COURSE DESCRIPTION CARD - SYLLABUS

Course name
Electrothermal processes

Course

Field of study
Electrical Engineering

Year/Semester
2/3

Area of study (specialization)
Lighting Engineering

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	Laboratory classes	Other (e.g. online)
15	15	
Tutorials	Projects/seminars	

Number of credit points

3

Lecturers

Responsible for the course/lecturer:
Przemysław Skrzypczak, Ph. D., Eng.

email: przemyslaw.s.skrzypczak@put.poznan.pl

tel. 61 6652585

Faculty of Control, Robotics and Electrical Engineering

ul. Piotrowo 3A 60-965 Poznań

Responsible for the course/lecturer:

Prerequisites

The student starting classes on this subject must have a basic knowledge of the basics of heat generation processes, temperature measurement methods and heat flow paths. Must have knowledge of the physics of phenomena: conduction, convection and radiation. Should be aware of the effects of temperature on aging processes, including electronic components.

The student should have the ability to use knowledge in the field of electrothermal to determine and evaluate the expected temperature values in real systems. Must be able to assess the impact of individual external factors on the temperature parameters obtained.

The student should be aware of the need to cooperate with others and expand their knowledge. He should also be ready to search for necessary information about the material parameters of the materials used in the source materials.

Course objective

The student is acquainted with the amount of thermal energy generated by individual light sources. Studnet will deepen knowledge of heat flow paths and determining the amount of power generated and transmitted to the environment. Studnet is familiarized with methods used in real systems to remove heat generated by light sources, including energy-saving LED lighting

Course-related learning outcomes

Knowledge

The student has expanded knowledge in the field of measurements of electrical quantities and selected non-electrical quantities, in particular temperature measurements significant for the operational reasons of lighting fixture points. Has knowledge of lighting power limits and the reasons for their occurrence. The student has in-depth knowledge of the development of the results of the experiment with particular emphasis on methods of forecasting thermal effects and knows the processes occurring in the life cycle of selected electrical devices with particular emphasis on electrothermal and lighting devices. Has in-depth knowledge of the implementation of heating processes and phenomena occurring during heating by various electrothermal methods, and has knowledge of how to apply this knowledge in practice to achieve specific effects - heating of various loads.

Skills

The student has the ability to obtain information from literature, databases and other sources regarding material parameters from which particular elements of thermal and light systems are made. Has the ability to interpret, evaluate, critically analyze and synthesize with the determination of semi-optimal solutions under specific design assumptions. He is also characterized by the ability to draw conclusions and to formulate and comprehensively justify opinions on heating methods and ways of removing excessive heat energy from lighting devices.

Studnet has the ability to work individually and in a team, is able to manage the team in a way that ensures the implementation of the task of determining the thermal energy generated in the system of its discharge routes in the set time. The student is able to determine the directions of further learning and organize the self-education process.

Students are also provided with materials in English, thanks to which he acquired the ability to use English at B2 + level of the European Language Description System, also in professional matters, reads and understands the specialist literature in the field of electrothermal issues, and is able to prepare and give a presentation on the implementation design or research task.

Social competences

Studnet understands and is able to work in a group, demonstrates the ability to coordinate team work, acquires these competences during laboratory classes during the implementation of measurement tasks, analysis of obtained results as well as their development and presentation.

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Knowledge acquired during lectures is checked by a final test carried out at the end of the semester, in addition based on individual activity during classes, diligence and accuracy in the performance of assigned tasks, scoring on the final test (14 weeks of classes).

Knowledge and skills acquired during laboratory classes are assessed by the assessment of reports made individually and in groups during the presentation of laboratory results.

Programme content

LECTURES

During lectures with a multimedia presentation, there are presented heat generation and energy balance in various light sources,

- lecture in the form of a discussion on the impact of temperature on electrical and photometric parameters of light sources,

- presentation in the form of a multimedia presentation with the preceding content related to subjects related to lighting technology covering the content of issues of construction of high power light emitting diodes with particular emphasis on heat flow paths.

The lecture supported by calculation examples regarding thermal parameters of diode cooling systems, thermal parameters of lighting fittings using light-emitting diodes, calculations carried out in connection with real cooling systems and thus with practice, discussion on economic aspects regarding the improvement of cooling systems at the cost of complicating the housing design,

During lectures, a multimedia presentation with animations - films from a thermal imaging camera regarding thermal parameters of modern light sources used as replacements for classic light sources, a lecture based on the results of research conducted at the Department.

The lecture presents in tabular form supplemented with verbal commentary thermal requirements for electrical components used in the construction of lighting fixtures.

The lecture presents the possibility of using Peltier modules in diode cooling systems and methods for calculating thermal parameters of systems using Peltier modules.

LABORATORY CLASSES

- During the laboratory, providing students with a proprietary "fixture" program for students to use at home, enabling the estimation of the luminaire's temperature under given ambient conditions,

- computational experiments carried out in the luminaire program confirmed by real temperature results obtained during laboratory classes

- discussion on the measurement results obtained and the reasons for the differences in their values with those obtained during computer simulations

- demonstrating changes in temperature values in systems located in different external conditions (use of a temperature chamber)

- discussion of their course, time constants and monotonicity based on real-time characteristics of temperature changes

The use SolidWorks software to modeling of thermal energy flow and occurring system temperatures

The use QuickField software to modeling of thermal energy flow and occurring system temperatures

The presented program contents and implemented laboratory classes are based on the results of scientific research carried out at the Department.

Teaching methods

The teaching methods used:

- lecture with multimedia presentation (including drawings, photos, animations, sound, films) supplemented with examples given on the board

- lecture conducted in an interactive way with the formulation of questions to a group of students or to specific students indicated

- students' activity during classes is taken into account when issuing the final grade

- initiating discussions during the lecture

- theory presented in close connection with practice

- theory presented in relation to the current knowledge of students

- taking into account various aspects of the issues presented, including: economic

Bibliography

Basic

1. Hauser J.: Elektrotechnika. Podstawy elektrotermii i techniki świetlnej, Wyd. PP, Poznań, 2006

2. Filin S.: Termoelektryczne urządzenia chłodnicze, IPPU MASTA 2002

3. Wesołowski M, Skrzypczak P, Hauser J.: Thermal resistance of LED diodes. Precission of catalogue data. Elektronika 12/2015 s.45-49

4. Materiały do zajęć laboratoryjnych dostępne na stronie lumen.iee.put.poznan.pl oraz platformie Moodle

Additional

1. Skrzypczak P.: Badania parametrów cieplnych diodowych zamienników lamp tradycyjnych, VI Konferencja Naukowo-Techniczna: Energooszczędność w oświetleniu, Poznań 26.05.2015 s.: 31-36

2. Skrzypczak P.: Analiza układów chłodzenia diod elektroluminescencyjnych dużej mocy z wykorzystaniem ogniw Peltiera ; Politechnika Poznańska. Wydział Elektryczny.

Breakdown of average student's workload

	Hours	ECTS
Total workload	80	3,0
Classes requiring direct contact with the teacher	50	2,0
Student's own work (literature studies, preparation for laboratory classes, preparation for tests) [1]	30	1,0

[1] delete or add other activities as appropriate