

PROGRAMME OF EDUCATION

FACULTY: MECHANICAL AND POWER ENGINEERING

MAIN FIELD OF STUDY: POWER ENGINEERING

in area of technical science

EDUCATION LEVEL: 2nd level, Master of Science

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 30.09.2015

In effect since 01.10.2015

PROGRAMME OF STUDIES**1. Description**

<p><i>Number of semesters:</i></p> <p>4</p>	<p><i>Number ECTS points necessary to obtain qualifications:</i></p> <p>120</p>
<p><i>Prerequisites (particularly for second-level studies):</i></p> <p>1st level qualifications and engineering skills necessary to continue education at 2nd level studies: knowledge of physics and mathematics that enables understanding of the fundamentals of physical phenomena used in the energetics and formulating and solving simple design tasks in the field of energetics, knowledge and skills in the field of mechanics, electronics, electrical , materials, metrology, fluid mechanics, thermodynamics and the basics of machine design, enabling taking of measurements, analysis and design of simple components and power systems, the ability to use to formulate and solve engineering tasks, and methods and experimental design, knowledge and skills in methods and techniques design, enabling the formulation of a simple engineering problem and develop the solution using appropriate computational tools, skills of interpretation, presentation and documentation of the experiment, and the presentation and documentation of the project tasks.</p>	<p><i>Upon completion of studies graduate obtains</i></p> <p><i>professional degree of:</i> Master of Science</p> <p>2nd level qualifications</p>
<p><i>Possibility of continuing studies:</i> 3rd level doctoral studies</p>	<p><i>Graduate profile, employability:</i> 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. 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.

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. 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 ² of course/group of courses	Way ³ of crediting	Course/group of courses			
			lec	cl	lab	pr	sem		ZZU	CNPS	total	BK classes ¹			university-wide ⁴	practical ⁵	kind ⁶	type ⁷
1	ENN0702	Marketing and Management	1,2					K2ENG_W06	18	90	3	1,5	T	Z			KO	Ob
		Total	1,2						18	90	3	1,5						

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 ¹
lec	cl	lab	pr	sem				
1,2					18	90	3	1,5

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

²Traditional – enter T, remote – enter Z

³Exam – 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)

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

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

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

⁷Optional – enter W, obligatory – enter Ob

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 ² of course/group of courses	Way ³ of crediting	Course/group of courses			
			lec	cl	lab	pr	sem		ZZU	CNPS	total	BK classes ¹			university-wide ⁴	practical ⁵	kind ⁶	type ⁷
1	ENN0901	Probability theory	1,2					K2ENG_W01	18	120	4	2	T	E			PD	Ob
2	ENN0901	Probability theory		1,2				K2ENG_U05	18	120	4	3	T	Z		P	PD	Ob
3	ENN0502	Numerical methods	1,8					K2ENG_W02	27	150	5	2,5	T	E			PD	Ob
4	ENN0502	Numerical methods			1,2			K2ENG_U06	18	60	2	1,5	T	Z		P	PD	Ob
Total			3	1,2	1,2				81	450	15	9						

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 ² of course/group of courses	Way ³ of crediting	Course/group of courses			
			lec	cl	lab	pr	sem		ZZU	CNPS	total	BK classes ¹			university-wide ⁴	practical ⁵	kind ⁶	type ⁷
1	ENN0195	Quantum Physics	1,8					K2ENG_W03	27	180	6	3	T	E			PD	Ob
Total			1,8						27	180	6	3						

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 ¹
lec	cl	lab	pr	sem				
4,8	1,2	1,2			108	630	21	12

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

²Traditional – enter T, remote – enter Z

³Exam – 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)

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

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

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

⁷Optional – enter W, obligatory – enter Ob

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

4.1.3.1. Obligatory main-field-of-study 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 ² of course/group of courses	Way ³ of crediting	Course/group of courses			
			lec	cl	lab	pr	sem		ZZU	CNPS	total	BK classes ¹			university-wide ⁴	practical ⁵	kind ⁶	type ⁷
1	ENN0554	Mathematical Modelling of Energy Generation Installations	1,2					K2ENG_W05	18	120	4	2	T	E			K	Ob.
2	ENN0554	Mathematical Modelling of Energy Generation Installations			2,4			K2ENG_U07	36	120	4	3	T	Z		P	K	Ob.
3	ENN1113	New Generation Energy Technologies	1,2					K2ENG_W04	18	90	3	1,5	T	E			K	Ob.
4	ENN1063	Energy Systems	1,2					K2ENG_W07	18	60	2	1	T	Z			K	Ob.
5	ENN1063	Energy Systems		0,6				K2ENG_U08	9	30	1	0,75	T	Z		P	K	Ob.
6	ENN1302	Environmental Management	1,2					K2ENG_W06 K2ENG_K02	18	60	2	1	T	Z			K	Ob.
7	ENN1381	Diploma Seminar					1,2	K2ENG_U01 K2ENG_U02 K2ENG_K01 K2ENG_K03 K2ENG_K04 K2ENG_K05	18	60	2	1,5	T	Z		P	K	Ob.
Total			4,8	0,6	2,4		1,2		135	540	18	10,75						

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 ¹
lec	cl	lab	pr	sem				
4,8	0,6	2,4		1,2	135	540	18	10,75

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

²Traditional – enter T, remote – enter Z

³Exam – 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)

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

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

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

⁷Optional – enter W, obligatory – enter Ob

4.2. List of optional modules:

4.2.1. List of general education modules

4.2.1.1. 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 ² of course/group of courses	Way ³ of crediting	Course/group of courses			
			lec	cl	lab	pr	sem		ZZU	CNPS	total	BK classes ¹			university-wide ⁴	practical ⁵	kind ⁶	type ⁷
1	HNN100400BK	Humanities Course	0,6					K2ENG_W06 K2ENG_K02	9	60	2	1	T	Z	O		KO	W
		Total	0,6						9	60	2	1						

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 ² of course/group of courses	Way ³ of crediting	Course/group of courses			
			lec	cl	lab	pr	sem		ZZU	CNPS	total	BK classes ¹			university-wide ⁴	practical ⁵	kind ⁶	type ⁷
1	JZL100589C JZL100846C JZL100847C	Foreign Language (continue) B2+ level		0,6				K2ENG_U04	9	30	1	0,75	T	Z	O	P	KO	W
2	JZL100586C JZL100591C JZL100597C	Foreign Language (second), any level		1,8				K2ENG_U09	27	60	2	1,5	T	Z	O	P	KO	W
		Total		2,4					36	90	3	2,25						

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

²Traditional – enter T, remote – enter Z

³Exam – 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)

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

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

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

⁷Optional – enter W, obligatory – enter Ob

4.2.1.3. Sporting classes module (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 ² of course/group of courses	Way ³ of crediting	Course/group of courses			
			lec	cl	lab	pr	sem		ZZU	CNPS	total	BK classes ¹			university-wide ⁴	practical ⁵	kind ⁶	type ⁷
1	WFW020000BK	Sporting Classes		0,53					8	8	1	1	T	Z	O	P	KO	W
		Total		0,53					8	8	1	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 ¹
lec	cl	lab	pr	sem				
0,6	2,93				53	158	6	4,25

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

4.2.2.1. Individual master of science project module (min. 6 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 ² of course/group of courses	Way ³ of crediting	Course/group of courses			
			lec	cl	lab	pr	sem		ZZU	CNPS	total	BK classes ¹			university-wide ⁴	practical ⁵	kind ⁶	type ⁷
1	ENN1364	Master Individual Student Project				4		K2ENG_U01 K2ENG_U03 K2ENG_K01 K2ENG_K04	60	180	6	1	T	Z		P	K	W
		Total				4			60	180	6	1						

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

²Traditional – enter T, remote – enter Z

³Exam – 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)

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

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

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

⁷Optional – enter W, obligatory – enter Ob

4.2.2.2. Master of science diploma dissertation 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 ² of course/group of courses	Way ³ of crediting	Course/group of courses			
			lec	cl	lab	pr	sem		ZZU	CNPS	total	BK classes ¹			university-wide ⁴	practical ⁵	kind ⁶	type ⁷
1	ENN1435	Master Thesis						K2ENG_U01 K2ENG_U02 K2ENG_U03 K2ENG_K01 K2ENG_K04 K2ENG_K05		600	20	4	T	Z		P	K	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 ¹
lec	cl	lab	pr	sem				
			4		60	780	26	5

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

²Traditional – enter T, remote – enter Z

³Exam – 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)

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

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

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

⁷Optional – enter W, obligatory – enter Ob

4.2.3. List of specialization modules

4.2.3.1. Specialization subjects 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 ² of course/group of courses	Way ³ of crediting	Course/group of courses			
			lec	cl	lab	pr	sem		ZZU	CNPS	total	BK class ¹ es			university-wide ⁴	practical ⁵	kind ⁶	type ⁷
1	ENN0185	Physics of the Renewable Energy	1,2					S2OZE_W01	18	60	2	1	T	Z			S	W
2	ENN0185	Physics of the Renewable Energy		0,6				S2OZE_U01	9	60	2	1,5	T	Z		P	S	W
3	ENN0185	Physics of the Renewable Energy					0,6	S2OZE_U02	9	30	1	0,75	T	Z		P	S	W
4	ENN0174	Water Power Engineering	1,2					S2OZE_W03	18	60	2	1	T	Z			S	W
5	ENN0174	Water Power Engineering		0,6				S2OZE_U04	9	60	2	1,5	T	Z		P	S	W
6	ENN0174	Water Power Engineering				0,6		S2OZE_U05	9	120	4	3	T	Z		P	S	W
7	ENN0141	Geothermal Power Engineering	0,6					S2OZE_W07	9	30	1	0,5	T	Z			S	W
8	ENN0141	Geothermal Power Engineering		0,6				S2OZE_U09	9	60	2	1,5	T	Z		P	S	W
9	ENN0196	Photo-thermal Energy Conversion System	0,6					S2OZE_W09	9	30	1	0,5	T	Z			S	W
10	ENN0196	Photo-thermal Energy Conversion System				1,2		S2OZE_U12	18	210	7	5,25	T	Z		P	S	W
11	ENN0356	Refrigeration Heating Systems	0,6					S2OZE_W05	9	30	1	0,5	T	Z			S	W
12	ENN0356	Refrigeration Heating Systems				0,6		S2OZE_U07	9	120	4	3	T	Z		P	S	W
13	ENN1122	Power Production Systems and Technology From Biomass	1,2					S2OZE_W08	18	60	2	1	T	Z			S	W
14	ENN1122	Power Production Systems and Technology From Biomass		0,6				S2OZE_U10	9	60	2	1,5	T	Z		P	S	W
15	ENN1122	Power Production Systems and Technology From Biomass				0,6		S2OZE_U11	9	30	1	0,75	T	Z		P	S	W
16	ENN0571	Fuel Cell and Technology of Hydrogen Production	1,2					S2OZE_W02	18	60	2	1	T	Z			S	W
17	ENN0571	Fuel Cell and Technology of Hydrogen Production			0,6			S2OZE_U03	9	30	1	0,75	T	Z		P	S	W
18	ENN0305	Pollutants Emission Control	0,6					S2OZE_W04	9	30	1	0,5	T	Z			S	W
19	ENN0305	Pollutants Emission Control			1,2			S2OZE_U06	18	60	2	1,5	T	Z		P	S	W
20	ENN0131	Wind Power Plants	0,6					S2OZE_W06	9	30	1	0,5	T	Z			S	W
21	ENN0131	Wind Power Plants				1,2		S2OZE_U08	18	150	5	3,75	T	Z		P	S	W
Total			7,8	2,4	1,8	3,6	1,2		252	1380	46	31,25	7,8					

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

²Traditional – enter T, remote – enter Z

³Exam – 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)

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

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

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

⁷Optional – 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 ¹
lec	cl	lab	pr	sem				
7,8	2,4	1,8	3,6	1,2	252	1380	46	31,25

4.3. Diploma dissertation module

Type of diploma dissertation	magister		
Number of diploma dissertation semesters	Number of ECTS points		Code
1	20		ENN1435
Character of diploma dissertation			
Experimental/project/ literature survey			
Number of BK¹ ECTS points	4		

5. Ways of verifying assumed educational effects

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

- 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 BK¹)**
64,75 ECTS points

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

Number of ECTS points for obligatory subjects	21
Number of ECTS points for optional subjects	0
Total number of ECTS points	21

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	13
including laboratory classes and projects	6
Number of ECTS points for optional subjects	63
including: laboratory classes and projects	29
diploma dissertation	20
Total number of ECTS points	76

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)
6 ECTS points

10. Total number of ECTS points, which student may obtain doing optional modules (min. 30% of total number of ECTS points)
78 ECTS points (65 %)

11. Range of the diploma exam

1. Theoretical problems

- 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. Construction and technological problems

- 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
- 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. Operational problems

- 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 <i>master thesis</i> 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)