Code: **02 33 0627 00** ECTS credits: **3**

Course name

Course name in Polish **Power Devices and Systems**

Language of instruction Polish

Programme Elektronika i telekomunikacja

Level of studies first cycle

Unit running the programme Katedra Mikroelektroniki i Technik Informatycznych, K-25

Course coordinator and academic teachers

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Form of classes and number of teaching hours per semester

Lec.	**Tut.**	**Lab.**	**Proj.**	**Sem.**	**Other**	**total number of teaching hours per semester**
15	0	30	0	0	0	**45**

Learning outcomes

Student knows structures and understands operation of basic power semiconductor devices;
Understands the link between the properties of a device and requirements imposed by an application, can use technical data and is able to use this knowledge and skills to select a device;
Knows and can implement the rules of reliable use of power semiconductor devices, understands and can implement simple protection and cooling circuits;
Knows topologies, understands operation and can design and realize simple control circuits for field-effect power transistors and thyristors;
Knows basic methodologies of computer-aided modelling of power semiconductor devices and converter circuits, understands limitations related to the use of models and can use a chosen circuit simulator in system design.

Prerequisites Electric Circuits, Circuit Theory, Measurements

Course organisation and content

Instruction is conducted through mutual complementing and synergy between lecture and laboratory. Subject content listed in the lecture field is therefore common for both forms of instruction, however not all of it is taught through both forms.

LECTURE
1. The aim of power semiconductor devices: ideal and real semiconductor switch, crucial parameters of power devices.
2. Physical bases of power semiconductor device operation: blocking and breakdown, conduction mechanisms, dynamic states.
3. Structure and operation of power semiconductor devices—rectifier diodes and switching diodes based on PN junction, Schottky junction and PIN structure, thyristors (SCRs), triacs and diacs, Bipolar Junction Transistors, MOSFETs, Insulated Gate Bipolar Transistors, Static Induction Transistors: specificity of structure and operation of high voltage and current capability devices; properties, parameters, static and dynamic characteristics.
4. Application of power semiconductor devices in switched mode electronic systems: selection criteria, basic circuit configurations, operation and basics of design of simple control circuits; chosen applications—rectifiers, AC voltage controllers, DC converters:

operation basics, role of power semiconductor devices and influence on system performance.
5. Reliable use of power semiconductor devices: safe operating area; influence of temperature on device operation, power loss, basics of design of simple cooling systems, heat sinks; external circuit influence, simple protection circuits for semiconductor devices.
6. Power semiconductor device models: structure basics, guidelines for use in computer-aided design of power electronic systems, model limitations.

LABORATORY
A first part of laboratory courses (24 hrs) includes 12 exercises embracing experiment, simulation, calculation and design, grouped into 6 blocks of 4 hours. A second part (6 hrs) comprises partial design, prototyping, and tests of a simple practical electronic converter.

Form of assessment

Lecture: final written test. Laboratory: student's work during classes, reports on realised exercises and design, short written tests after each exercise block. Final note: 50% lecture, 50% laboratory.

Basic reference materials

Benda V., Gowar J., Grant D. A.: Power Semiconductor Devices: Theory and Applications. Wiley, 1999. ISBN 0-471-97644-X.
Mohan N., Undeland T.M., Robbins W.P.: Power Electronics: Converters, Applications, and Design. Wiley, 2003. ISBN 0-471-22693-9.

Other reference materials

Napieralski A., Napieralska M.: Polowe półprzewodnikowe przyrządy dużej mocy. Wydawnictwa Naukowo-Techniczne, 1995. ISBN 83-204-1817-8.
Luciński J.: Układy z tyrystorami dwukierunkowymi. Warszawa: Wydawnictwa Naukowo-Techniczne, 1982. ISBN 83-204-0752-4.
Maksimović D., Erickson R.W.: Fundamentals of Power Electonics. Kluwer, 2001. ISBN 0-7923-7270-0.
Rashid M.H. (ed.): Power Electronics Handbook. Academic Press, 2006. ISBN 0-12-581650-2.

Average student workload outside classroom

60

Total student workload **105**

Comments

The lecture is given in the first half of the semester.

Updated on

2008-12-02