Zał. nr 5 do ZW 79/2013

COURSE DESCRIPTION

3E+ Summer School 2017

Course name: Thermal comfort and renewable energy for low energy buildings

The course's form	***Lecture***	***Tutorial***	***Laboratory***	***Project***	***Seminar***
Total number of hours	*16 h*		*30 h*		*14 h*
Form of completion	*mark*		*mark*		*mark*
Number of ECTS points	***3***				
including number of ECTS points for practical (P) classes	*2*				
including number of ECTS points for direct teacher-student contact (BK) classes	*2*				

- Initial requirements: none
- Name, surname, title of teacher:

  Marta Laska PhD, Małgorzata Szylgowska-Zgrzywa PhD, Marek Badura PhD, Agnieszka Chmielewska PhD,

- Course's aims and educational outcomes:

  SUBJECT OBJECTIVES

  C1. Knowledge about low Energy demand buildings, thermal comfort and renewable sources of Energy.
  C2. Practical basic knowledge concerning low energy buildings design, ventilation and heat load calculation and renewable energy sources sizing.
  C3. Practical knowledge concerning thermal comfort, ventilation and renewable energy sources measurements; basics of thermovision.

  SUBJECT EDUCATIONAL EFFECTS

  Relating to knowledge:

  PEK_W01 Knows and understands the basics of thermal comfort achievement methods and its importance for building users.
  PEK_W02 Knows and understands the basics of renewable energy systems design in low energy demand buildings.
  PEK_W03 Knows the basic tools for building thermal comfort and the building envelope quality assessment and understands their principles of work.

  Relating to skills:

  PEK_U01 Is able to assess the thermal comfort conditions in a building in a basic range.
  PEK_U02 Is able to determine the amount of fresh air needed in the building and the building heat load by simple methods.
  PEK_U03 Can prepare the conception of underfloor heating system basing on the heat load of particular room.
  PEK_U03 Can select the basic heat and energy sources elements for single family house (heat pump, solar collector, photovoltaic panels).

  Relating to competences:

PEK_K01 Is able to work on the implementation of tasks independently or in a team (laboratory tasks, reports and presentations preparation).
PEK_K02 Is responsible for the accuracy of the work results and its correct interpretation.
PEK_K03 Is aware of the need to increase knowledge in the field of contemporary techniques in low energy demand buildings systems.

- Form of teaching (traditional / e-learning): traditional
- Short description of the course content:

The main goal of the course is to teach the students the holistic approach to the design of the low energy demand buildings with special emphasis on the utilisation of renewable energy in building installations, application of heat recovery systems and maintaining thermal comfort of users. The course focuses on the subject of thermal comfort, local heat production (to supply heating and domestic hot water systems) with additional aspect of passive cooling and heat recovery through ventilation for low energy buildings. The subject covers solutions based on sustainable design including among others solar thermal collectors, air-to-water heat pumps, energy recovery heat exchangers in air handling units and ground heat exchangers. Students will participate mostly in active forms like laboratory, calculus and simple project. All practical exercises will be preceded by short lectures.

- Lecture – content:

Form of classes - lecture		**Number of hours**
Lec 1	Introduction to the heating and thermal comfort. Building structure – partitions structure.	2
Lec 2	Ventilation bases – concept, airflow, design ventilation heat loss.	2
Lec 3	Indoor air quality basics - indoor air pollution and health, sources of indoor air pollutants, basic strategies to improve indoor air quality	2
Lec 4	Total design heat loss for a heated space. Thermovision for building envelope and building installations assessment.	2
Lec 5	Design of an underfloor heating system	2
Lec 6	Heat sources sizing for heating and hot water purposes in low energy demand buildings	2
Lec 7	Solar energy and solar thermal collectors used for domestic hot water preparation in different climates	2
Lec 8	Heat pumps as heat source for building heating and domestic hot water preparation low energy demand buildings	2
	Total hours	**16**

- Tutorial – content: none
- Seminar – content:

Form of classes - seminar		**Number of hours**
Sem 1	Presentation of the partial results of students' work.	4

Sem 2	Presentation of the partial results of students' work.	4
Sem 3	Presentation of the partial results of students' work.	4
Sem 4	Final presentation of the results of students' work.	2
	Total hours	**14**

- Laboratory – content:

Form of classes - laboratory		**Number of hours**
Lab 1	Building partition design and the heat transfer coefficient calculation.	3
Lab 2	The ventilation system conception. Air flow calculation. Conception of the air exchange organisation in the building.	3
Lab 3	Calculation of the total heat load of the single family house.	3
Lab 4	Measurement of indoor thermal comfort parameters and CO_2 concentration in the air.	3
Lab 5	Indoor air quality measurements - sensors and instruments used for indoor air quality assessment.	3
Lab 6	Basic calculations and design of the underfloor heating system. Thermovision.	3
Lab 7	Sizing of the photovoltaic panels in the single family house. Simulation of the system in various geographic locations.	3
Lab 8	Heat sources and hot water tank sizing. Calculation of heat/energy demand for domestic hot water preparation. Selection of devices.	3
Lab 9	Sizing of the thermal solar collectors in the single family house. Simulation in various geographic locations.	3
Lab 10	Air-to-water heat pump selection for heating and hot tap water preparation purposes. The heat source power chart analysis.	3
	Total hours	**30**

- Project – content: none
- Basic literature:
  1. 2013 ASHRAE handbook: fundamentals
  2. 2012 ASHRAE handbook: heating, ventilating, and air-conditioning systems and equipment
  3. Watkins, David E.: Heating services in buildings : design, installation, commissioning & maintenance: 2011
  4. EN 12831:2003 Heating systems in buildings. Method for calculation of the design heat load
- Additional literature:
  1. Vedavarz, Ali.: HVAC: handbook of heating, ventilation and air conditioning for design and implementation: 2007
  2. Quaschning, Volker: Understanding Renewable Energy Systems
- Completion rules:

1. Lectures and labs attendance.
2. Performance of tasks.
3. Team reports preparation.