Name of the module/subject     Code       Municipal Energy Systems     Code       Field of study     Profile of study     Year /Semester       Environmental Engineering Second-cycle     (brak)     1 / 2			STUDY MODULE DE	SCRIPTION FORM		
Field of study       Politic of study (great al study (great al study) (great al study (great al study) (great al study (great al study) (great al study)		•		Code		
Environmental Engineering Second-cycle         (Iprak)         1/2           Elective path/specialty         Automation of and Air Protection         Subject offered in: Polish         Course (computatory, elective)           Cycle of study:         Form of study (full-time, part-time)         Form of study (full-time, part-time)         No. of credits           No. of nours         Lacture:         30         Classes:         15         Laboratory:         -           Studs of the course in the study program (Basic, major, other)         (university-wide, from another file)         No. of credits           Education areas and fields of science and at         ECTS distribution (number and 5)         4           Responsible for subject / lecturer:         prof. of hab. in2. Tomasz Mróz email: tomasz. mroz @put, pornan, pl         ECIS distribution (number and 5)           reflective of 60-665 Poznaf         Classification of renewable and non-renewable primary energy sources, evaluation of energy capacity of demand and supply side of energy market; .         Project/ and science equation in evaluation of energy systems in built environment: Capacity of demand and supply side of energy systems in built environment: built environment:           2         Skills         Application of energy balancing, economic and ecological evaluation of energy systems in built environment: built environment:           3         Social competencies         Awareness of the course in energy. economic and ecologic efficiency of energy systems in buil			5(6)115		Year /Semester	
Elective path/specially         Course (compulsory, elective)           Heating, Air Conditioning and Air Protection         Subject offered in:         Course (compulsory, elective)           System of study:         Form of study (full-time,part-time)         Form of study (full-time,part-time)           No. of hours         Lecture:         30         Classes:         15         Laboratory:         Project/seminars:         15         4           Status of the course in the study program (Basic, mapr, other)         (university-wide, from another field)         (brak)           Education areas and fields of science and art         Consect (brack)         Consect (brack)         Consect (brack)           Responsible for subject / lecturer:         prof. dt hab. in2. Tomasz Mróż ermait: tomasz.mroz@put.poznan.pl         tel. (brack)         Consect (brack)           Prerequisites in terms of knowledge, skills and social competencies:         1         Knowledge         Classification of renewable and non-renewable primary energy sources, evaluation of energy systems in built environment:         2         Skills         Calculation of coefficients of energy, economic and ecological evaluation of energy systems in built environment:           2         Skills         Application of energy balance equation in evaluation of energy systems in built environment:         2           3         Social competencies         Awareneses of the need to constantly update and supplement kno	Envi	ronmental Engin	eering Second-cycle		-	
Cycle of study:         Form of study (full-time, part-time)           Second-cycle studies         full-time           No. of hours         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)         4           Education areas and fields of science and att         ECTS distribution (number and %)         ECTS distribution (number and %)           Ford, dr hab, inż. Tomasz Mróz         emait: tomasz.mroz@put.poznan.pl         ECI (1) 6552900         Forauty of Cvi and Environmental Engineering           Procepuisites in terms of knowledge, skills and social competencies:         1         Knowledge         Classification of renewable and non-renewable primary energy sources, evaluation of energy balancing, economic and ecological evaluation of energy systems in built environment.           2         Skills         Application of energy balancing, economic and ecological evaluation of energy systems in built environment.           3         Social competencies         Awareness of the need to constantly update and supplement knowledge and skills.           9         Nucleores and reference to the educational results for a field of study           1         Knowledge         1         Avareness of the neergy systems in communities and planning of their modermization	Elective path/specialty			Subject offered in:	Course (compulsory, elective)	
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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 at       (brak)       (brak)       (brak)         Responsible for subject / lecturer:       prof. of hab. in2. Tomasz Mróz       email: tomasz.mroz@put.poznan.pl       ECTS distribution (number and %)         ref. of thab. in2. Tomasz Mróz       email: tomasz.mroz@put.poznan.pl       etail: tomasz.mroz@put.poznan.pl       ECTS distribution of number and %)         Precequisites in terms of knowledge, skills and social competencies:       Imain and supply side of energy market; ,       Principles of energy balancing, economic and ecological evaluation of energy systems in built environment;         3       Social coefficients of the course:       Application of energy balancing, economic and ecological evaluation of energy systems in built environment;         3       Social competencies       Awareness of the need to constantly update and supplement knowledge and skills.         Assumptions and objectives of the course:       Imaid environment;         1       Instudent has a theoretical and practical knowledge on energy systems in communities - [K2_W03, K2_W04, K2_W07]         2. The student has a theoretical and practical knowledge on the structure and principles of exploitation of		Second-c	ycle studies	full-time		
Status of the course in the study program (Basic, major, other)       (Iniversity-wide, from another field)         (brak)       (brak)         Education areas and fields of science and at       ECTS distribution (number and %)         Responsible for subject / lecturer:       prof. dr hab, in2. Tomasz Mróż email: tomasz.mroz@put.poznan.pl         tel. (61) 6652900       Faculty of Civil and Environmental Engineering ul. Piotrows 5 60-965 Poznań         Prerequisites in terms of knowledge, skills and social competencies:         1       Knowledge         Classification of renewable and non-renewable primary energy sources, evaluation of energy capacity of demand and supply side of energy market; , Principles of energy balancing, economic and ecological evaluation of energy systems in built environment; Calculation of coefficients of energy, balancing, economic and ecologic efficiency of energy systems in built environment; Calculation of coefficients of energy systems in communities and planning of their modernization and development.         3       Social competencies         Assumptions and objectives of the course:         Purchase by the students the knowledge and skills in analysis of energy systems in communities and planning of their modernization and development.         Study outcomes and reference to the educational results for a field of study         Yeard of the course:         Purchase by the students the knowledge on the structure and principles of exploitation of as systems in communities - [K2_W03, K2_W04, K2_W07]         1. The student has a t	No. of h					
(brak)         (brak)           Education areas and fields of science and art         ECTS distribution (number and %)           Responsible for subject / lecturer: prof. dr hab. inz. Tomasz Mróz email: tomasz.mroz@put.poznan.pl tel. (61) 6652900         Faculty of Civil and Environmental Engineering ul. Piotrows 5 60-965 Poznań           Prerequisites in terms of knowledge, skills and social competencies:         Image: Classification of renewable and non-renewable primary energy sources, evaluation of energy capacity of demand and supply side of energy market; . Principles of energy balancing, economic and ecological evaluation of energy systems in built environment.           2         Skills         Application of energy balancing, economic and ecologic efficiency of energy systems in built environment.           3         Social competencies         Application of energy balance equation in evaluation of energy systems in built environment; Calculation of coefficients of energy, economic and ecologic efficiency of energy systems in built environment;           3         Social competencies         Avareness of the need to constantly update and supplement knowledge and skills.           Purchase by the students the knowledge and skills in analysis of energy systems in communities and planning of their modernization and development.           1. The student has a theoretical and practical knowledge on the structure and principles of exploitation of electro-energy systems in communities - [K2_W03, K2_W04, K2_W07]           3. The student has a theoretical and practical knowledge on the structure and principles of exploitation of distric eating and distric cooling syste		0.4000		i rejecticommarci		
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and %)         Responsible for subject / lecturer:         prof. dr hab. in2. Tomasz Mróz         email: tomasz.mroz@put.poznan.pl         tel. (61) 6652900         Faculty of Civil and Environmental Engineering         ul. Piotrowo 5 60-965 Poznań         Prerequisites in terms of knowledge, skills and social competencies:         1       Knowledge         Pinciples of energy balancing, economic and ecological evaluation of energy systems in built environment.         2       Skills         Application of energy balancing, economic and ecological evaluation of energy systems in built environment.         3       Social competencies         Awareness of the need to constantly update and supplement knowledge and skills.         Assumptions and objectives of the course:         Purchase by the students the knowledge and skills in analysis of energy systems in communities and planning of their modernization and development.         Study outcomes and reference to the educational results for a field of study         Knowledge:         1. The student has a theoretical and practical knowledge on the structure and principles of exploitation of gas systems in communities - [K2_W03, K2_W04, K2_W07]         3. The student has a theoretical and practical knowledge on the structure and principles of exploitation of gas systems in communities - [K2_W03, K2_W04, K2_W07]         3. The student has a theoretical and practical knowledge on the structure and pri	Educati		<b>X 7</b>			
prof. dr hab. inž. Tomasz Mróz email: tomasz.mroz@put.poznan.pl tel. (61) 6652900         Facutly of Civil and Environmental Engineering ul. Piotrowo 5 60-965 Poznań         Prerequisites in terms of knowledge, skills and social competencies:         1       Knowledge         2       Classification of renewable and non-renewable primary energy sources, evaluation of energy capacity of demand and supply side of energy market; , Principles of energy balancing, economic and ecological evaluation of energy systems in built environment.         2       Skills       Application of energy balance equation in evaluation of energy systems in built environment; Calculation of coefficients of energy, economic and ecologic efficiency of energy systems in built environment;         3       Social competencies       Awareness of the need to constantly update and supplement knowledge and skills.         Assumptions and objectives of the course:       Purchase by the students the knowledge and skills in analysis of energy systems in communities and planning of their modernization and development.         1       The student has a theoretical and practical knowledge on energy systems in communities - [K2_W03, K2_W04, K2_W07]         2. The student has a theoretical and practical knowledge on the structure and principles of exploitation of gas systems in communities - [K2_W03, K2_W04, K2_W07]         3. The student has a theoretical and practical knowledge on the structure and principles of exploitation of gas systems in communities - [K2_W03, K2_W04, K2_W07]         4. The student has a theoretical and practical knowledge on the structure and pri	Educati					
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email: tomasz.mroz@put.poznan.pl tel. (61) 6652900         Faculty of Civil and Environmental Engineering ul. Piotrowo 5 60-965 Poznań         Prerequisites in terms of knowledge, skills and social competencies:         1       Knowledge         2       Skills         Classification of renewable and non-renewable primary energy sources, evaluation of energy capacity of demand and supply side of energy market; .         Principles of energy balancing, economic and ecological evaluation of energy systems in built environment.         2       Skills         Application of energy balance equation in evaluation of energy systems in built environment;         3       Social competencies         Purchase by the students the knowledge and skills in analysis of energy systems in communities and planning of their modernization and development.         Study outcomes and reference to the educational results for a field of study         Knowledge:         1. The student has a theoretical and practical knowledge on the structure and principles of exploitation of electro-energy systems in communities - [K2_W03, K2_W04, K2_W07]         3. The student has a theoretical and practical knowledge on the structure and principles of exploitation of gas systems in communities - [K2_W03, K2_W04, K2_W07]         3. The student has a theoretical and practical knowledge on the structure and principles of exploitation of gas systems in communities - [K2_W03, K2_W04, K2_W07]         3. The student has a theoretical and practical knowledge on the structure and princi	Resp	onsible for subj	ect / lecturer:			
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<ul> <li>Purchase by the students the knowledge and skills in analysis of energy systems in communities and planning of their modernization and development.</li> <li>Study outcomes and reference to the educational results for a field of study</li> <li>Knowledge: <ol> <li>The student has a theoretical and practical knowledge on energy systems in communities - [K2_W03, K2_W04, K2_W07]</li> <li>The student has a theoretical and practical knowledge on the structure and principles of exploitation of electro-energy systems in communities - [K2_W03, K2_W04, K2_W07]</li> <li>The student has a theoretical and practical knowledge on the structure and principles of exploitation of gas systems in communities - [K2_W03, K2_W04, K2_W07]</li> <li>The student has a theoretical and practical knowledge on the structure and principles of exploitation of district eating and district cooling systems in communities - [K2_W03, K2_W04, K2_W07]</li> <li>The student has a theoretical and practical knowledge on the structure and principles of exploitation of district eating and district cooling systems in communities - [K2_W03, K2_W04, K2_W07]</li> <li>The student knows the principles of demand and supply side analysis of energy markets in communities and market interdependences between energy sides - [K2_W06]</li> <li>The student knows the methods of multicriteria aided planning of modernization and development of energy market in communities - [K2_W03, K2_W04, K2_W06]</li> </ol></li></ul>	3		Awareness of the need to constan	tly update and supplement ki	nowledge and skills.	
modernization and development.         Study outcomes and reference to the educational results for a field of study         Knowledge:         1. The student has a theoretical and practical knowledge on energy systems in communities - [K2_W03, K2_W04, K2_W07]         2. The student has a theoretical and practical knowledge on the structure and principles of exploitation of electro-energy systems in communities - [K2_W03, K2_W04, K2_W07]         3. The student has a theoretical and practical knowledge on the structure and principles of exploitation of gas systems in communities - [K2_W03, K2_W04, K2_W07]         4. The student has a theoretical and practical knowledge on the structure and principles of exploitation of district eating and district cooling systems in communities - [K2_W03, K2_W04, K2_W07]         5. The student knows the principles of demand and supply side analysis of energy markets in communities and market interdependences between energy sides - [K2_W06]         6. The student knows the methods of multicriteria aided planning of modernization and development of energy market in communities - [K2_W03, K2_W04, K2_W06]	Assu	mptions and obj	ectives of the course:			
<ul> <li>Knowledge:</li> <li>1. The student has a theoretical and practical knowledge on energy systems in communities - [K2_W03, K2_W04, K2_W07]</li> <li>2. The student has a theoretical and practical knowledge on the structure and principles of exploitation of electro-energy systems in communities - [K2_W03, K2_W04, K2_W07]</li> <li>3. The student has a theoretical and practical knowledge on the structure and principles of exploitation of gas systems in communities - [K2_W03, K2_W04, K2_W07]</li> <li>4. The student has a theoretical and practical knowledge on the structure and principles of exploitation of district eating and district cooling systems in communities - [K2_W03, K2_W04, K2_W07]</li> <li>5. The student knows the principles of demand and supply side analysis of energy markets in communities and market interdependences between energy sides - [K2_W06]</li> <li>6. The student knows the methods of multicriteria aided planning of modernization and development of energy market in communities - [K2_W03, K2_W04, K2_W06]</li> </ul>				energy systems in communi	ities and planning of their	
<ol> <li>The student has a theoretical and practical knowledge on energy systems in communities - [K2_W03, K2_W04, K2_W07]</li> <li>The student has a theoretical and practical knowledge on the structure and principles of exploitation of electro-energy systems in communities - [K2_W03, K2_W04, K2_W07]</li> <li>The student has a theoretical and practical knowledge on the structure and principles of exploitation of gas systems in communities - [K2_W03, K2_W04, K2_W07]</li> <li>The student has a theoretical and practical knowledge on the structure and principles of exploitation of gas systems in communities - [K2_W03, K2_W04, K2_W07]</li> <li>The student has a theoretical and practical knowledge on the structure and principles of exploitation of district eating and district cooling systems in communities - [K2_W03, K2_W04, K2_W07]</li> <li>The student has a theoretical and practical knowledge on the structure and principles of exploitation of district eating and district cooling systems in communities - [K2_W03, K2_W04, K2_W07]</li> <li>The student knows the principles of demand and supply side analysis of energy markets in communities and market interdependences between energy sides - [K2_W06]</li> <li>The student knows the methods of multicriteria aided planning of modernization and development of energy market in communities - [K2_W03, K2_W04, K2_W06]</li> </ol>		Study outco	mes and reference to the e	ducational results for	a field of study	
<ol> <li>The student has a theoretical and practical knowledge on the structure and principles of exploitation of electro-energy systems in communities - [K2_W03, K2_W04, K2_W07]</li> <li>The student has a theoretical and practical knowledge on the structure and principles of exploitation of gas systems in communities - [K2_W03, K2_W04, K2_W07]</li> <li>The student has a theoretical and practical knowledge on the structure and principles of exploitation of district eating and district cooling systems in communities - [K2_W03, K2_W04, K2_W07]</li> <li>The student has a theoretical and practical knowledge on the structure and principles of exploitation of district eating and district cooling systems in communities - [K2_W03, K2_W04, K2_W07]</li> <li>The student knows the principles of demand and supply side analysis of energy markets in communities and market interdependences between energy sides - [K2_W06]</li> <li>The student knows the methods of multicriteria aided planning of modernization and development of energy market in communities - [K2_W03, K2_W04, K2_W06]</li> </ol>	Knov	vledge:				
<ol> <li>The student has a theoretical and practical knowledge on the structure and principles of exploitation of gas systems in communities - [K2_W03, K2_W04, K2_W07]</li> <li>The student has a theoretical and practical knowledge on the structure and principles of exploitation of district eating and district cooling systems in communities - [K2_W03, K2_W04, K2_W07]</li> <li>The student knows the principles of demand and supply side analysis of energy markets in communities and market interdependences between energy sides - [K2_W06]</li> <li>The student knows the methods of multicriteria aided planning of modernization and development of energy market in communities - [K2_W06]</li> </ol>	2. The	student has a theoret	cal and practical knowledge on the			
<ul> <li>communities - [K2_W03, K2_W04, K2_W07]</li> <li>4. The student has a theoretical and practical knowledge on the structure and principles of exploitation of district eating and district cooling systems in communities - [K2_W03, K2_W04, K2_W07]</li> <li>5. The student knows the principles of demand and supply side analysis of energy markets in communities and market interdependences between energy sides - [K2_W06]</li> <li>6. The student knows the methods of multicriteria aided planning of modernization and development of energy market in communities - [K2_W03, K2_W04, K2_W06]</li> </ul>	-			structure and principles of ev	valoitation of gas systems in	
<ul> <li>district cooling systems in communities - [K2_W03, K2_W04, K2_W07]</li> <li>5. The student knows the principles of demand and supply side analysis of energy markets in communities and market interdependences between energy sides - [K2_W06]</li> <li>6. The student knows the methods of multicriteria aided planning of modernization and development of energy market in communities - [K2_W03, K2_W04, K2_W06]</li> </ul>	commu	unities - [K2_W03, K2	_W04, K2_W07]			
interdependences between energy sides - [K2_W06] 6. The student knows the methods of multicriteria aided planning of modernization and development of energy market in communities - [K2_W03, K2_W04, K2_W06]	district	cooling systems in co	mmunities - [K2_W03, K2_W04, K2	2_W07]	· · ·	
communities - [K2_W03, K2_W04, K2_W06]	interde	pendences between e	energy sides - [K2_W06]			
Skills:	commu	unities - [K2_W03, K2		or modernization and develo	opment of energy market in	
	Skills	5:				

1. The student can evaluate the energy capacity of demand and supply side of energy market in communities [K2\_U09, K2\_U10]

2. The student can identify and calculate the evaluation criteria of demand and supply side of energy markets in communities - [K2\_U12, K2\_U18]

3. The student can identify the basic trends of energy market development in communities - [K2\_U01, K2\_U08, K2\_U18]

4. The student is able to use one of multicriteria analysis in planning of modernization and development of energy markets in communities - [K2\_U10, K2\_U14]

### Social competencies:

1. The student understands the need for teamwork in solving theoretical and practical problems - [K2\_K03]

2. The student is aware of the need to sustainable development of energy markets in communities - [K2\_K05]

3. The student sees the need for systematic increasing his skills and competences - [K2\_K01]

# Assessment methods of study outcomes

Lectures:

Written examination ? multiple choice test consisting of 30 questions

Continuous assessment during lectures (rewarding activity of the students).

Project:

- preparation and defending the project on energy planning,

- continuous assessment during lectures (rewarding activity of the students)

### Course description

#### Lectures:

Basic knowledge on energy systems in communities: energy market, demand and supply side of energy market, market interdependency;

Description of demand and supply side of electro-energy system in communities; Principles of evaluation of demand and supply side of electro-energy system in communities;

Description of demand and supply side of gas system in communities; Principles of evaluation of demand and supply side of gas system in communities;

Description of demand and supply side of distrct heating and district cooling energy system in communities; Principles of evaluation of demand and supply side of district heating and cooling energy;

Evaluation criteria of energy systems in communities based on energy, economy and ecological issues;

Energy planning procedures based and system approach and multicriteria aided decision making (ELECTRE III/IV, AHP);

Project:

1. Energy planning for chosen Energy system in community

## Basic bibliography:

1. Mitosek M., Mechanika płynów w inżynierii i ochronie środowiska. Warszawa, PWN 2001

2. Orzechowski Z., Prywer J., Zarzycki R., Mechanika płynów w inżynierii środowiska. Wyd. 2 zmienione. Warszawa, WNT 2001

Jeżowiecka-Kabsch K., Szewczyk H., Mechanika płynów. Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław 2001
 Mitosek M., Matlak M., Kodura A., Zbiór zadań z hydrauliki dla inżynierii i ochrony środowiska. Oficyna wydawnicza Politechniki Warszawskiej, Warszawa 2004

5. Orzechowski Z., Prywer J., Zarzycki R., Zadania z mechanika płynów w inżynierii środowiska. Warszawa, WNT 2001

6. Bogusławski L. (Red.), Ćwiczenia laboratoryjne z mechaniki płynów. Wydawnictwo Politechniki Poznańskiej, Poznań 1999

7. Niełacny M., Ćwiczenia laboratoryjne z mechaniki płynów. Wydawnictwo Politechniki Poznańskiej, Poznań 1996

## Additional bibliography:

1. Munson B.R., Young D.F., Okiishi T.H., Fundamentals of Fluid Mechanics (4rd. Ed.). John Wiley and Sons Inc., New York 2002

2. White F.M., Fluid Mechanics. McGrawHill Book Company. 5th Int. Ed. Boston 2003

## Result of average student's workload

Activity

Time (working hours)

1. Participation in lectures		30	
2. Participation in projects		30	
3. Participation in consultations related to the project		6	
4. Preparation of the project	20		
5. Preparation for the final examination		20	
6. Preparation for the defending of the project	14		
Student's wo	rkload		
Source of workload	hours	ECTS	
Total workload	120	4	
Contact hours	66	3	
Practical activities	70	1	