STUDY MODULE DESCRIPTION FORM

Name of the module/subject	Code
The work of electric power system	**1010314491010313673**

Field of study	Profile of study (general academic, practical)	Year /Semester
Power Engineering	**(brak)**	**5 / 9**
Elective path/specialty	**Subject offered in:**	**Course (compulsory, elective)**
Electrical Power Engineering	**Polish**	**obligatory**

Cycle of study:	Form of study (full-time,part-time)
First-cycle studies	**part-time**

No. of hours	No. of credits
Lecture: **18** Classes: **-** Laboratory: **9** Project/seminars: **9**	**5**

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 %)
technical sciences	**5 100%**

Responsible for subject / lecturer:

dr inż. Ireneusz Grządzielski
email: ireneusz.grzadzielski@put.poznan.pl
tel. 61 665 2392
Faculty of Electrical Engineering
Piotrowo 3A, 60-965 Poznań

Prerequisites in terms of knowledge, skills and social competencies:

1	**Knowledge**	Possesses basic knowledge of the theory of electrical circuits, electrical machines, electric power engineering and electrical power generation
2	**Skills**	Has effective self-study ability in the domain of the chosen specialization, is able to integrate the knowledge acquired at the credited courses
3	**Social competencies**	Is aware of the need to develop his knowledge and competencies, is ready to undertake the cooperation and team work

Assumptions and objectives of the course:

Getting knowledge of the electric power system operation under steady operating conditions, methods of simulation computations of the power flows in the HV and EHV meshed networks, market-based power flow optimization, computations of the symmetrical and asymmetrical steady short-circuit conditions in the power system, practical use of the power flow computation program (PLANS) and short-circuit computation program (SCC) applied by the PSE Operator.

Getting knowledge of the electric power system operation under transient operating conditions, electric power system stability investigations under both the small disturbances and the instantaneous high disturbances in the active power balance.

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

Knowledge:

1. Has basic knowledge of the energy security questions, especially of risks and ways to increase the energy security level - [K_W07+]

2. Has elementary knowledge of fundamentals of the electric power engineering and electric power systems and grid - [K_W11+++]

3. 2Has elementary knowledge of fundamentals of the electric power engineering and electric power systems and grid - [K_W14+++]

Skills:

1. Can use acquired mathematical methods and models as well as the computer simulation to discuss and assess the operation of the electric power elements and systems - [K_U07++]

2. Can identify and formulate specifications of the simple practical tasks in the power engineering domain - [K_U18+]

Social competencies:

1. Is aware of the weight and understands the non-technical aspects and effects of the electric power engineer?s activities and responsibility including those related to the environmental impact and regarding the responsibility for the undertaken decisions - [K_K02+]

Assessment methods of study outcomes

Lectures:

1. Assessment during courses (bonus for activity and perception quality)
2. Assessment of the knowledge shown at the written and oral examinations.

Laboratory:

1.Test of the knowledge necessary to deal with problems posed in the lab tasks.
2. Assessment of the knowledge and skills related to the lab task completion.
3. Assessment of the task report.

Design

1.On-line assesssment of the preparation to the design tasks,
2.Evaluation of the completed design task.

Course description

Lectures: Transient states in the electric power system. Steady states in electric power system. Market-based optimization of the power system operation. Power flow calculations -role of the node potential method. Application of the Gauss and Newton-Raphson iteration technique to solve the no-linear node equations. Power flow optimization. Estimation of the power system conditions. Calculations of the steady short-circuit conditions in the electric power system - non-symmetrical short-circuit analysis using symmetrical component method, models of the system elements for symmetrical components.

Transient states in electric power system: types of states, system disturbances. Scope of the transient state' study and analysis. Models of the System elements for the transient analysis needs. Electric power system stability. Small swing of the generators' rotor - local angle stability. Power-angle characteristics - application of the I Lapunov rule. Influence of the voltage regulation on local stability. Stability under the large instantaneous disturbance of the active power balance - global angle stability. Application of the indirect Lapunov rule. Voltage stability - voltage stability conditions.

Laboratory: involves experiments carried out using the power flow programs (PLANS) and short-circuit calculation programs (SCC) concerning topics presented in lectures.

Design: encompasses the design tasks carried out according to the subjects presented in lectures.

Basic bibliography:

1. Kremens Z. , Sobierajski M. : Analiza systemów elektroenergetycznych. WNT, Warszawa, 1996.
2. Kacejko P., Machowski J.: Zwarcia w systemach elektroenergetycznych. WNT, Warszawa, 2002.
3. Machowski J.: Regulacja i stabilność systemu elektroenergetycznego. OWPW, Warszawa 2007.
4. Poradnik Inżyniera Elektryka . t.3. WNT, Warszawa 2005

Additional bibliography:

1. Cegielski M.: Sieci i systemy elektroenergetyczne. PWN, Warszawa, 1979.
2. Machowski J., Białek J., Bumby J. Power System Dynamics: Stability and Control. IEEE Wiley, 2008

Result of average student's workload

Activity	Time (working hours)
1. participation in lecture courses	18
2. participation in labs	9
3. participation in design classes	9
4. participation in discussions related to lectures	4
5. participation in discussions related to labs	4
6. preparation to labs	10
7. lab reports	10
8. participation in discussions related to design	10
9. design task completion	15
10. preparation to examination	15
11. taking an examination	3

Student's workload

Source of workload	hours	ECTS

Total workload	107	5
Contact hours	52	2
Practical activities	34	2