

STUDY MODULE DESCRIPTION FORM		
Name of the module/subject The work of electric power system		Code 1010314391010313673
Field of study Power Engineering	Profile of study (general academic, practical) (brak)	Year /Semester 5 / 9
Elective path/specialty Electrical Power Engineering	Subject offered in: polish	Course (compulsory, elective) obligatory
Cycle of study: First-cycle studies	Form of study (full-time, part-time) part-time	
No. of hours Lecture: 18 Classes: - Laboratory: 9 Project/seminars: 9		No. of credits 5
Status of the course in the study program (Basic, major, other) (brak)		(university-wide, from another field) (brak)
Education areas and fields of science and art technical sciences		ECTS distribution (number and %) 5 100%
Responsible for subject / lecturer: Dr inż. Ireneusz Grządzielski email: ireneusz.grzadzieski@put.poznan.pl tel. tel. 61 665 2635 (2392) Wydział Wydział Elektryczny ul. 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. Has 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		
<p>Lectures:</p> <ol style="list-style-type: none"> 1. Assessment during courses (bonus for activity and perception quality) 2. Assessment of the knowledge shown at the written and oral examinations. <p>Laboratory:</p> <ol style="list-style-type: none"> 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. <p>Design</p> <ol style="list-style-type: none"> 1. On-line assessment of the preparation to the design tasks, 2. Evaluation of the completed design task. 		
Course description		
<p>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.</p> <p>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.</p> <p>Laboratory: involves experiments carried out using the power flow programs (PLANS) and short-circuit calculation programs (SCC) concerning topics presented in lectures.</p> <p>Design: encompasses the design tasks carried out according to the subjects presented in lectures.</p>		
Basic bibliography:		
<ol style="list-style-type: none"> 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:		
<ol style="list-style-type: none"> 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