

FACULTY OF ELECTRICAL  
ENGINEERING**SUBJECT CARD**

Name in Polish: **Termokinetyka urządzeń elektrycznych i elektronicznych**  
 Name in English: **Thermokinetics of electric and electronic devices**  
 Main field of study (if applicable): **Electrical Engineering**  
 Specialization (if applicable): **Industrial Electrical Engineering**  
 Level and form of studies: **2nd level, full-time**  
 Kind of subject: **obligatory**  
 Subject code: **ELR051211**  
 Group of courses: **NO**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU):	30				
Number of hours of total student workload (CNPS):	60				
Form of crediting:	crediting with grade				
For group of courses mark (X) final course:					
Number of ECTS points:	2				
including number of ECTS points for practical (P) classes :					
including number of ECTS points for direct teacher-student contact (BK) classes:	1.40				

**PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES**

1. Knowledge of mathematics and physics.
2. Knowledge of electrical engineering fundamentals.
3. Basic knowledge of electrical devices and electronic systems.

**SUBJECT OBJECTIVES**

- C1. Learning of basic and combined mechanisms of heat transfer.  
 C2. Gaining knowledge of the effective heat removal from electrical and electronic equipment.  
 C3. Learning methods for solving problems of heat transfer.

**SUBJECT LEARNING OUTCOMES***relating to knowledge:*

- PEU\_W01 He knows the fundamental concepts of heat flow and techniques for thermal measurements.  
 PEU\_W02 He knows the rules for the selection criteria of natural convection and forced to solve the heat dissipation problem of electrical and electronic devices.  
 PEU\_W03 He knows methods of increasing of heat transfer removal from electrical and electronic devices.

*relating to skills:**relating to social competences:*

- PEU\_K01 Ability to thinking independently, finding and analyzing of information.

PROGRAMME CONTENT		
Form of classes - lecture		Number of hours:
Lec 1	Introduction. Basic concepts and definitions related to the heat transfer.	2
Lec 2	Mechanisms of heat conduction in solids, liquids and gases. Heat conduction in the single-and multi-layer systems with different geometry.	2
Lec 3	Combined heat transfer mechanisms.	2
Lec 4	Examples of thermal calculations for simple and complex heat transfer mechanisms.	2
Lec 5	Natural convection – characteristics of the phenomenon, the criteria used to calculate the thermal parameters.	2
Lec 6	Examples of the use of natural convection for cooling electrical and electronic systems.	2
Lec 7	Forced convection - turbulent flow, laminar and transitional modes. Description of the phenomenon in different geometrical arrangements .	2
Lec 8	The selection criterion depending on the system geometry, coolant and its parameters, the nature of the flow. Methods for determining the parameters of the heat flow.	2
Lec 9	The use of phase change of coolant to intensify the heat removal of the devices.	2
Lec 10	Heat Pipes - construction, principle of operation, types. The use of heat pipes in cooling systems.	2
Lec 11	The application of thermoelectric phenomena to cooling of electric end electronic devices.	2
Lec 12	Radiation heat transfer - description of the phenomenon, fundamental laws and parameters.	2
Lec 13	Heat screens selection to the electrical and electronic systems.	2
Lec 14	Cooling equipment. Basic techniques for thermal measurements.	2
Lec 15	Written test.	2
Total hours:		<b>30</b>

TEACHING TOOLS USED
N1. Traditional lecture. N2. Problem lecture. N3. Multimedia presentation. N4. Consultations.

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT		
Evaluation <i>F – forming (during semester)</i> <i>P – concluding (at semester end)</i>	Educational effect number	Way of evaluating educational effect achievement
F1(w)	PEU_W01 PEU_W02 PEU_W03 PEU_K01	Written test.
P(w)	P=F1	

PRIMARY AND SECONDARY LITERATURE
<b>PRIMARY LITERATURE:</b> [1] Wiśniewski S., Wiśniewski T., Wymiana ciepła, WNT, Wyd. 5 zmienione, Warszawa, 2000 [2] Kostowski E., Przepływ ciepła, Wydawnictwo Politechniki Śląskiej, 2000 [3] Kalinowski E., Przekazywanie ciepła i wymienniki, Oficyna Wydawnicza PWR, Wrocław, 1995 [4] Furmański P., Domański R., Wymiana ciepła, przykłady obliczeń i zadania, Oficyna Wydawnicza Politechniki Warszawskiej, Warszawa, 2002 <b>SECONDARY LITERATURE:</b> [1] William S. Janna, Engineering heat transfer, CRC press, Taylor&Francis Group, LLC, 2009 [2] Pastucha L. Otwinowski H., Podstawy przekazywania ciepła, Wydawnictwo Politechniki Częstochowskiej, 1999 [3] Pelc T., Borczyński J., Odprowadzanie ciepła z przyrządów półprzewodnikowych, Wydawnictwa Komunikacji i Łączności, W-wa, 1986 [4] Kostowski E., Górniak H., Sikoraj., Szymczyk J., Ziębik A., Zbiór zadań z przepływu ciepła, Wydawnictwo Politechniki Śląskiej, Gliwice, 2006

SUBJECT SUPERVISOR
Anna Kisiel, anna.kisiel@pwr.edu.pl