Nome		STUDY MODULE D	E20	RIPTION FORM				
	f the module/subject peration of the p	ower network and local e	nerg	ly sources	Coo 101	^{de} 10314391010315994		
Field of study Electrical Engineering				Profile of study (general academic, practical) (brak)		Year /Semester 5 / 9		
Elective path/specialty				Subject offered in:		Course (compulsory, elective)		
	Power Networks	and Electric Power System	em	Polish		obligatory		
Cycle of	f study:		Form	of study (full-time,part-ti	me)			
	First-cyc	ele studies	part-time					
No. of h	ours					No. of credits		
Lectur	e: 9 Classes	s: • Laboratory: •	F	roject/seminars:	9	2		
Status c	of the course in the study	program (Basic, major, other)	(u	niversity-wide, from anot	,			
		(brak)			(bra	ak)		
Educatio	on areas and fields of sci	ence and art				ECTS distribution (number and %)		
technical sciences						2 100%		
Responsible for subject / lecturer: Andrzej Trzeciak email: andrzej.trzeciak@put.poznan.pl tel. 61 665 2581 Elektryczny								
Poz	nań, ul. Piotrowo 3A							
_			-					
Prere	quisites in term	s of knowledge, skills and	d so	cial competencie	es:			
Prere	equisites in term Knowledge	s of knowledge, skills and Basic knowledge in field of powe of power generation. Basic theor synchronous and asynchronous	er net ory of p	work, power flow, sho protections, electric ma	t-circuit achines	(transformers and		
	•	Basic knowledge in field of power of power generation. Basic theor	er net ory of p s gene	work, power flow, sho protections, electric ma rators) and electrical	t-circuit achines equipm	(transformers and ent.		
1	Knowledge	Basic knowledge in field of power of power generation. Basic theor synchronous and asynchronous Effective self-education in study	er net ory of p gene field.	work, power flow, sho protections, electric ma rators) and electrical Skills in basic network	rt-circuit achines equipm c calcula	(transformers and ent. ations of power flow, short- ompetences in innovation		
1 2 3	Knowledge Skills Social competencies	Basic knowledge in field of power of power generation. Basic theor synchronous and asynchronous Effective self-education in study circuits and voltage regulaton. Student should have consciousn	er net ory of p gene field.	work, power flow, sho protections, electric ma rators) and electrical Skills in basic network	rt-circuit achines equipm c calcula	(transformers and ent. ations of power flow, short- ompetences in innovation		
1 2 3 Assu Studies	Knowledge Skills Social competencies mptions and obj	Basic knowledge in field of power of power generation. Basic theor synchronous and asynchronous Effective self-education in study circuits and voltage regulaton. Student should have consciousn technologies for power engeneer	er net ry of p gene field. ness c ering, i d fault	work, power flow, sho protections, electric ma rators) and electrical Skills in basic network of necessity of improvin readiness to work indi- conditions. Distributed	t-circuit achines equipm c calcula ng his c vidual a	(transformers and ent. ations of power flow, short- ompetences in innovation nd cooperate within groups.		
1 2 3 Assu Studies	Knowledge Skills Social competencies mptions and obj s of various source en trical networks, power	Basic knowledge in field of power of power generation. Basic theor synchronous and asynchronous Effective self-education in study circuits and voltage regulaton. Student should have consciousn technologies for power engeneer ectives of the course: ergy characteristics in normal and	er net ory of p gene field. ness c ering, d fault k for g	work, power flow, shor protections, electric ma rators) and electrical Skills in basic network of necessity of improvin readiness to work indiv conditions. Distributed prid elements.	rt-circuit achines equipm c calcula ng his c vidual a d genera	(transformers and ent. ations of power flow, short- ompetences in innovation nd cooperate within groups. ation and operating problem		
1 2 3 Assu Studies in elect	Knowledge Skills Social competencies mptions and obj s of various source en trical networks, power	Basic knowledge in field of power of power generation. Basic theor synchronous and asynchronous Effective self-education in study circuits and voltage regulaton. Student should have consciousn technologies for power engenee ectives of the course: ergy characteristics in normal and quality performance, overload risk	er net ory of p gene field. ness c ering, d fault k for g	work, power flow, shor protections, electric ma rators) and electrical Skills in basic network of necessity of improvin readiness to work indiv conditions. Distributed prid elements.	rt-circuit achines equipm c calcula ng his c vidual a d genera	(transformers and ent. ations of power flow, short- ompetences in innovation nd cooperate within groups. ation and operating problem		
1 2 3 Assu Studies in elect Know 1. Sys	Knowledge Skills Social competencies mptions and obj s of various source en trical networks, power Study outco vledge:	Basic knowledge in field of power of power generation. Basic theor synchronous and asynchronous Effective self-education in study circuits and voltage regulaton. Student should have consciousn technologies for power engeneer ectives of the course: ergy characteristics in normal and quality performance, overload risk mes and reference to the construction and properties wind f	er net bry of g gene field. ness c ering, d fault k for g	work, power flow, shor protections, electric ma rators) and electrical Skills in basic network of necessity of improvin readiness to work indir conditions. Distributed prid elements.	t-circuit achines equipm c calcula ng his c vidual a d genera for a f	(transformers and ent. ations of power flow, short- ompetences in innovation nd cooperate within groups. ation and operating problem ield of study		
1 2 3 Assu Studies in elect Know 1. Sys genera 2. Know	Knowledge Skills Social competencies mptions and obj s of various source en trical networks, power Study outco vledge: tematic knowledge in ting plants [K_W09-	Basic knowledge in field of power of power generation. Basic theor synchronous and asynchronous Effective self-education in study circuits and voltage regulaton. Student should have consciousn technologies for power engeneer ectives of the course: ergy characteristics in normal and quality performance, overload risk mes and reference to the construction and properties wind f	er net ry of p gene field. ness c æring, d fault k for c e edu	work, power flow, shor protections, electric ma rators) and electrical Skills in basic network of necessity of improvin readiness to work indirect conditions. Distributed grid elements. cational results	t-circuit achines equipm c calcula ng his c vidual a d genera for a f	(transformers and ent. ations of power flow, short- ompetences in innovation nd cooperate within groups. ation and operating problem ield of study ants heat and power		
1 2 3 Studies in elect 1. Sys genera 2. Know [KW_2 3. Know	Knowledge Skills Social competencies mptions and obj s of various source en trical networks, power Study outco vledge: tematic knowledge in ting plants [K_W09- wledge in distributed g 24+++, K_W25++] wyledge in minimizatio	Basic knowledge in field of power of power generation. Basic theor synchronous and asynchronous Effective self-education in study circuits and voltage regulaton. Student should have consciousn technologies for power engenee ectives of the course: ergy characteristics in normal and quality performance, overload risk mes and reference to the construction and properties wind f ++]	er net ry of p s gene r field. hess c ering, d fault k for c e edu farms	work, power flow, shor protections, electric ma rators) and electrical Skills in basic network of necessity of improvin readiness to work indivi- conditions. Distributed grid elements. cational results , small hydro plants, b cooperating with distril	t-circuit achines equipm c calcula ng his c vidual a d genera for a f	(transformers and ent. ations of power flow, short- ompetences in innovation nd cooperate within groups. ation and operating problem ield of study ants heat and power etworks		
1 3 Assu Studies in elect 1. Sys genera 2. Know [KW_2 3. Know Skills 1. Skil	Knowledge Skills Social competencies mptions and obj s of various source en trical networks, power Study outco Vledge: tematic knowledge in ting plants [K_W09- wledge in distributed g 24+++, K_W25++] wledge in minimizatio s: Is in connection project	Basic knowledge in field of power of power generation. Basic theor synchronous and asynchronous Effective self-education in study circuits and voltage regulaton. Student should have consciousn technologies for power engeneer ectives of the course: ergy characteristics in normal and quality performance, overload risk mes and reference to the construction and properties wind f ++]	er net ry of p gene field. ness c ering, d fault k for ç e edu farms nd its c s and	work, power flow, shor protections, electric ma rators) and electrical Skills in basic network of necessity of improvin readiness to work indir conditions. Distributed rid elements. cational results , small hydro plants, b cooperating with distril power quality degrada	t-circuit achines equipm c calcula c calcula d genera d genera for a f iogas pl oution n ation [(transformers and ent. ations of power flow, short- ompetences in innovation nd cooperate within groups. ation and operating problem ield of study ants heat and power etworks KW_24+++, K_W25++]		
1 3 Assu Studies in elect Know 1. Sys genera 2. Knov [KW_2 3. Kno Skills 1. Skil [K_U22 2. Abil	Knowledge Skills Social competencies mptions and obj s of various source en trical networks, power Study outco vledge: tematic knowledge in ting plants [K_W09- wledge in distributed g 24+++, K_W25++] wledge in minimizatio s: ls in connection projec 2++, K_U23++] ity to implementation of	Basic knowledge in field of power of power generation. Basic theor synchronous and asynchronous Effective self-education in study circuits and voltage regulaton. Student should have consciousn technologies for power engeneer ectives of the course: ergy characteristics in normal and quality performance, overload risk mes and reference to the construction and properties wind f ++] peneration connection methods an n of short-circuit thermal problems cts of distributed generation and a expert and design tools for determ	er net ry of p gene field. field. d fault k for ç e edu farms nd its (s and and da	work, power flow, shor protections, electric ma rators) and electrical Skills in basic network of necessity of improvin readiness to work indir conditions. Distributed grid elements. cational results , small hydro plants, b cooperating with distril power quality degrada	t-circuit achines equipm (calcula (genera d genera for a f iogas pl oution n ation [(transformers and ent. ations of power flow, short- ompetences in innovation nd cooperate within groups. ation and operating problem ield of study ants heat and power etworks <u>KW_24+++, K_W25++]</u> ork secure exploitation		
1 3 Assu Studies in elect 1. Sys genera 2. Knov [KW_2 3. Knov [KW_2 3. Knov [KW_2 2. Abil [K_U22 2. Abil cooper 3. Use	Knowledge Skills Social competencies mptions and obj s of various source en trical networks, power Study outco vledge: tematic knowledge in ting plants [K_W09- wledge in distributed g 24+++, K_W25++] wledge in minimizatio S: Is in connection projec 2++, K_U23++] ity to implementation of ated with distributed g e knowledge of the nur	Basic knowledge in field of power of power generation. Basic theor synchronous and asynchronous Effective self-education in study circuits and voltage regulaton. Student should have consciousn technologies for power engeneer ectives of the course: ergy characteristics in normal and quality performance, overload risk mes and reference to the construction and properties wind f ++] peneration connection methods an n of short-circuit thermal problems	er net ry of p s gene field. field. d fault k for c e edu farms d fault farms md its o s and da hinatic	work, power flow, shor protections, electric ma rators) and electrical Skills in basic network of necessity of improvin readiness to work indir conditions. Distributed grid elements. cational results , small hydro plants, b cooperating with distril power quality degrada etermine parameters for on of secure exploitatio	t-circuit achines equipm c calcula d genera d genera for a f iogas pl oution n ation [or netwo	(transformers and ent. ations of power flow, short- ompetences in innovation nd cooperate within groups. ation and operating problem field of study ants heat and power etworks <u>KW_24+++, K_W25++]</u> ork secure exploitation neters for network		
1 3 Assu Studies in elect 1. Sys genera 2. Knov [KW_2 3. Knov [KW_2 3. Knov [KW_2 2. Abil [K_U22 2. Abil cooper 3. Use networ	Knowledge Skills Social competencies mptions and obj s of various source en trical networks, power Study outco vledge: tematic knowledge in ting plants [K_W09- wledge in distributed g 24+++, K_W25++] wledge in minimizatio s: ls in connection project 2++, K_U23++] ity to implementation of ated with distributed g	Basic knowledge in field of power of power generation. Basic theor synchronous and asynchronous Effective self-education in study circuits and voltage regulaton. Student should have consciousn technologies for power engeneer ectives of the course: ergy characteristics in normal and quality performance, overload risk mes and reference to the construction and properties wind f ++] generation connection methods an n of short-circuit thermal problems ets of distributed generation and a expert and design tools for determ generation [K_U22++, K_U23++ neric analysis for selected issues	er net ry of p s gene field. field. d fault k for c e edu farms d fault farms md its o s and da hinatic	work, power flow, shor protections, electric ma rators) and electrical Skills in basic network of necessity of improvin readiness to work indir conditions. Distributed grid elements. cational results , small hydro plants, b cooperating with distril power quality degrada etermine parameters for on of secure exploitatio	t-circuit achines equipm c calcula d genera d genera for a f iogas pl oution n ation [or netwo	(transformers and ent. ations of power flow, short- ompetences in innovation nd cooperate within groups. ation and operating problem field of study ants heat and power etworks <u>KW_24+++, K_W25++]</u> ork secure exploitation neters for network		
1 2 3 Studies in elect 1. Sys genera 2. Know [KW_2 3. Know [KW_2 3. Know [K_U22 2. Abil [K_U22 2. Abil cooper 3. Use networ Socia	Knowledge Skills Social competencies mptions and obj s of various source en trical networks, power Study outco vledge: tematic knowledge in ting plants [K_W09- wledge in distributed g 24+++, K_W25++] wledge in minimizatio s: Is in connection projec 2++, K_U23++] ity to implementation of ated with distributed g e knowledge of the nur k [K_U22++] al competencies:	Basic knowledge in field of power of power generation. Basic theor synchronous and asynchronous Effective self-education in study circuits and voltage regulaton. Student should have consciousn technologies for power engeneer ectives of the course: ergy characteristics in normal and quality performance, overload risk mes and reference to the construction and properties wind f ++] generation connection methods an n of short-circuit thermal problems ets of distributed generation and a expert and design tools for determ generation [K_U22++, K_U23++ neric analysis for selected issues	er net ry of p s gene field. d fault k for c e edu farms nd its o s and and do +] in fiel	work, power flow, shor protections, electric ma rators) and electrical Skills in basic network of necessity of improvin readiness to work indivi- conditions. Distributed grid elements. cational results , small hydro plants, b cooperating with distril power quality degrada etermine parameters for on of secure exploitation d of distributed gener	t-circuit achines equipm c calcula ng his c vidual a d genera for a f iogas pl oution n ation [or netwo on parar ation cc	(transformers and ent. ations of power flow, short- ompetences in innovation nd cooperate within groups. ation and operating problem ield of study ants heat and power etworks KW_24+++, K_W25++] ork secure exploitation neters for network poperated with distributed		

Assessment methods of study outcomes

- assessment of knowledge and skills on the basis of test consisting on solving of design problem.

- permanent assessment on lectures and projects.

Obtaining additional points activity during lectures and projects, in particular way for:

- activity on classes in any attempt to solving of the problem to solve,

- skill of co-operation in workgroups.

Course description

Distributed generation characteristic: wind turbines, medium size industrial combined heat and power (CHP) installations, biomass/biogas fired plants, small hydroelectric plants (SHEP). Distributed generation connections to HV, MV and LV networks. Source regulation range, voltage levels and power flows in networks Distributed generation in fault conditions. Power quality performance in networks with distributed generation. Short-circuit risk for grid components in networks with distributed generation.

Update 2017: High power hybrid power plants, wind turbines and photovoltaic In distribution networks

Applied training methods

Lecture: the theory of the closely related to practice, Multimedia lecture

Project: case study of the real MV distribution network, working in a team

Basic bibliography:

1. Kacejko P.: Generacja rozproszona w systemie elektroenergetycznym. Wydawnictwo Politechniki Lubelskiej, Lublin, 2004 r.

2. Zajczyk R.: Zwarcia w układach elektroenergetycznych, Gdańsk, 2005 r.

3. Kahl T..: Sieci elektroenergetyczne, WNT, Warszawa, 1984 r.

4. Lubośny Z.: Farmy wiatrowe w systemie elektroenergetycznym, WNT, Warszawa, 2009 r.

Additional bibliography:

 Marszałkiewicz K., Grządzielski I., Trzeciak A.: Ocena wielokryterialna możliwości przyłączenia jednostek wytwórczych do sieci elektroenergetycznej średniego napięcia. Wiadomości Elektrotechniczne, Warszawa, 2012, 1 - ISSN 0043-5112 ss. 3-8.
 Thekla N., Boutsika A., Papathanassiou S.A.: Short-circuit calculations in networks with distributed generation. Electric

2. Thekia N., Boutsika A., Paparianassiou S.A.: Short-circuit calculations in networks with distributed generation. Electric Power Systems Research 2008 No 78.

3. Marszałkiewicz K., Grządzielski I., Trzeciak A.: Impact of Voltage Conditions on Distributed Generation Connctiivity in Medium Voltage Grids. Acta Energetica, 4/25 2015 ISSN 2300-3022

Result of average student's workload

Activity	Time (working hours)				
1. Participation in lectures	9				
2. Participation in project classes	9				
3. Project implementation	30				
4. Consultations	5				

Student's workload

Source of workload	hours	ECTS
Total workload	53	2
Contact hours	23	1
Practical activities	44	1