STUDY MODULE DESCRIPTION FORM

Name of the module/subject	Code
Switching processes in electric power networks	**1010311361010315997**

Field of study	Profile of study (general academic, practical)	Year /Semester
Electrical Engineering	**(brak)**	**3 / 6**
Elective path/specialty: **Distribution Devices and Electrical**	Subject offered in: **Polish**	Course (compulsory, elective): **obligatory**
Cycle of study: **First-cycle studies**	Form of study (full-time,part-time): **full-time**	

No. of hours	No. of credits
Lecture: **30** Classes: **15** Laboratory: **-** Project/seminars: **15**	**4**

Status of the course in the study program (Basic, major, other)	(university-wide, from another field)
(brak)	**(brak)**

Education areas and fields of science and art	ECTS distribution (number and %)

Responsible for subject / lecturer:

dr hab. inż. Ryszard Batura
email: ryszard.batura@put.poznan.pl
tel. 061 665 2767
Wydział Elektryczny
ul. Piotrowo 3A, 60-965 Poznań

Prerequisites in terms of knowledge, skills and social competencies:

1	**Knowledge**	Fundamentals of the electrical devices and measuring equipment and ots application. Knowledge. Knowledge of the single- and three-phase AC systems and the electric power distribution system?s structure.
2	**Skills**	Ability to acquire information from the literature in the field and other sources and to analyze it in evaluative way. Ability to deal with the analytical, simulation and experimental tools. 1c. Has understanding of the aspects and effects of the engineer?s responsibility for made decisions. Is able to work in the team.
3	**Social competencies**	Has basic knowledge of the construction solutions, parameters and choice criterions of electric power switches, MV switchgears, bus bars and bus ducts. Is able to construct the test networks and to carry out the electric power devices tests.

Assumptions and objectives of the course:

Getting familiar with switching phenomena under the normal and disturbed conditions; acquisition of skills to analyze it; getting familiar with the overvoltage limiters? design method and practice.

Study outcomes and reference to the educational results for a field of study

Knowledge:

1. Has ordered and theoretically underpinned knowledge of the electric circuits theory, knows basic electrical engineering?s rules, knows basic features of the electric circuits elements, has knowledge about the steady and transient states in electric power networks. - [K_W04 ++]

2. Has knowledge of the phenomena accompanying the switching processes. Is able to construct schemes of the electric power system elements to analyze the transient states. - [K_W04 ++]

3. Can find values of the expected recovery voltage, over-voltages, overcurrents during cut-off operation with and without the electric arc re-ignition for different DC and AC circuits - [K_W04 ++]

4. Is familiar with methods of calculation and limiting the latter and can find it in analytical way - [K_W04 ++]

Skills:

1. Can carry out analysis of the simple electric system and devices? operation implementing adequate methods and tools. - [K_U11 +]

2. To use data sheets and application notes to choose the proper elements of the electric network or system being designed. - [K_U17 +]

Social competencies:

1. Has understanding of the need and knows opportunities of the lifelong learning (second and third cycle studies, post-graduate courses) as well as the need for upgrading the professional, personal and social competencies. Is able to think and act in the professional way. - [K_K01 +]

Assessment methods of study outcomes

Lectures:

?Assessment of the knowledge and skills during the problem-type written examination,

?Continuous assessment, at each class (bonus for activity and perception quality).

Classes:

?Test and bonus for a knowledge necessary to solve tasks in the scope of the lectures? subjects.

?Assessment of the skills related to the class task accomplishment.

Projects:

?Test and bonus for a knowledge necessary to accomplish the design task,

?Assessment of the knowledge and skills related to the design task accomplishment.

Adding extra points for activity in discussions, especially for:

?effectiveness of implementation of the knowledge acquired when solving a given problem.

?ability to cooperate in the team accomplishing in practice a specific task in lab.

?remarks related to the educational materials? enhancement,

?care and esthetic form of the elaborated designs ? within the individual work.

Course description

Actualization 2017: DC cut off(breaking (the cut off conditions referring to the voltage-current curves and power balance for the constant and variable arc length, electric arc?s limit length, finding the arc duration and cut off operation in the analytical and graphical way) and description of influence of the circuit parameters and arc ignition manner on the switching overvoltages. Conditions of the AC current cut-off nearby the natural current-zero crossing and using step-up voltage. Post-arc end electric resistance of the contact gap for the short and long arcs. Development of the electric power network elements? scheme for the transient states analysis (equivalent schemes of generators, transformers, overhead and cable lines. Current and voltage transformers, bus bar). Finding overvoltages, overcurrents and recovery voltages during the fault clearance in the three-phase circuits with isolated and earthened neutral point; resistive load currents? switching; switching on and cut off of condensers with and without electric arc re-ignition; cut off of the low inductive currents and asynchronous motors. Overvoltage and overcurrent limiting methods. Discussions and design work with the lecture-related subjects. The applied methods of education: lectures - the lecture with multimedia introduction (in this: drawings, of picture, catalogues) replenished with examples passed on board, the practice - the solving on board the example tasks, projecting - the detailed reviewing by leader the project records the project and the discussions over comments.

Basic bibliography:

1. 1. Królikowski Cz.: Inżynieria łączenia obwodów elektrycznych wielkich mocy, Wydawnictwo Politechniki Poznańskiej, 1998.

2. 2. Królikowski Cz.: Technika łączenia obwodów elektroenergetycznych, WNT, Warszawa, 1990.

3. 3. Bolkowski St.: Teoria obwodów elektrycznych, WNT, Warszawa, 1995.

4. 4. Batura R., Janiszewski J., Przepięcia łączeniowe w sieciach dystrybucyjnych średniego napięcia, XVII Sympozjum, Współczesne urządzenia oraz usługi elektroenergetyczne, telekomunikacyjne i informatyczne, Oddz. Poznański SEP, Sekcja: Sieci i instalacje - zagadnienia wybrane, Poznań, 2014, ss. 7-19.

5. 5. Batura R., Zagrożenia przepięciowe w sieciach elektroenergetycznych średniego napięcia, Przegląd Naukowo-Metodyczny, Edukacja dla Bezpieczeństwa, Rok IX, Nr 1/2016, ss. 1409-1429

Additional bibliography:

1. 1. Magazins Elektroinstalator, Elektroinfo.

2. 2. Related standards.

3. 3. Manufacturers? data sheets.

4. 4. Internet publications

Result of average student's workload

Activity	Time (working hours)
1. Lectures	30
2. Classes	15
3. Projects	15
4. Part in consultations	30
5. The preparation to occupations, the study of laboratory documentation	30

Student's workload

Source of workload	hours	ECTS
Total workload	120	4

Contact hours	90	3
Practical activities	30	1