of heating. Hot water systems arrangements. Selection of hot water system depending on hot water demand and its variability. Methods for implementing the priority of hot water. The annual fuel demand for heating and hot water. Pipes used in heating installations. Materials and their characteristics. Compensation for thermal line extension. Thermal insulation of heating installations. Automation used in heating systems. Thermostatic valves. Hydraulic stabilization of heating system. Types of regulators, installation diagrams. Heaters classification. Requirements and rules for the selection of convection heaters. Panel heating systems. Advantages and limitations of use. Example solutions of floor and wall heaters. Differences in selection of conventional and panel heater. Thermal and technological requirements for floor heating. Radiator - floor systems. The tasks and types of operational control. Theoretical basis of qualitative and quantitative regulation. Chart control for weather control. Pumps in heating and hot water systems - principles of selection. The use of solar energy for heating systems. Systems diagrams. Types of solar collectors. Rules for the selection and placement of collectors. Heat pumps in heating systems ? the conditions of use.

Basic bibliography:

Additional bibliography:

Result of average student's workload

Activity	Time (working hours)

1. Participation in lectures	45
2. Participation in ex. auditorium	15
3. Participation in projects	30
4. Preparation to ex. auditorium	8
5. Preparation to attend and pass the exam	45
6. Participation in the consultation	5
7. Project realisation	30

Student's workload

Source of workload	hours	ECTS
Total workload	180	7
Contact hours	97	4
Practical activities	45	2