

## **PROGRAMME OF EDUCATION**

**FACULTY: MECHANICAL AND POWER ENGINEERING**

**MAIN FIELD OF STUDY: POWER ENGINEERING**

in area of science technical science

**EDUCATION LEVEL: 2nd level**

**FORM OF STUDIES: part-time**

**PROFILE: general academic**

**SPECIALIZATION: RENEWABLE SOURCES OF ENERGY**

**LANGUAGE OF STUDY: POLISH**

Content:

1. Assumed educational effects – attachment no. 1
2. Programme of studies – attachment no. 2

Faculty Council Resolution of 26.09.2012

In effect since 01.10.2012

Edited adjustment\_April 2014

**PROGRAMME OF STUDIES**

**1. Description**

<p><i>Number of semesters: 3</i></p>	<p><i>Number ECTS points necessary to obtain qualifications: 90</i></p>
<p><i>Prerequisites (particularly for second-level studies):</i></p> <p>first degree qualifications and skills necessary to continue the engineering education at the secondary level studies:</p> <p>knowledge of physics and mathematics that enables understanding of the fundamentals of physical phenomena used in the energy sector and to formulate and solve simple design tasks in the field of energy, knowledge and skills in the field of mechanics, electronics, electrical engineering, materials science, metrology, fluid mechanics, thermodynamics and the basics of machine design, enabling the measurement, analysis and design of simple components and of power systems, skill to formulate and solve engineering tasks, methods and experimental design, knowledge and skills in methodology and design techniques to enable formulation of a simple engineering problems and develop the solution using appropriate tools information, skills in interpretation, presentation and documentation of the experimental results, and the presentation and documentation of the project tasks.</p>	<p><i>Upon completion of studies graduate obtains professional degree of:</i></p> <p><i>magister inżynier</i></p> <p><i>2nd level qualifications</i></p>

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<sup>2</sup>Traditional – enter T, remote – enter Z

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<sup>4</sup>University-wide course /group of courses – enter O

<sup>5</sup>Practical course / group of courses – enter P. For the group of courses – in brackets enter the number of ECTS points assigned to practical courses

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<sup>7</sup> Optional – enter W, obligatory – enter Ob

<p><i>Possibility of continuing studies: third level PhD studies</i></p>	<p><i>Graduate profile, employability:</i></p> <p>A graduate has the detailed knowledge and skills in the field of advanced technologies and processes, and methods for testing the operation of machinery and equipment in the power industry and related industries.</p> <p>He is prepared for the design, optimization and implementation of new energy technologies, in particular renewable energy sources and to work in the local governments and self-employment in the conditions of the functioning of the energy market and the principle of sustainable development. He knows a foreign language at B2+ level and a second foreign language at A1 or A2 level</p>
<p><i>Indicate connection with University's mission and its development strategy:</i></p>	<p>The training program is in accordance with mission of the university in the transfer of knowledge and skills to maintain high quality of education and the development of creative, critical and tolerant personality of students through the development and nurturing a strong sense of academic community based on intellectual and social communication of students and employees.</p>

**2. Fields of science and scientific disciplines to which educational effects apply:** technical science

**3. Concise analysis of consistency between assumed educational effects and labour market needs:** The expected educational effect provide the growth of engineering competence obtained on the first degree of education, especially in terms of knowledge and skills, with particular emphasis on creativity in solving specific technical problems. The education program equips a graduate with the attributes thus enabling him to adapt to the rapidly changing requirements of the job market.

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<sup>7</sup> Optional – enter W, obligatory – enter Ob

## 4. List of education modules:

### 4.1 List of obligatory modules:

#### 4.1.1 List of general education modules

##### 4.1.1.1 Liberal-managerial subjects module (min. 2 ECTS points):

No.	Course/group of courses code	Name of course/group of courses (denote group of courses with symbol GK)	Weekly number of hours					Field-of-study educational effect symbol	Number of hours		Number of ECTS points		Form <sup>2</sup> of course/group of courses	Way <sup>3</sup> of crediting	Course/group of courses				
			lec	cl	lab	pr	sem		ZZU	CNPS	total	BK classes <sup>1</sup>			university-wide <sup>4</sup>	practical <sup>5</sup>	kind <sup>6</sup>	type <sup>7</sup>	
1	ENN0701	Marketing and management	1,07					K2ENG_W06	16	60	2	1	T	Z	O			KO	Ob
		Total	1,07						16	60	2	1							

#### Altogether for general education modules

Total number of hours					Total number of ZZU hours	Total number of CNPS hours	Total number of ECTS points	Number of ECTS points for BK classes <sup>1</sup>
lec	cl	lab	pr	sem				
1,07					16	60	2	1

#### 4.1.2 List of basic sciences modules

##### 4.1.2.1 Mathematics module

No.	Course/group of courses code	Name of course/group of courses (denote group of courses with symbol GK)	Weekly number of hours					Field-of-study educational effect symbol	Number of hours		Number of ECTS points		Form <sup>2</sup> of course/group of courses	Way <sup>3</sup> of crediting	Course/group of courses				
			lec	cl	lab	pr	sem		ZZU	CNPS	total	BK classes <sup>1</sup>			university-wide <sup>4</sup>	practical <sup>5</sup>	kind <sup>6</sup>	type <sup>7</sup>	
1	ENN0900	Probability theory	2,13					K2ENG_W01	32	90	3	1,5	T	E				PD	Ob

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<sup>4</sup>University-wide course /group of courses – enter O

<sup>5</sup>Practical course / group of courses – enter P. For the group of courses – in brackets enter the number of ECTS points assigned to practical courses

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2	ENN0900	Probability theory		1,07				K2ENG_U05	16	60	2	1,5	T	Z		P	PD	Ob
3	ENN0502	Numerical methods	2,13					K2ENG_W02	32	90	3	1,5	T	E			PD	Ob
4	ENN0502	Numerical methods			2,13			K2ENG_U06	32	60	2	1,5	T	Z		P	PD	Ob
Total			4,26	1,07	2,13				112	300	10	6						

#### 4.1.2.2 Physics module

No.	Course/group of courses code	Name of course/group of courses (denote group of courses with symbol GK)	Weekly number of hours					Field-of-study educational effect symbol	Number of hours		Number of ECTS points		Form <sup>2</sup> of course/group of courses	Way <sup>3</sup> of crediting	Course/group of courses				
			lec	cl	lab	pr	sem		ZZU	CNPS	total	BK classes <sup>1</sup>			university-wide <sup>4</sup>	practical <sup>5</sup>	kind <sup>6</sup>	type <sup>7</sup>	
1	ENN0192	Quantum Physics	2,13					K2ENG_W03	32	90	3	1,5	T	E				PD	Ob
Total			2,13						32	90	3	1,5							

#### Altogether for basic sciences modules:

Total number of hours					Total number of ZZU hours	Total number of CNPS hours	Total number of ECTS points	Number of ECTS points for BK classes <sup>1</sup>
lec	cl	lab	pr	sem				
6,39	1,07	2,13			144	390	13	7,5

### 4.1.3 List of main-field-of-study modules

#### 4.1.3.1 Obligatory main-field-of-study modules

No.	Course/group of courses code	Name of course/group of courses (denote group of courses with symbol GK)	Weekly number of hours					Field-of-study educational effect symbol	Number of hours		Number of ECTS points		Form <sup>2</sup> of course/group of courses	Way <sup>3</sup> of crediting	Course/group of courses				
			lec	cl	lab	pr	sem		ZZU	CNPS	total	BK classes <sup>1</sup>			university-wide <sup>4</sup>	practical <sup>5</sup>	kind <sup>6</sup>	type <sup>7</sup>	
1	ENN0553	Mathematical modelling of energy generation installations	1,6					K2ENG_W05	24	60	2	1	T	E				K	Ob.
2	ENN0553	Mathematical modelling of energy generation installations			2,67			K2ENG_U07	40	120	4	3	T	Z		P		K	Ob.
3	ENN1112	New generation energy technologies	1,07					K2ENG_W04	16	90	3	1,5	T	E				K	Ob.

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<sup>3</sup>Exam – enter E, crediting – enter Z. For the group of courses – after the letter E or Z - enter in brackets the final course form (lec, cl, lab, pr, sem)

<sup>4</sup>University-wide course / group of courses – enter O

<sup>5</sup>Practical course / group of courses – enter P. For the group of courses – in brackets enter the number of ECTS points assigned to practical courses

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<sup>7</sup>Optional – enter W, obligatory – enter Ob

4	ENN1062	Energy systems	1,07					K2ENG_W07	16	60	2	1	T	Z			K	Ob.
5	ENN1062	Energy systems		0,53				K2ENG_U08	8	30	1	0,75	T	Z		P	K	Ob.
6	ENN1300	Environmental management	1,07					K2ENG_W06 K2ENG_K02	16	60	2	1	T	Z			K	Ob.
7	ENN1380	Master seminar					1,07	K2ENG_U01 K2ENG_U02 K2ENG_K01 K2ENG_K03 K2ENG_K04 K2ENG_K05	16	60	2	1,5	T	Z		P	K	Ob.
Total			4,81	0,53	2,67		1,07		136	480	16	9,75						

### Altogether for main-field-of-study modules:

Total number of hours					Total number of ZZU hours	Total number of CNPS hours	Total number of ECTS points	Number of ECTS points for BK classes <sup>1</sup>
lec	cl	lab	pr	sem				
4,81	0,53	2,67		1,07	136	480	16	9,75

## 4.2 List of optional modules

### 4.2.1 List of general education modules

#### 4.2.1.1 Liberal-managerial subjects modules (*min.1 ECTS points*):

No.	Course/group of courses code	Name of course/group of courses (denote group of courses with symbol GK)	Weekly number of hours					Field-of-study educational effect symbol	Number of hours		Number of ECTS points		Form <sup>2</sup> of course/group of courses	Way <sup>3</sup> of crediting	Course/group of courses			
			lec	cl	lab	pr	sem		ZZU	CNPS	total	BK classes <sup>1</sup>			university-wide <sup>4</sup>	practical <sup>5</sup>	kind <sup>6</sup>	type <sup>7</sup>
1	HNN100200BK	Humanities	0,53					K2ENG_W06 K2ENG_K02	8	30	1	0,5	T	Z	O		KO	W
Total			0,53						8	30	1	0,5						

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<sup>3</sup>Exam – enter E, crediting – enter Z. For the group of courses – after the letter E or Z - enter in brackets the final course form (lec, cl, lab, pr, sem)

<sup>4</sup>University-wide course /group of courses – enter O

<sup>5</sup>Practical course / group of courses – enter P. For the group of courses – in brackets enter the number of ECTS points assigned to practical courses

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#### 4.2.1.2 Foreign languages module (min. 3 ECTS points):

No.	Course/group of courses code	Name of course/group of courses (denote group of courses with symbol GK)	Weekly number of hours					Field-of-study educational effect symbol	Number of hours		Number of ECTS points		Form <sup>2</sup> of course/group of courses	Way <sup>3</sup> of crediting	Course/group of courses			
			lec	cl	lab	pr	sem		ZZU	CNPS	total	BK classes <sup>1</sup>			university-wide <sup>4</sup>	practical <sup>5</sup>	kind <sup>6</sup>	type <sup>7</sup>
1	JZL100655BK	Foreign Language, B2+ level		0,53				K2ENG_U04	8	30	1	0,75	T	Z	O	P	KO	W
2	JZL100655BK	Foreign Language (second), any level		2,13				K2ENG_U09	32	60	2	1,5	T	Z	O	P	KO	W
Total				2,66					40	90	3	2,25						

#### Altogether for general education modules:

Total number of hours					Total number of ZZU hours	Total number of CNPS hours	Total number of ECTS points	Number of ECTS points for BK classes <sup>1</sup>
lec	cl	lab	pr	sem				
0,53	2,66				48	120	4	2,75

## 4.2.2 List of main-field-of-study modules

#### 4.2.2.1 Master individual student project module (min. 5 ECTS points):

No..	Course/group of courses code	Name of course/group of courses (denote group of courses with symbol GK)	Weekly number of hours					Field-of-study educational effect symbol	Number of hours		Number of ECTS points		Form <sup>2</sup> of course/group of courses	Way <sup>3</sup> of crediting	Course/group of courses			
			lec	cl	lab	pr	sem		ZZU	CNPS	total	BK classes <sup>1</sup>			university-wide <sup>4</sup>	practical <sup>5</sup>	kind <sup>6</sup>	type <sup>7</sup>
1	ENN1363	Master individual student project					4,00		60	150	5	2	T	Z		P	K	W
Total						4			60	150	5	2						

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<sup>4</sup>University-wide course /group of courses – enter O

<sup>5</sup>Practical course / group of courses – enter P. For the group of courses – in brackets enter the number of ECTS points assigned to practical courses

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#### 4.2.2.2 Master thesis module (min. 20 ECTS points):

No..	Course/group of courses code	Name of course/group of courses (denote group of courses with symbol GK)	Weekly number of hours					Field-of-study educational effect symbol	Number of hours		Number of ECTS points		Form <sup>2</sup> of course/group of courses	Way <sup>3</sup> of crediting	Course/group of courses			
			lec	cl	lab	pr	sem		ZZU	CNPS	total	BK classes <sup>1</sup>			university-wide <sup>4</sup>	practical <sup>5</sup>	kind <sup>6</sup>	type <sup>7</sup>
1	ENN1430	Master thesis						K2ENG_U01 K2ENG_U02 K2ENG_U03 K2ENG_K01 K2ENG_K04 K2ENG_K05	600	20	4	T	Z		P		W	
Total									600	20	4							

#### Altogether for main-field-of-study modules:

Total number of hours					Total number of ZZU hours	Total number of CNPS hours	Total number of ECTS points	Number of ECTS points for BK classes <sup>1</sup>
lec	cl	lab	pr	sem				
			4		60	750	25	6

### 4.2.3 List of specialization modules

#### 4.2.3.1 Specialization Renewable sources of energy modules (min. 30 ECTS points):

No..	Course/group of courses code	Name of course/group of courses (denote group of courses with symbol GK)	Weekly number of hours					Field-of-study educational effect symbol	Number of hours		Number of ECTS points		Form <sup>2</sup> of course/group of courses	Way <sup>3</sup> of crediting	Course/group of courses			
			lec	cl	lab	pr	sem		ZZU	CNPS	total	BK classes <sup>1</sup>			university-wide <sup>4</sup>	practical <sup>5</sup>	kind <sup>6</sup>	type <sup>7</sup>
1	ENN0181	Physics of the renewable energy	1,07					S2OZE_W01	16	60	2	1	T	Z			S	W
2	ENN0181	Physics of the renewable energy		1,07				S2OZE_U01	16	60	2	1,5	T	Z		P	S	W
3	ENN0181	Physics of the renewable energy					0,53	S2OZE_U02	8	30	1	0,75	T	Z		P	S	W

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4	ENN0570	Fuel cell and technology of hydrogen production	1,07					S2OZE_W02	16	60	2	1	T				S	W
5	ENN0570	Fuel cell and technology of hydrogen production			0,53			S2OZE_U03	8	30	1	0,75	T	Z		P	S	W
6	ENN0173	Water power engineering	1,07					S2OZE_W03	16	60	2	1	T				S	W
7	ENN0173	Water power engineering		0,53				S2OZE_U04	8	30	1	0,75	T	Z		P	S	W
8	ENN0173	Water power engineering				0,53		S2OZE_U05	16	60	2	1,5	T	Z		P	S	W
9	ENN0301	Pollutants emission control	1,07					S2OZE_W04	16	60	2	1	T				S	W
10	ENN0301	Pollutants emission control			1,07			S2CCK_U06	16	60	2	1,5	T	Z		P	S	W
11	ENN0355	Refrigeration heating systems	0,53					S2OZE_W05	8	30	1	0,5	T				S	W
12	ENN0355	Refrigeration heating systems				0,53		S2OZE_U07 K2ENG_K04	8	30	1	0,75	T	Z		P	S	W
13	ENN0130	Wind power plants	0,53					S2OZE_W06	8	30	1	0,5	T				S	W
14	ENN0130	Wind power plants				1,07		S2OZE_U08	16	60	2	1,5	T	Z		P	S	W
15	ENN0140	Geothermal power engineering	0,53					S2OZE_W07	8	30	1	0,5	T				S	W
16	ENN0140	Geothermal power engineering		0,53				S2OZE_U09	8	30	1	0,75	T	Z		P	S	W
17	ENN1122	Power production systems and technology from biomass	1,07					S2OZE_W08	16	60	2	1	T				S	W
18	ENN1122	Power production systems and technology from biomass		0,53				S2OZE_U10	8	30	1	0,75	T	Z		P		W
19	ENN0194	Photo-thermal energy conversion system	0,53					S2OZE_W09	8	30	1	0,5	T				S	W
20	ENN0194	Photo-thermal energy conversion system				1,07		S2OZE_U12	16	60	2	1,5	T			P	S	W
Total			7,47	2,66	1,60	3,20	0,53		240	900	30	19						

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<sup>4</sup>University-wide course /group of courses – enter O

<sup>5</sup>Practical course / group of courses – enter P. For the group of courses – in brackets enter the number of ECTS points assigned to practical courses

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<sup>7</sup> Optional – enter W, obligatory – enter Ob

**Altogether for specialization modules:**

Total number of hours					Total number of ZZU hours	Total number of CNPS hours	Total number of ECTS points	Number of ECTS points for BK classes <sup>1</sup>
lec	cl	lab	pr	sem				
7,47	2,66	1,6	3,2	0,53	240	900	30	19

**4.3 Diploma dissertation module**

Type of diploma dissertation	magister	
Number of diploma dissertation semesters	Number of ECTS points	Code
1	20	ESN1430
Character of diploma dissertation		
Experimental, literature survey, project		
Number of BK <sup>1</sup> ECTS points	4	

**5. Ways of verifying assumed educational effects**

Type of classes	Ways of verifying assumed educational effects
lecture	examination, progress/final test
class	progress/final test
laboratory	pretest, report from laboratory
project	project defence
seminar	participation in discussion, topic presentation, essay
diploma dissertation	prepared diploma dissertation

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<sup>4</sup>University-wide course /group of courses – enter O

<sup>5</sup>Practical course / group of courses – enter P. For the group of courses – in brackets enter the number of ECTS points assigned to practical courses

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<sup>7</sup> Optional – enter W, obligatory – enter Ob

**6. Total number of ECTS points, which student has to obtain from classes requiring direct academic teacher-student contact** (enter total of ECTS points for courses/groups of courses denoted with code BK<sup>1</sup>)

**46 ECTS**

**7. Total number of ECTS points, which student has to obtain from basic sciences classes**

Number of ECTS points for obligatory subjects	13
Number of ECTS points for optional subjects	0
Total number of ECTS points	13

**8. Total number of ECTS points, which student has to obtain from practical classes, including laboratory classes** (enter total number of ECTS points for courses/group of courses denoted with code P)

Number of ECTS points for obligatory subjects laboratory and project subject	11 5
Number of ECTS points for optional subjects laboratory and project subject <i>master thesis</i>	44 15 20
Total number of ECTS points	55

**9. Minimum number of ECTS points, which student has to obtain doing education modules offered as part of university-wide classes or other main field of study** (enter number of ECTS points for courses/groups of courses denoted with code OG)

**4 ECTS points**

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<sup>4</sup>University-wide course /group of courses – enter O

<sup>5</sup>Practical course / group of courses – enter P. For the group of courses – in brackets enter the number of ECTS points assigned to practical courses

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<sup>7</sup> Optional – enter W, obligatory – enter Ob

## 10. Total number of ECTS points, which student may obtain doing optional modules (min. 30% of total number of ECTS points)

**59 ECTS points**

## 11. Range of diploma dissertation

### 1. Theoretical issues

- 1.1. Quantum phenomena in nature (blackbody radiation, photoelectric effect, mass defect in nuclear transformations)
- 1.2. Modeling of properties of substances
- 1.3. Modeling of energy conversion processes. Exergy analysis
- 1.4. Methods of mathematical modeling of power systems
- 1.5. Fundamentals of hydrology - hydrology graphs, type of rivers, the concentration of energy
- 1.6. Fundamentals of aero- power engineering - the use of wind energy, physics of the wind
- 1.7. Fundamentals of helio- power engineering – efficiency of use of solar radiation
- 1.8. Basics of fuel cells
- 1.9. Thermodynamic base of operation of heat pumps
- 1.10. Energy efficiency of refrigerating heating systems
- 1.11. Real cycle of heat pump
- 1.12. Processing of biomass - chemical and physical processes

### 2. Design and technological issues

- 2.1. Water turbines and generators - design and system solutions
- 2.2. Types of wind turbines and wind power systems construction
- 2.3. Solar collectors - construction solutions
- 2.4. Photovoltaic cells - construction solutions
- 2.5. Heat pumps - construction solutions
- 2.6. Support devices for heat pump systems
- 2.7. Renewable energy in heating engineering
- 2.8. Refrigerating heating systems for waste heat recovery
- 2.9. Types of fuel cells and their characteristics

<sup>1</sup>BK – number of ECTS points assigned to hours of classes requiring direct contact of teachers with students

<sup>2</sup>Traditional – enter T, remote – enter Z

<sup>3</sup>Exam – enter E, crediting – enter Z. For the group of courses – after the letter E or Z - enter in brackets the final course form (lec, cl, lab, pr, sem)

<sup>4</sup>University-wide course /group of courses – enter O

<sup>5</sup>Practical course / group of courses – enter P. For the group of courses – in brackets enter the number of ECTS points assigned to practical courses

<sup>6</sup> KO – general education, PD – basic sciences, K – field-of-studies, S – specialization

<sup>7</sup> Optional – enter W, obligatory – enter Ob

- 2.10. Methods of hydrogen production and storage techniques
- 2.11. Technologies of use of heat energy from geothermal water for the needs of the economy
- 2.12. Power production system and technology from biomass
- 2.13. Storage of energy - technical solutions

**3. Exploitation issues**

- 3.1. Diagnostics, security and reliability of power systems
- 3.2. Management systems in the power industry
- 3.3. Energy markets – marketing actions
- 3.4. Environmental policy instruments used in the production of energy
- 3.5. Clean technologies in the power industry
- 3.6. Environmental aspects of the use of renewable energy sources
- 3.7. Exploitation of water turbines
- 3.8. Exploitation problems related to combustion and co-firing of biomass
- 3.9. Emissions of pollutants control - continuous and periodic measurements, measuring apparatus
- 3.10. The operating parameters of heating systems based on heat pumps
- 3.11. Operating point of bivalent and monoenergetic heat pump
- 3.12. The properties and characteristics of wind turbines

**12. Requirements concerning deadlines for crediting courses/groups of courses for all courses in particular modules**

<i>No.</i>	<i>Course code</i>	<i>Name of course</i>	<i>Crediting by deadline of... (number of semester)</i>
	Faculty Council Resolution No. 4/D/2008 of 19.09.2008	The condition for admission the student to the execution of the master thesis module is to pass all subjects in plan of studies in the semester prior to the semester of graduation	

**13. Plan of studies (attachment no. 1)**

<sup>1</sup>BK – number of ECTS points assigned to hours of classes requiring direct contact of teachers with students

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<sup>5</sup>Practical course / group of courses – enter P. For the group of courses – in brackets enter the number of ECTS points assigned to practical courses

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