

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, part-time**
 Kind of subject: **obligatory**
 Subject code: **ELR041275**
 Group of courses: **NO**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU):	22				
Number of hours of total student workload (CNPS):	108				
Form of crediting:	crediting with grade				
For group of courses mark (X) final course:					
Number of ECTS points:	4				
including number of ECTS points for practical (P) classes :					
including number of ECTS points for direct teacher-student contact (BK) classes:	2.80				

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 removal of heat from electrical and electronic equipment.
 C3. Learning methods for solving problems of heat transfer.

SUBJECT EDUCATIONAL EFFECTS*relating to knowledge:*

- PEK_W01 He knows concepts of heat flow and basic techniques for thermal measurements.
 PEK_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.
 PEK_W03 He knows methods of increasing of heat transfer from electrical and electronic devices.

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

- PEK_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. Mechanisms of heat conduction in solids, liquids and gases. Heat conduction in the single-and multi-layer systems with different geometry.	2
Lec 2	Combined heat transfer mechanisms. Examples of thermal calculations.	2
Lec 3	Natural convection - characteristics of the phenomenon, the criteria used to calculate the thermal parameters. Examples of the use of natural convection for cooling electrical and electronic systems.	2
Lec 4	Forced convection - turbulent flow, laminar and transitional mode. description of phenomenon in different geometrical arrangements.	2
Lec 5	The selection of 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 6	The use of phase change of coolant to intensify the heat removal of the devices.	2
Lec 7	Heat Pipes - construction, principle of operation, types. The use of heat pipes in cooling systems.	2
Lec 8	The application of thermoelectric phenomena to cooling of electric and electronic devices.	2
Lec 9	Radiation heat transfer - description of the phenomenon, fundamental laws and parameters. Heat screens selection of the electrical and electronic systems.	2
Lec 10	Cooling equipment. Basic techniques for thermal measurements.	2
Lec 11	Written test.	2
Total hours:		22

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS 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)	PEK_W01 PEK_W02 PEK_W03 PEK_K01	Written test.
P(w)	P=F1	

PRIMARY AND SECONDARY LITERATURE
PRIMARY LITERATURE: [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 SECONDARY LITERATURE: [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., Sikora J., Szymczyk J., Ziębiak A., Zbiór zadań z przepływu ciepła, Wydawnictwo Politechniki Śląskiej, Gliwice, 2006

SUBJECT SUPERVISOR
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MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
ELR041275 - Thermokinetics of electric and electronic devices
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY **Electrical Engineering**
AND SPECIALIZATION **Industrial Electrical Engineering**

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	S2ETP_W09	C.1	Lec1 Lec2 Lec9 Lec10 Lec11	N.1 N.2 N.3 N.4
PEK_W02	S2ETP_W09	C.2 C.3	Lec3 Lec4 Lec5	N.1 N.2 N.3 N.4
PEK_W03	S2ETP_W09	C.3	Lec6 Lec7 Lec8	N.1 N.2 N.3 N.4
PEK_K01	K2ETK_K06	C.1 C.2 C.3	Lec1 Lec2 Lec3 Lec4 Lec5 Lec6 Lec7 Lec8 Lec9 Lec10 Lec11	N.1 N.2 N.3 N.4