# PROGRAMME OF EDUCATION

FACULTY: MECHANICAL AND POWER ENGINEERING

MAIN FIELD OF STUDY: POWER ENGINEERING

in area of technical science

EDUCATION LEVEL: 1st level, inżynier

FORM OF STUDIES: full-time

PROFILE: general academic

LANGUAGE OF STUDY: Polish

Content:



Faculty Council Resolution of 26.09.2012
In effect since 01.10.2012

Update: Faculty Council Resolution of 10.07.2013

**Edited adjustment_April 2014**

**PROGRAMME OF STUDIES – specialization ELECTRIC POWER ENGINEERING**

**1. Description**

| | |
|---|---|
| *Number of semesters:* 7 | *Number ECTS points necessary to obtain qualifications:* 210 |
| *Prerequisites (particularly for second-level studies):* matriculation examination in the following subjects: mathematics, physics and foreign language. | *Upon completion of studies graduate obtains professional degree of:* inżynier 1st level qualifications |
| *Possibility of continuing studies:* 2nd level studies | *Graduate profile, employability:* Has knowledge of engineering and design using computer techniques. Knows a foreign language at the B2 level. Is prepared to work in companies involved in the manufacture, processing and distribution of energy, and local government structures dealing with power engineering issues. Has the necessary knowledge and skills to perform engineering tasks, especially in the field of electricity production. |
| *Indicate connection with University's mission and its development strategy:* | The curriculum is consistent with the mission of the university in the transfer of knowledge and skills to maintain high quality of education and realized one of the strategic objectives of which is to develop graduate profile for civil society. |

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

**3. Concise analysis of consistency between assumed educational effects and labor market needs:**

Expected learning outcomes to ensure the achievement of knowledge and skills in mathematics, physics and chemistry of applied then to the knowledge and technical skills including social competences. The curriculum equips graduates with the attributes enabling him to adapt to the rapidly changing requirements of the labor 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. 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 | PRZ1152 | Intellectual and Industrial Property Protection | 2 | | | | | K1ENG_W13 | 30 | 60 | 2 | 1 | T | Z | O | | KO | Ob |
| | | Total | 2 | | | | | | 30 | 60 | 2 | 1 | | | | | | |

#### 4.1.1.2. *Information Technologies* Module *Information Technologies* *(min. 4 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 | INN1004 | Information Technologies | 2 | | | | | K1ENG_W06 | 30 | 60 | 2 | 1 | T | Z | O | | KO | Ob |
| 2 | INN1003 | Application packages | | | 2 | | | K1ENG_U02 | 30 | 60 | 2 | 1,5 | T | Z | O | P | KO | Ob |
| | | Total | 2 | 0 | 2 | 0 | 0 | | 60 | 120 | 4 | 2,5 | | | | | | |

[1]BK – number of ECTS points assigned to hours of classes requiring direct contact of teachers with students
[2]Traditional – enter T, remote – enter Z
[3]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)
[4]University-wide course /group of courses – enter O
[5]Practical course / group of courses – enter P. For the group of courses – in brackets enter the number of ECTS points assigned to practical courses
[6] KO – general education, PD – basic sciences, K – field-of-studies, S – specialization
[7] Optional – enter W, obligatory – enter Ob

**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 | | | | |
| 4 | 0 | 2 | 0 | 0 | 90 | 180 | 6 | 3,5 |

## 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] | | | universit y-wide[4] | practical[5] | kind[6] | type[7] |
| 1 | MAP1142 | Mathematical Analysis 1A | 2 | | | | | K1ENG_W02 K1ENG_K01 | 30 | 150 | 5 | 2,5 | T | E | O | | PD | Ob |
| 2 | MAP1142 | Mathematical Analysis 1A | | 2 | | | | K1ENG_U08 K1ENG_K01 | 30 | 90 | 3 | 2,25 | T | Z | O | P | PD | Ob |
| 3 | MAP1140 | Algebra and Analytic Geometry | 2 | | | | | K1ENG_W01 K1ENG_K01 | 30 | 60 | 2 | 1 | T | E | O | | PD | Ob |
| 4 | MAP1140 | Algebra and Analytic Geometry | | 1 | | | | K1ENG_U07 K1ENG_K01 | 15 | 60 | 2 | 1,5 | T | Z | O | P | PD | Ob |
| 5 | MAP1144 | Mathematical Analysis 2.2A | 3 | | | | | K1ENG_W02 K1ENG_K01 | 45 | 150 | 5 | 2,5 | T | E | O | | PD | Ob |
| 6 | MAP1144 | Mathematical Analysis 2.2A | | 2 | | | | K1ENG_U08 K1ENG_K01 | 30 | 90 | 3 | 2,25 | T | Z | O | P | PD | Ob |
| | | Total | 7 | 5 | 0 | 0 | 0 | | 180 | 600 | 20 | 12 | | | | | | |

### 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] | | | universit y-wide[4] | practical[5] | kind[6] | type[7] |
| 1 | FZP1065 | Physics 1.6 | 2 | | | | | K1ENG_W03 K1ENG_K01 K1ENG_K02 K1ENG_K03 K1ENG_K04 | 30 | 90 | 3 | 1,5 | T | E | O | | PD | Ob |
| 2 | FZP1065 | Physics 1.6 | | 2 | | | | K1ENG_U03 K1ENG_K01 K1ENG_K02 K1ENG_K03 K1ENG_K04 | 30 | 60 | 2 | 1,5 | T | Z | O | P | PD | Ob |
| 3 | FZP1066 | Physics 2.11 | 2 | | | | | K1ENG_W03 K1ENG_K01 K1ENG_K02 K1ENG_K03 K1ENG_K04 | 30 | 90 | 3 | 1,5 | T | E | O | | PD | Ob |

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 4 | FZP1066 | Physics 2.11 | | | 2 | | | K1ENG_U03<br>K1ENG_K01<br>K1ENG_K02<br>K1ENG_K03<br>K1ENG_K04 | 30 | 60 | 2 | 1,5 | T | Z | O | P | PD | Ob |
| | | Total | 4 | 2 | 2 | 0 | 0 | | 120 | 300 | 10 | 6 | | | | | | |

### 4.1.2.3 *Chemistry* 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 | CHC1101 | Chemistry | 2 | | | | | K1ENG_W04 | 30 | 90 | 3 | 1,5 | T | Z | O | | PD | Ob |
| 2 | CHC1101 | Chemistry | | | 1 | | | K1ENG_U10 | 15 | 30 | 1 | 0,75 | T | Z | O | P | PD | Ob |
| | | Total | 2 | 0 | 1 | 0 | 0 | | 45 | 120 | 4 | 2,25 | | | | | | |

[1]BK – number of ECTS points assigned to hours of classes requiring direct contact of teachers with students
[2]Traditional – enter T, remote – enter Z
[3]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)
[4]University-wide course /group of courses – enter O
[5]Practical course / group of courses – enter P. For the group of courses – in brackets enter the number of ECTS points assigned to practical courses
[6] KO – general education, PD – basic sciences, K – field-of-studies, S – specialization
[7] Optional – enter W, obligatory – enter Ob

## 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 | | | | |
| 13 | 7 | 3 | 0 | 0 | 345 | 1020 | 34 | 20,25 |

## 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] | | | universit y-wide[4] | practical[5] | kind[6] | type[7] |
| 1 | ESN0371 | Power industry machinery | 2 | | | | | K1ENG_W08 | 30 | 60 | 2 | 1 | T | Z | | | K | Ob |
| 2 | ESN0220 | Descriptive geometry | 2 | | | | | K1ENG_W07 | 30 | 60 | 2 | 1 | T | Z | | | K | Ob |
| 3 | ESN0220 | Descriptive geometry | | 1 | | | | K1ENG_U13 | 15 | 30 | 1 | 0,75 | T | Z | | P | K | Ob |
| 4 | ESN0940 | Technical drawing | | | | 2 | | K1ENG_U13 | 30 | 60 | 2 | 2,25 | T | Z | | P | K | Ob |
| 5 | ESN0780 | Basics of metrology and experiment techniques | 2 | | | | | K1ENG_W05 | 30 | 60 | 2 | 1 | T | Z | | | K | Ob |
| 6 | ESN0780 | Basics of metrology and experiment techniques | | 1 | | | | K1ENG_U11 K1ENG_U12 | 15 | 30 | 1 | 0,75 | T | Z | | P | K | Ob |
| 7 | ESN0780 | Basics of metrology and experiment techniques | | | 1 | | | K1ENG_U11 K1ENG_U12 | 15 | 30 | 1 | 0,75 | T | Z | | P | K | Ob |
| 8 | ESN0710 | Fundamentals of Materials Science | 2 | | | | | K1ENG_W09 | 30 | 90 | 3 | 1,5 | T | E | | | K | Ob |
| 9 | ESN0420 | Engineering Materials and Consumables | 1 | | | | | K1ENG_W09 | 15 | 30 | 1 | 0,5 | T | Z | | | K | Ob |
| 10 | ESN0420 | Engineering Materials and Consumables | | | 1 | | | K1ENG_U24 | 15 | 30 | 1 | 0,75 | T | Z | | P | K | Ob |
| 9 | ESN0760 | Fundamentals of fluid mechanics | 2 | | | | | K1ENG_W10 | 30 | 60 | 2 | 1 | T | Z | | | K | Ob |
| 10 | ESN0760 | Fundamentals of fluid mechanics | | 1 | | | | K1ENG_U14 | 15 | 30 | 1 | 0,75 | T | Z | | P | K | Ob |
| 13 | ESN0470 | Fluid mechanics | 1 | | | | | K1ENG_W10 | 15 | 60 | 2 | 1 | T | E | | | K | Ob |
| 14 | ESN0470 | Fluid mechanics | | 1 | | | | K1ENG_U14 | 15 | 30 | 1 | 0,75 | T | Z | | P | K | Ob |
| 15 | ESN0480 | Fluid mechanics -lab. | | | 2 | | | K1ENG_U15 | 30 | 60 | 2 | 1,5 | T | Z | | P | K | Ob |
| 16 | ESN0800 | Basics of thermodynamics | 2 | | | | | K1ENG_W11 | 30 | 60 | 2 | 1 | T | Z | | | K | Ob |
| 17 | ESN0800 | Basics of thermodynamics | | 1 | | | | K1ENG_U16 | 15 | 30 | 1 | 0,75 | T | Z | | P | K | Ob |
| 18 | ESN1190 | Thermodynamics | 1 | | | | | K1ENG_W11 | 15 | 60 | 2 | 1 | T | E | | | K | Ob |
| 19 | ESN1190 | Thermodynamics | | 1 | | | | K1ENG_U16 | 15 | 30 | 1 | 0,75 | T | Z | | P | K | Ob |
| 20 | ESN1200 | Thermodynamics – lab. | | | 2 | | | K1ENG_U17 K1ENG_K04 | 30 | 60 | 2 | 1,5 | T | Z | | P | K | Ob |
| 21 | ESN0875 | Heat transfer | 2 | | | | | K1ENG_W21 | 30 | 60 | 2 | 1 | T | Z | | | K | Ob |
| 22 | ESN0875 | Heat transfer | | 2 | | | | K1ENG_U28 | 30 | 60 | 2 | 1,5 | T | Z | | P | K | Ob |
| 23 | ESN1040 | Combustion and fuels | 2 | | | | | K1ENG_W18 | 30 | 90 | 3 | 1,5 | T | E | | | K | Ob |
| 24 | ESN1040 | Combustion and fuels | | 1 | | | | K1ENG_U25 K1ENG_U26 | 15 | 30 | 1 | 0,75 | T | Z | | P | K | Ob |
| 25 | ESN1040 | Combustion and fuels | | | 1 | | | K1ENG_U25 K1ENG_U26 | 15 | 30 | 1 | 0,75 | T | Z | | P | K | Ob |
| 26 | ESN0730 | Fundamental mechanics and strength of materials | 1 | | | | | K1ENG_W12 | 15 | 30 | 1 | 0,5 | T | Z | | | K | Ob |
| 27 | ESN0730 | Fundamental mechanics and strength of materials | | 1 | | | | K1ENG_U18 | 15 | 30 | 1 | 0,75 | T | Z | | P | K | Ob |
| 28 | ESN0460 | Mechanics and strength of materials | 2 | | | | | K1ENG_W12 | 30 | 90 | 2 | 1 | T | Z | | | K | Ob |
| 29 | ESN0460 | Mechanics and strength of materials | | 2 | | | | K1ENG_U18 | 30 | 90 | 2 | 1,5 | T | Z | | P | K | Ob |
| 30 | ESN0650 | Fundamentals of Control Systems | 2 | | | | | K1ENG_W14 | 30 | 90 | 3 | 1,5 | T | E | | | K | Ob |

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 31 | ESN0650 | Fundamentals of Control Systems | | 1 | | | | K1ENG_U19 | 15 | 30 | 1 | 0,75 | T | Z | | P | K | Ob |
| 32 | ESN0650 | Fundamentals of Control Systems | | | 2 | | | K1ENG_U20<br>K1ENG_K04 | 30 | 60 | 2 | 1,5 | T | Z | | P | K | Ob |
| 33 | ESN0660 | Fundamentals of Electronics | 1 | | | | | K1ENG_W15 | 15 | 30 | 1 | 0,5 | T | Z | | | K | Ob |
| 34 | ESN0660 | Fundamentals of Electronics | | | 1 | | | K1ENG_U21 | 15 | 30 | 1 | 0,75 | T | Z | | P | K | Ob |
| 35 | ESN0680 | Fundamentals of Electrical Engineering | 2 | | | | | K1ENG_W16 | 30 | 60 | 2 | 1 | T | Z | | | K | Ob |
| 36 | ESN0680 | Fundamentals of Electrical Engineering | | 1 | | | | K1ENG_U22 | 15 | 30 | 1 | 0,75 | T | Z | | P | K | Ob |
| 37 | ESN0680 | Fundamentals of Electrical Engineering | | | 1 | | | K1ENG_U23 | 15 | 30 | 1 | 0,75 | T | Z | | P | K | Ob |
| 38 | ESN0400 | Electrical machines and devices | 2 | | | | | K1ENG_W20 | 30 | 90 | 3 | 1,5 | T | E | | | K | Ob |
| 39 | ESN0400 | Electrical machines and devices | | | 1 | | | K1ENG_U27<br>K1ENG_K01<br>K1ENG_K04 | 15 | 30 | 1 | 0,75 | T | Z | | P | K | Ob |
| 40 | ESN0891 | Power Distribution | 2 | | | | | K1ENG_W28 | 30 | 90 | 3 | 1,5 | T | E | | | K | Ob |
| 41 | ESN0891 | Power Distribution | | 1 | | | | K1ENG_U36 | 15 | 30 | 1 | 0,75 | T | Z | | P | K | Ob |
| 42 | ESN0622 | Basics of Machine Design I | 2 | | | | | K1ENG_W22 | 30 | 60 | 2 | 1 | T | Z | | | K | Ob |
| 43 | ESN0622 | Basics of Machine Design I | | | | 1 | | K1ENG_U30 | 15 | 60 | 2 | 1,5 | T | Z | | P | K | Ob |
| 44 | ESN0642 | Basics of Machine Design II | 2 | | | | | K1ENG_W22 | 30 | 90 | 3 | 1,5 | T | E | | | K | Ob |
| 45 | ESN0642 | Basics of Machine Design II | | | | 1 | | K1ENG_U30 | 15 | 60 | 2 | 1,5 | T | Z | | P | K | Ob |
| 46 | ESN0062 | CAD | | | 2 | | | K1ENG_U13 | 30 | 60 | 2 | 1,5 | T | Z | | P | K | Ob |
| 47 | ESN0331 | Utility Boilers | 2 | | | | | K1ENG_W25 | 30 | 60 | 3 | 1,5 | T | E | | | K | Ob |
| 48 | ESN0331 | Utility Boilers | | | | 1 | | K1ENG_U33 | 15 | 30 | 1 | 0,75 | T | Z | | P | K | Ob |
| 49 | ESN1190 | Flue-gases cleaning techniques | 2 | | | | | K1ENG_W23 | 30 | 60 | 2 | 1 | T | Z | | | K | Ob |
| 50 | ESN1190 | Flue-gases cleaning techniques | | 1 | | | | K1ENG_U31 | 15 | 30 | 1 | 0,75 | T | Z | | P | K | Ob |
| 51 | ESN0136 | Power and heat stations | 2 | | | | | K1ENG_W26 | 30 | 90 | 3 | 1,5 | T | E | | | K | Ob |
| 52 | ESN0136 | Power and heat stations | | | 1 | | | K1ENG_U34 | 15 | 30 | 1 | 0,75 | T | Z | | P | K | Ob |
| 53 | ESN0523 | Power engineering metrology | 2 | | | | | K1ENG_W24 | 30 | 90 | 3 | 1,5 | T | E | | | K | Ob |
| 54 | ESN0523 | Power engineering metrology | | | 2 | | | K1ENG_U32 | 30 | 60 | 2 | 1,5 | T | Z | | P | K | Ob |
| 55 | ESN0041 | Research and testing of machines and devices | 1 | | | | | K1ENG_W24 | 15 | 30 | 1 | 0,5 | T | Z | | | K | Ob |
| 56 | ESN0041 | Research and testing of machines and devices | | | 1 | | | K1ENG_U33 | 15 | 30 | 1 | 0,75 | T | Z | | P | K | Ob |
| 57 | ESN0111 | Ecology | 2 | | | | | K1ENG_W19<br>K1ENG_K02 | 30 | 60 | 2 | 1 | T | Z | | | K | Ob |
| 58 | ESN0171 | Power engineering and environmental | 1 | | | | | K1ENG_W29<br>K1ENG_K02 | 15 | 30 | 1 | 0,5 | T | Z | | | K | Ob |
| 59 | ESN1370 | Engineer seminar | | | | | 1 | K1ENG_U01<br>K1ENG_U03<br>K1ENG_U05<br>K1ENG_K01<br>K1ENG_K04 | 15 | 30 | 1 | 0,75 | T | Z | | P | K | Ob |
| | | Total | 47 | 16 | 18 | 5 | 1 | | 1305 | 3030 | 100 | 60,5 | | | | | | |

### 4.1.3.1 *Obligatory main-field-of-study* module (optionally in English)

| 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 | ESN0761 | Fundamentals of Fluid Mechanics | 2 | | | | | K1ENG_W10 | 30 | 60 | 2 | 1 | T | Z | | | K | Ob |
| 2 | ESN0761 | Fundamentals of Fluid Mechanics | | 1 | | | | K1ENG_U14 | 15 | 30 | 1 | 0,75 | T | Z | | P | K | Ob |
| 3 | ESN0471 | Fluid Mechanics | 1 | | | | | K1ENG_W10 | 15 | 60 | 2 | 1 | T | E | | | K | Ob |
| 4 | ESN0471 | Fluid Mechanics | | 1 | | | | K1ENG_U14 | 15 | 30 | 1 | 0,75 | T | Z | | P | K | Ob |
| 5 | ESN0801 | Basics of Thermodynamics | 2 | | | | | K1ENG_W11 | 30 | 60 | 2 | 1 | T | Z | | | K | Ob |
| 6 | ESN0801 | Basics of Thermodynamics | | 1 | | | | K1ENG_U16 | 15 | 30 | 1 | 0,75 | T | Z | | P | K | Ob |
| 7 | ESN1191 | Thermodynamic | 1 | | | | | K1ENG_W11 | 15 | 60 | 2 | 1 | T | E | | | K | Ob |
| 8 | ESN1191 | Thermodynamic | | 1 | | | | K1ENG_U16 | 15 | 30 | 1 | 0,75 | T | Z | | P | K | Ob |
| 9 | ESN0876 | Heat Transfer | 2 | | | | | K1ENG_W21 | 30 | 60 | 2 | 1 | T | Z | | | K | Ob |
| 10 | ESN0876 | Heat Transfer | | 2 | | | | K1ENG_U28 | 30 | 60 | 2 | 1,5 | T | Z | | P | K | Ob |
| 11 | ESN1043 | Combustion and Fuels | 2 | | | | | K1ENG_W18 | 30 | 90 | 3 | 1,5 | T | E | | | K | Ob |
| 12 | ESN1043 | Combustion and Fuels | | 1 | | | | K1ENG_U25<br>K1ENG_U26 | 15 | 30 | 1 | 0,75 | T | Z | | P | K | Ob |
| 13 | ESN1043 | Combustion and Fuels | | | 1 | | | K1ENG_U25<br>K1ENG_U26 | 15 | 30 | 1 | 0,75 | T | Z | | P | K | Ob |
| 14 | ESN0731 | Fundamental Mechanics and Strength of Materials | 1 | | | | | K1ENG_W12 | 15 | 30 | 1 | 0,5 | T | Z | | | K | Ob |
| 15 | ESN0731 | Fundamental Mechanics and Strength of materials | | 1 | | | | K1ENG_U18 | 15 | 30 | 1 | 0,75 | T | Z | | P | K | Ob |
| 16 | ESN0461 | Mechanics and Strength of Materials | 2 | | | | | K1ENG_W12 | 30 | 90 | 2 | 1 | T | Z | | | K | Ob |
| 17 | ESN0461 | Mechanics and Strength of Materials | | 2 | | | | K1ENG_U18 | 30 | 90 | 2 | 1,5 | T | Z | | P | K | Ob |
| 18 | ESN0652 | Fundamentals of Control Systems | 2 | | | | | K1ENG_W14 | 30 | 90 | 3 | 1,5 | T | E | | | K | Ob |
| 19 | ESN0652 | Fundamentals of Control Systems | | 1 | | | | K1ENG_U19 | 15 | 30 | 1 | 0,75 | T | Z | | P | K | Ob |
| 20 | ESN0652 | Fundamentals of Control Systems | | | 2 | | | K1ENG_U20 | 30 | 60 | 2 | 1,5 | T | Z | | P | K | Ob |
| 21 | ESN0661 | Fundamentals of Electronics | 1 | | | | | K1ENG_W15 | 15 | 30 | 1 | 0,5 | T | Z | | | K | Ob |
| 22 | ESN0661 | Fundamentals of Electronics | | | 1 | | | K1ENG_U21 | 15 | 30 | 1 | 0,75 | T | Z | | P | K | Ob |
| 23 | ESN0681 | Fundamentals of Electrical Engineering | 2 | | | | | K1ENG_W16 | 30 | 60 | 2 | 1 | T | Z | | | K | Ob |
| 24 | ESN0681 | Fundamentals of Electrical Engineering | | 1 | | | | K1ENG_U22 | 15 | 30 | 1 | 0,75 | T | Z | | P | K | Ob |
| 25 | ESN0623 | Basics of Machine Design I | 2 | | | | | K1ENG_W22 | 30 | 60 | 2 | 1 | T | Z | | | K | Ob |
| 26 | ESN0623 | Basics of Machine Design I | | | | 1 | | K1ENG_U30 | 15 | 60 | 2 | 1,5 | T | Z | | P | K | Ob |
| 27 | ESN0643 | Basics of Machine Design II | 2 | | | | | K1ENG_W22 | 30 | 90 | 3 | 1,5 | T | E | | | K | Ob |
| 28 | ESN0643 | Basics of Machine Design II | | | | 1 | | K1ENG_U30 | 15 | 60 | 2 | 1,5 | T | Z | | P | K | Ob |

[1]BK – number of ECTS points assigned to hours of classes requiring direct contact of teachers with students
[2]Traditional – enter T, remote – enter Z
[3]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)
[4]University-wide course /group of courses – enter O
[5]Practical course / group of courses – enter P. For the group of courses – in brackets enter the number of ECTS points assigned to practical courses

[6] KO – general education, PD – basic sciences, K – field-of-studies, S – specialization
[7] Optional – enter W, obligatory – enter Ob

**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 | | | | |
| 47 | 16 | 18 | 5 | 1 | 1305 | 3030 | 100 | 60,5 |

# 4.2 List of optional modules

## 4.2.1 List of general education modules

### 4.2.1.1 Liberal-managerial subjects module *(min.4 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] | | | universit y-wide[4] | practical[5] | kind[6] | type[7] |
| 1 | HSN100100BK | Humanities | 2 | | | | | K1ENG_W30 K1ENG_K02 K1ENG_K06 | 30 | 60 | 2 | 1 | T | Z | O | | KO | W |
| 2 | HSN100100BK | Humanities | 1 | | | | | K1ENG_W30 K1ENG_K02 K1ENG_K06 | 15 | 30 | 1 | 0,5 | T | Z | O | | KO | W |
| 3 | ZSN100100BK | Management science | 1 | | | | | K1ENG_W30 K1ENG_K05 | 15 | 30 | 1 | 0,5 | T | Z | O | | KO | W |
| | | Total | 4 | | | | | | 60 | 120 | 4 | 2 | | | | | | |

### 4.2.1.2 *Foreign languages* 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[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] | | | universit y-wide[4] | practical[5] | kind[6] | type[7] |
| 1 | JZL100655BK | Foreign language B2.1 | | 4 | | | | K1ENG_U06 | 60 | 60 | 2 | 1,5 | T | Z | O | P | KO | W |
| 2 | JZL100655BK | Foreign language B2.2 | | 4 | | | | K1ENG_U06 | 60 | 90 | 3 | 2,25 | T | Z | O | P | KO | W |
| | | Total | | 8 | | | | | 120 | 150 | 5 | 3,75 | | | | | | |

#### 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 | WFW000000BK | Sporting classes | | 2 | | | | K1ENG_K03 | 30 | 30 | 1 | 1 | T | Z | O | P | KO | W |
| | | Total | | 2 | | | | | 30 | 30 | 1 | 1 | | | | | | |

[1]BK – number of ECTS points assigned to hours of classes requiring direct contact of teachers with students
[2]Traditional – enter T, remote – enter Z
[3]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)
[4]University-wide course /group of courses – enter O
[5]Practical course / group of courses – enter P. For the group of courses – in brackets enter the number of ECTS points assigned to practical courses
[6] KO – general education, PD – basic sciences, K – field-of-studies, S – specialization
[7] Optional – enter W, obligatory – enter Ob

### 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 | | | | |
| 4 | 10 | 0 | 0 | 0 | 210 | 300 | 10 | 6,75 |

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

#### 4.2.3.1. *Advanced design methods* **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 | | Advanced design methods: | | | 2 | | | K1ENG_U13 | 30 | 90 | 3 | 2,25 | T | Z | | P | K | W |
| | ESN0064 | CATIA | | | | | | | | | | | | | | | | |
| | ESN1022 | Solid Edge | | | | | | | | | | | | | | | | |
| | ESN0246 | 3D Graphic | | | | | | | | | | | | | | | | |
| | | Total | 0 | 0 | 2 | 0 | 0 | | 30 | 90 | 3 | 2,25 | | | | | | |

### 4.2.2.2. *Engineer Individual Student Project* **module** *(min. 4 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 | ESN1350 | Engineer Individual Student Project | | | | 4 | | K1ENG_U01<br>K1ENG_U03<br>K1ENG_U04<br>K1ENG_K01 | 60 | 120 | 4 | 1 | T | Z | | P | K | W |
| | | Total | | | | 4 | | | 60 | 120 | 4 | 1 | | | | | | |

### 4.2.2.3 *Professional practice* **module** *(min. 4 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 | ESN1410 | Professional practice | | | | | | K1ENG_U03<br>K1ENG_K04<br>K1ENG_K05 | | 120 | 4 | 0 | T | Z | | P | K | W |
| | | Total | | | | | | | | 120 | 4 | 0 | | | | | | |

### 4.2.2.4. *Engineer thesis* **module** *(min. 15 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 | ESN1420 | Engineer thesis | | | | | | K1ENG_U01<br>K1ENG_U03<br>K1ENG_U04<br>K1ENG_U05<br>K1ENG_K01<br>K1ENG_K04<br>K1ENG_K06 | | 450 | 15 | 2 | T | Z | | P | | W |
| | | Total | | | | 4 | | | | 450 | 15 | 2 | | | | | | |

[1]BK – number of ECTS points assigned to hours of classes requiring direct contact of teachers with students
[2]Traditional – enter T, remote – enter Z
[3]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)

[4]University-wide course /group of courses – enter O
[5]Practical course / group of courses – enter P. For the group of courses – in brackets enter the number of ECTS points assigned to practical courses
[6] KO – general education, PD – basic sciences, K – field-of-studies, S – specialization
[7] Optional – enter W, obligatory – enter Ob

**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 | | | | |
| 0 | 0 | 2 | 4 | 0 | 90 | 780 | 26 | 5,25 |

## 4.2.3. List of specialization modules

### 4.2.3.1. *Electric Power Engineering* module *(min. 34ECTS 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] | | | universit y-wide[4] | practical[5] | kind[6] | type[7] |
| 1 | ESN0412 | Turbomachinery | 2 | | | | | S1EEN_W02 | 30 | 90 | 3 | 1,5 | T | E | | | S | W |
| 2 | ESN0412 | Turbomachinery | | | | 1 | | S1EEN_U02 | 15 | 30 | 1 | 0,75 | T | Z | | P | S | W |
| 3 | ESN0840 | Pumps and pumping systems | 2 | | | | | S1EEN_W03 | 30 | 60 | 2 | 1 | T | Z | | | S | W |
| 4 | ESN0012 | Electric apparatuses | 1 | | | | | S1EEN_W04 | 15 | 30 | 1 | 0,5 | T | Z | | | S | W |
| 5 | ESN0825 | Electric measurements | 1 | | | | | S1EEN_W01 | 15 | 30 | 1 | 0,5 | T | Z | | | S | W |
| 6 | ESN0825 | Electric measurements | | | 1 | | | S1EEN_U01 | 15 | 30 | 1 | 0,75 | T | Z | | P | S | W |
| 7 | ESN0271 | Process Engineering and Apparatus | 2 | | | | | S1EEN_W06 | 30 | 60 | 2 | 1 | T | Z | | | S | W |
| 8 | ESN0271 | Process Engineering and Apparatus | | 1 | | | | S1EEN_U04 | 15 | 30 | 1 | 0,75 | T | Z | | P | S | W |
| 9 | ESN1292 | Electric energy generation | 2 | | | | | S1EEN_W04 | 30 | 60 | 2 | 1 | T | Z | | | S | W |
| 10 | ESN1292 | Electric energy generation | | | | 1 | | S1EEN_U03 | 15 | 30 | 1 | 0,75 | T | Z | | P | S | W |
| 11 | ESN0352 | Cryogenics and Gas Technologies in Power Engineering | 2 | | | | | S1EEN_W09 | 30 | 60 | 3 | 1,5 | T | E | | | S | W |
| 12 | ESN0352 | Cryogenics and Gas Technologies in Power Engineering | | 1 | | | | S1EEN_U07 | 15 | 30 | 1 | 0,75 | T | Z | | P | S | W |
| 13 | ESN0352 | Cryogenics and Gas Technologies in Power Engineering | | | 1 | | | S1EEN_U08 | 15 | 30 | 1 | 0,75 | T | Z | | P | S | W |
| 14 | ESN0025 | Automatics of power systems | 1 | | | | | S1EEN_W08 | 15 | 15 | 1 | 0,5 | T | Z | | | S | W |
| 15 | ESN0025 | Automatics of power systems | | | 1 | | | S1EEN_U06 | 15 | 15 | 1 | 0,75 | T | Z | | P | S | W |
| 16 | ESN0555 | Electrical drives | 1 | | | | | S1EEN_W01 S1EEN_K01 | 15 | 30 | 1 | 0,5 | T | Z | | | S | W |
| 17 | ESN0555 | Electrical drives | | | 1 | | | S1EEN_U01 | 15 | 30 | 1 | 0,75 | T | Z | | P | S | W |

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 18 | ESN0168 | Nuclear power engineering | 2 | | | | | K1ENG_W40 | 30 | 60 | 2 | 1 | T | Z | | | S | W |
| 19 | ESN0168 | Nuclear power engineering | | 1 | | | | K1ENG_U48 | 15 | 30 | 1 | 0,75 | T | Z | | P | S | W |
| 20 | ESN0168 | Nuclear power engineering | | | 1 | | | K1ENG_U49 | 15 | 30 | 1 | 0,75 | T | Z | | P | S | W |
| 21 | ESN1007 | Diagnostics and electric shock protection | 2 | | | | | S1EEN_W11 | 30 | 60 | 2 | 1 | T | Z | | | S | W |
| 22 | ESN1007 | Diagnostics and electric shock protection | | | 1 | | | S1EEN_U10 | 15 | 30 | 1 | 0,75 | T | Z | | P | S | W |
| 23 | ELR022405 | Designing of power networks and electrical installation | 2 | | | | | S1EEN_W10 | 30 | 60 | 2 | 1 | T | Z | | | S | W |
| 24 | ELR022405 | Designing of power networks and electrical installation | | | | 1 | | S1EEN_U09 K1ENG_K06 | 15 | 30 | 1 | 0,75 | T | Z | | P | S | W |
| | | Total | 20 | 3 | 6 | 3 | 0 | | 480 | 960 | 34 | 20 | | | | | | |

### 4.2.3.1. *Electric Power Engineering* module *(optionally in English)*

| 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 | ESN0353 | Cryogenics and Gas Technologies in Power Engineering | 2 | | | | | S1EEN_W09 | 30 | 60 | 3 | 1,5 | T | E | | | S | W |
| 2 | ESN0353 | Cryogenics and Gas Technologies in Power Engineering | | 1 | | | | S1EEN_U07 | 15 | 30 | 1 | 0,75 | T | Z | | P | S | W |
| 3 | ESN0353 | Cryogenics and Gas Technologies in Power Engineering | | | 1 | | | S1EEN_U08 | 15 | 30 | 1 | 0,75 | T | Z | | P | S | W |
| 4 | ESN0169 | Nuclear power engineering | 2 | | | | | K1ENG_W40 | 30 | 60 | 2 | 1 | T | Z | | | S | W |
| 5 | ESN0169 | Nuclear power engineering | | 1 | | | | K1ENG_U48 | 15 | 30 | 1 | 0,75 | T | Z | | P | S | W |
| 6 | ESN0169 | Nuclear power engineering | | | 1 | | | K1ENG_U49 | 15 | 30 | 1 | 0,75 | T | Z | | P | S | W |

[1]BK – number of ECTS points assigned to hours of classes requiring direct contact of teachers with students
[2]Traditional – enter T, remote – enter Z
[3]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)
[4]University-wide course /group of courses – enter O
[5]Practical course / group of courses – enter P. For the group of courses – in brackets enter the number of ECTS points assigned to practical courses
[6] KO – general education, PD – basic sciences, K – field-of-studies, S – specialization
[7] 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[1] |
|---|---|---|---|---|---|---|---|---|
| lec | cl | lab | pr | sem | | | | |
| 20 | 3 | 6 | 3 | 0 | 480 | 960 | 34 | 20 |

### 4.3 Training module (Faculty Council resolution on principles of crediting training – attachment no. 1)

| **Name of training** | **Praktyka zawodowa** | | |
|---|---|---|---|
| **Number of ECTS points** | **Number of ECTS points for BK classes[1]** | **Training crediting mode** | **Code** |
| 4 | 0 | Opinion from training tutor and a report from practice | ESN1410 |

| **Training duration** | **Training objective** |
|---|---|
| 4 weeks | - to familiarize with the methods of operation of equipment and production, and the procedures and methods of work organization,<br>- to confront knowledge with the practice and<br>- to use knowlege for solving attributed tasks |

### 4.4 Diploma dissertation module

| **Type of diploma dissertation** | inżynier | |
|---|---|---|
| **Number of diploma dissertation semesters** | **Number of ECTS points** | **Code** |
| **1** | **15** | **ESN1420** |
| **Character of diploma dissertation** | | |
| **experimental / design** | | |
| **Number of BK[1] ECTS points** | **2** | |

### 5. Ways of verifying assumed educational effects

| **Type of classes** | **Ways of verifying assumed educational effects** |
|---|---|
| lecture | exam, progress and final test |
| class | progress and final tests |
| laboratory | pretest, report from laboratory |
| project | project defence |
| seminar | participation in discussion, topic presentation, essay |
| training | report from training |
| diploma dissertation | evaluation of 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 BK[1])

**116,25 ECTS points**

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

| | |
|---|---|
| Number of ECTS points for obligatory subjects. | 34 |
| Number of ECTS points for optional subjects | 0 |
| Total number of ECTS points | 34 |

**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<br>Including laboratory classes and project | 57<br>30 |
| Number of ECTS points for optional subjects<br>Including laboratory classes and project<br>Including diploma dissertation | 44<br>16<br>*15* |
| Total number of ECTS points | 103 |

**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)

**50 ECTS points**

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

**72 ECTS points**

## 11. Range of diploma dissertation

### 1. Zagadnienia teoretyczne

1.1. Podstawowe równania mechaniki płynów – zasada zachowania masy, pędu i energii.
1.2. Równanie Bernoulliego dla płynu doskonałego i jego zastosowanie.
1.3. Przepływy laminarne i turbulentne. Rozkłady prędkości przepływu w przewodzie.
1.4. Pierwsza i druga zasada termodynamiki (entropia, zjawiska odwracalne i nieodwracalne).
1.5. Przemiany charakterystyczne gazu doskonałego. Równanie stanu gazu. Gaz wilgotny.
1.6. Przemiany charakterystyczne pary wodnej (układ p-v, T-s oraz i-s).
1.7.Spalanie paliw stałych, ciekłych i gazowych - specyfika spalania, stechiometria
1.8. Przewodzenie i przenikanie ciepła. Promieniowanie cieplne – podstawowe prawa. Rodzaje wymiany ciepła – podstawowe równania je opisujące. przekazywanie ciepła.
1.9. Podstawowe prawa i równania opisujące pole elektromagnetyczne.
1.10. Ciepło Joule'a dla wolnozmiennego pola elektrycznego.
1.11. Stany pracy systemu elektroenergetycznego (stan jałowy, obciążenie, zwarcie w systemie)

### 2. Zagadnienia konstrukcyjno-technologiczne

2.1. Podstawowe układy systemu elektroenergetycznego – niezawodność, pewność zasilania
2.2. Kotły parowe dużej wydajności - podział kotłów ze względu na konstrukcję komory paleniskowej i parametry pracy
2.3. Turbiny parowe i turbiny gazowe – rodzaje i konstrukcje turbin, zasada działania, sprawność stopnia
2.4. Generatory prądu elektrycznego – podstawowe typy, zasada działania i przeznaczenie
2.5. Wymienniki ciepła w procesach przemysłowych (rodzaje, budowa, zasada pracy, zastosowania)
2.6. Rozproszone źródła energii elektrycznej przykłady i zastosowanie.
2.7. Reaktory jądrowe w energetyce
2.8. Techniki redukcji zanieczyszczeń pyłowych i gazowych w spalinach emitowanych do atmosfery
2.9. System elektroenergetyczny i jego elementy składowe
2.10. Wymagania stawiane dla elektroenergetycznej automatyki zabezpieczeniowej

### 3. Zagadnienia eksploatacyjne

3.1. Metody pomiaru ciśnienia, temperatury i przepływu płynu
3.2. Charakterystyki wentylatora, punkt pracy, metody regulacji parametrów pracy wentylatora
3.3. Charakterystyki pomp wirowych, metody regulacji i zasady doboru pomp do układu pompowego.
3.4. Pomiary energetyczne silników lub urządzeń cieplnych, ocena niepewności pomiarów – na wybranym przykładzie.
3.5. Zagadnienia dotyczące budowy i eksploatacji siłowni cieplnych - konwencjonalnych
3.6. Zagadnienia dotyczące projektowania i eksploatacji instalacji elektroenergetycznych
3.7. Oddziaływanie systemu elektroenergetycznego na środowisko i środowiska na system

3.8. Wpływ techniki spalania i rodzaju paliwa na emisję zanieczyszczeń do atmosfery
3.9. Grupy urządzeń elektrycznych stosowanych w szerokorozumianej energetyce
3.10. Organizacja ochrony przeciwporażeniowej w odbiorczych instalacjach elektroenergetycznych

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

| *No.* | *Course code* | *Name of course* | *Crediting by deadline of... (number of semester)* |
|---|---|---|---|
| | 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. 2)**

**PROGRAMME OF STUDIES - specialization THERMAL POWER ENGINEERING**

**1. Description**

| | |
|---|---|
| *Number of semesters:* 7 | *Number ECTS points necessary to obtain qualifications:* 210 |
| *Prerequisites (particularly for second-level studies):*<br>matriculation examination in the following subjects: mathematics, physics and foreign language. | *Upon completion of studies graduate obtains professional degree of:* engineer<br>1st level qualifications |
| *Possibility of continuing studies:*<br>2nd level of study | *Graduate profile, employability:*<br>Has knowledge of engineering and design using computer techniques. Knows a foreign language at the B2 level. Is prepared to work in companies involved in the manufacture, processing and distribution of energy, and local government structures dealing with power engineering issues. Has the necessary knowledge and skills to perform engineering tasks, especially in the production of thermal energy. |
| *Indicate connection with University's mission and its development strategy:* | The curriculum is consistent with the mission of the university in the transfer of knowledge and skills to maintain high quality of education and realized one of the strategic objectives of which is to develop graduate profile for civil society. |

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

3. **Concise analysis of consistency between assumed educational effects and labor market needs:**
Expected learning outcomes to ensure the achievement of knowledge and skills in mathematics, physics and chemistry of applied then to the knowledge and technical skills including social competences. The curriculum equips graduates with the attributes enabling him to adapt to the rapidly changing requirements of the labor 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. 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 | PRZ1152 | Intellectual and Industrial Property Protection | 2 | | | | | K1ENG_W13 | 30 | 60 | 2 | 1 | T | Z | O | | KO | Ob |
| | | Total | 2 | | | | | | 30 | 60 | 2 | 1 | | | | | | |

#### 4.1.1.2 *Information technologies* module *(min. 4 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 | INN1004 | Information Technologies | 2 | | | | | K1ENG_W06 | 30 | 60 | 2 | 1 | T | Z | O | | KO | Ob |
| 2 | INN1003 | Application packages | | | 2 | | | K1ENG_U02 | 30 | 60 | 2 | 1,5 | T | Z | O | P | KO | Ob |
| | | Total | 2 | | 2 | | | | 60 | 120 | 4 | 2,5 | | | | | | |

[1]BK – number of ECTS points assigned to hours of classes requiring direct contact of teachers with students
[2]Traditional – enter T, remote – enter Z
[3]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)
[4]University-wide course /group of courses – enter O
[5]Practical course / group of courses – enter P. For the group of courses – in brackets enter the number of ECTS points assigned to practical courses
[6] KO – general education, PD – basic sciences, K – field-of-studies, S – specialization
[7] Optional – enter W, obligatory – enter Ob

**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 | | | | |
| 4 | | 2 | | | 90 | 180 | 6 | 3,5 |

## 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 | MAP1142 | Mathematical analysis 1.1A | 2 | | | | | K1ENG_W02 K1ENG_K01 | 30 | 150 | 5 | 2,5 | T | E | O | | PD | Ob |
| 2 | MAP1142 | Mathematical analysis 1.1A | | 2 | | | | K1ENG_U08 K1ENG_K01 | 30 | 90 | 3 | 2,25 | T | Z | O | P | PD | Ob |
| 3 | MAP1140 | Algebry and analytic geometry | 2 | | | | | K1ENG_W01 K1ENG_K01 | 30 | 60 | 2 | 1 | T | E | O | | PD | Ob |
| 4 | MAP1140 | Algebry and analytic geometry | | 1 | | | | K1ENG_U07 K1ENG_K01 | 15 | 60 | 2 | 1,5 | T | Z | O | P | PD | Ob |
| 5 | MAP1144 | Mathematical analysis 2.2A | 3 | | | | | K1ENG_W02 K1ENG_K01 | 45 | 150 | 5 | 2,5 | T | E | O | | PD | Ob |
| 6 | MAP1144 | Mathematical analysis 2.2A | | 2 | | | | K1ENG_U08 K1ENG_K01 | 30 | 90 | 3 | 2,25 | T | Z | O | P | PD | Ob |
| | | Total | 7 | 5 | | | | | 180 | 600 | 20 | 12 | | | | | | |

### 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 | FZP1065 | Physics 1.6 | 2 | | | | | K1ENG_W03 K1ENG_K01 K1ENG_K02 K1ENG_K03 K1ENG_K04 | 30 | 90 | 3 | 1,5 | T | E | O | | PD | Ob |
| 2 | FZP1065 | Physics 1.6 | | 2 | | | | K1ENG_U03 K1ENG_K01 K1ENG_K02 K1ENG_K03 K1ENG_K04 | 30 | 60 | 2 | 1,5 | T | Z | O | P | PD | Ob |
| 3 | FZP1066 | Physics 2.11 | 2 | | | | | K1ENG_W03 K1ENG_K01 K1ENG_K02 K1ENG_K03 K1ENG_K04 | 30 | 90 | 3 | 1,5 | T | E | O | | PD | Ob |
| 4 | FZP1066 | Physics 2.11 | | | 2 | | | K1ENG_U03 K1ENG_K01 | 30 | 60 | 2 | 1,5 | T | Z | O | P | PD | Ob |

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | K1ENG_K02<br>K1ENG_K03<br>K1ENG_K04 | | | | | | | | | | |
| | | Total | 4 | 2 | 2 | | | | 120 | 300 | 10 | 6 | | | | | | |

### 4.1.2.3 *Chemistry* 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 | CHC1101 | Chemistry | 2 | | | | | K1ENG_W04 | 30 | 90 | 3 | 1,5 | T | Z | O | | PD | Ob |
| 2 | CHC1101 | Chemistry | | | 1 | | | K1ENG_U10 | 15 | 30 | 1 | 0,75 | T | Z | O | P | PD | Ob |
| | | Total | 2 | | 1 | | | | 45 | 120 | 4 | 2,25 | | | | | | |

[1]BK – number of ECTS points assigned to hours of classes requiring direct contact of teachers with students
[2]Traditional – enter T, remote – enter Z
[3]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)
[4]University-wide course /group of courses – enter O
[5]Practical course / group of courses – enter P. For the group of courses – in brackets enter the number of ECTS points assigned to practical courses
[6] KO – general education, PD – basic sciences, K – field-of-studies, S – specialization, [7] Optional – enter W, obligatory – enter Ob

### 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 | | | | |
| 13 | 7 | 3 | | | 345 | 1020 | 34 | 20,25 |

## 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[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 | ESN0371 | Power industry machinery | 2 | | | | | K1ENG_W08 | 30 | 60 | 2 | 1 | T | Z | | | K | Ob |
| 2 | ESN0220 | Descriptive geometry | 2 | | | | | K1ENG_W07 | 30 | 60 | 2 | 1 | T | Z | | | K | Ob |
| 3 | ESN0220 | Descriptive geometry | | 1 | | | | K1ENG_U13 | 15 | 30 | 1 | 0,75 | T | Z | | P | K | Ob |

| | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 4 | ESN0940 | Technical drawing | | | | 2 | | K1ENG_U13 | 30 | 60 | 2 | 1,5 | T | Z | | P | K | Ob |
| 5 | ESN0780 | Basics of metrology and experiment techniques | 2 | | | | | K1ENG_W05 | 30 | 60 | 2 | 1 | T | Z | | | K | Ob |
| 6 | ESN0780 | Basics of metrology and experiment techniques | | 1 | | | | K1ENG_U11 | 15 | 30 | 1 | 0,75 | T | Z | | P | K | Ob |
| 7 | ESN0780 | Basics of metrology and experiment techniques | | | 1 | | | K1ENG_U12 | 15 | 30 | 1 | 0,75 | T | Z | | P | K | Ob |
| 8 | ESN0710 | Fundamentals of Materials Science | 2 | | | | | K1ENG_W09 | 30 | 90 | 3 | 1,5 | T | E | | | K | Ob |
| 9 | ESN0420 | Engineering Materials and Consumables | 1 | | | | | K1ENG_W09 | 15 | 30 | 1 | 0,5 | T | Z | | | K | Ob |
| 10 | ESN0420 | Engineering Materials and Consumables | | | 1 | | | K1ENG_U24 | 15 | 30 | 1 | 0,75 | T | Z | | P | K | Ob |
| 11 | ESN0760 | Fundamentals of fluid mechanics | 2 | | | | | K1ENG_W10 | 30 | 60 | 2 | 1 | T | Z | | | K | Ob |
| 12 | ESN0760 | Fundamentals of fluid mechanics | | 1 | | | | K1ENG_U14<br>K1ENG_K04 | 15 | 30 | 1 | 0,75 | T | Z | | P | K | Ob |
| 13 | ESN0470 | Fluid mechanics | 1 | | | | | K1ENG_W10 | 15 | 60 | 2 | 1 | T | E | | | K | Ob |
| 14 | ESN0470 | Fluid mechanics | | 1 | | | | K1ENG_U14<br>K1ENG_K04 | 15 | 30 | 1 | 0,75 | T | Z | | P | K | Ob |
| 15 | ESN0480 | Fluid mechanics - laboratory | | | 2 | | | K1ENG_U15<br>K1ENG_K04 | 30 | 60 | 2 | 1,5 | T | Z | | P | K | Ob |
| 16 | ESN0800 | Basics of thermodynamics | 2 | | | | | K1ENG_W11 | 30 | 60 | 2 | 1 | T | Z | | | K | Ob |
| 17 | ESN0800 | Basics of thermodynamics | | 1 | | | | K1ENG_U16 | 15 | 30 | 1 | 0,75 | T | Z | | P | K | Ob |
| 18 | ESN1190 | Thermodynamics | 1 | | | | | K1ENG_W11 | 15 | 60 | 2 | 1 | T | E | | | K | Ob |
| 19 | ESN1190 | Thermodynamics | | 1 | | | | K1ENG_U16 | 15 | 30 | 1 | 0,75 | T | Z | | P | K | Ob |
| 20 | ESN1200 | Thermodynamics -lab. | | | 2 | | | K1ENG_U17<br>K1ENG_K04 | 30 | 60 | 2 | 1,5 | T | Z | | P | K | Ob |
| 21 | ESN0875 | Heat transfer | 2 | | | | | K1ENG_W21 | 30 | 60 | 2 | 1 | T | Z | | | K | Ob |
| 22 | ESN0875 | Heat transfer | | 2 | | | | K1ENG_U28 | 30 | 60 | 2 | 1,5 | T | Z | | P | K | Ob |
| 23 | ESN1040 | Combustion and fuels | 2 | | | | | K1ENG_W18<br>K1ENG_K02 | 30 | 90 | 3 | 1,5 | T | E | | | K | Ob |
| 24 | ESN1040 | Combustion and fuels | | 1 | | | | K1ENG_U25 | 15 | 30 | 1 | 0,75 | T | Z | | P | K | Ob |
| 25 | ESN1040 | Combustion and fuels | | | 1 | | | K1ENG_U26<br>K1ENG_K04 | 15 | 30 | 1 | 0,75 | T | Z | | P | K | Ob |
| 26 | ESN0730 | Fundamental mechanics and strength of materials | 1 | | | | | K1ENG_W12 | 15 | 30 | 1 | 0,5 | T | Z | | | K | Ob |
| 27 | ESN0730 | Fundamental mechanics and strength of materials | | 1 | | | | K1ENG_U18 | 15 | 30 | 1 | 0,75 | T | Z | | P | K | Ob |
| 28 | ESN0460 | Mechanics and strength of materials | 2 | | | | | K1ENG_W12 | 30 | 60 | 2 | 1 | T | Z | | | K | Ob |
| 29 | ESN0460 | Mechanics and strength of materials | | 2 | | | | K1ENG_U18 | 30 | 60 | 2 | 1,5 | T | Z | | P | K | Ob |
| 30 | ESN0651 | Fundamentals of Control Systems | 2 | | | | | K1ENG_W14 | 30 | 90 | 3 | 1,5 | T | E | | | K | Ob |
| 31 | ESN0651 | Fundamentals of Control Systems | | 1 | | | | K1ENG_U19 | 15 | 30 | 1 | 0,75 | T | Z | | P | K | Ob |
| 32 | ESN0651 | Fundamentals of Control Systems | | | 2 | | | K1ENG_U20<br>K1ENG_K04 | 30 | 60 | 2 | 1,5 | T | Z | | P | K | Ob |
| 33 | ESN0660 | Fundamentals of Electronics | 1 | | | | | K1ENG_W15 | 15 | 30 | 1 | 0,5 | T | Z | | | K | Ob |
| 34 | ESN0660 | Fundamentals of Electronics | | | 1 | | | K1ENG_U21 | 15 | 30 | 1 | 0,75 | T | Z | | P | K | Ob |
| 35 | ESN0680 | Electrical Engineering Fundamentals | 2 | | | | | K1ENG_W16 | 30 | 60 | 2 | 1 | T | Z | | | K | Ob |
| 36 | ESN0680 | Electrical Engineering Fundamentals | | 1 | | | | K1ENG_U22 | 15 | 30 | 1 | 0,75 | T | Z | | P | K | Ob |
| 37 | ESN0680 | Electrical Engineering Fundamentals | | | 1 | | | K1ENG_U23 | 15 | 30 | 1 | 0,75 | T | Z | | P | K | Ob |
| 38 | ESN0400 | Electrical machines and devices | 2 | | | | | K1ENG_W20 | 30 | 90 | 3 | 1,5 | T | E | | | K | Ob |
| 39 | ESN0400 | Electrical machines and devices | | | 1 | | | K1ENG_U27<br>K1ENG_K01<br>K1ENG_K04 | 15 | 30 | 1 | 0,75 | T | Z | | P | K | Ob |
| 40 | ESN0891 | Power Distribution | 2 | | | | | K1ENG_W28 | 30 | 90 | 3 | 1,5 | T | E | | | K | Ob |
| 41 | ESN0891 | Power Distribution | | 1 | | | | K1ENG_U36 | 15 | 30 | 1 | 0,75 | T | Z | | P | K | Ob |

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 42 | ESN0622 | Basics of Machine Design I | 2 | | | | | K1ENG_W22 | 30 | 60 | 2 | 1 | T | Z | | | K | Ob |
| 43 | ESN0622 | Basics of Machine Design I | | | | 1 | | K1ENG_U30<br>K1ENG_K04 | 15 | 60 | 2 | 1,5 | T | Z | | P | K | Ob |
| 44 | ESN0642 | Basics of Machine Design II | 2 | | | | | K1ENG_W22 | 30 | 90 | 3 | 1,5 | T | E | | | K | Ob |
| 45 | ESN0642 | Basics of Machine Design II | | | | 1 | | K1ENG_U30<br>K1ENG_K04 | 15 | 60 | 2 | 1,5 | T | Z | | P | K | Ob |
| 46 | ESN0065 | CAD | | | 2 | | | K1ENG_U13 | 30 | 60 | 2 | 1,5 | T | Z | | P | K | Ob |
| 47 | ESN0331 | Energy boilers | 2 | | | | | K1ENG_W25 | 30 | 90 | 3 | 1,5 | T | E | | | K | Ob |
| 48 | ESN0331 | Energy boilers | | | | 1 | | K1ENG_U33 | 15 | 30 | 1 | 0,75 | T | Z | | P | K | Ob |
| 49 | ESN1190 | Flue-gases cleaning techniques | 2 | | | | | K1ENG_W23 | 30 | 60 | 2 | 1 | T | Z | | | K | Ob |
| 50 | ESN1190 | Flue-gases cleaning techniques | | 1 | | | | K1ENG_U31 | 15 | 30 | 1 | 0,75 | T | Z | | P | K | Ob |
| 51 | ESN0136 | Power and heat stations | 2 | | | | | K1ENG_W26 | 30 | 90 | 3 | 1,5 | T | E | | | K | Ob |
| 52 | ESN0136 | Power and heat stations | | | 1 | | | K1ENG_U34 | 15 | 30 | 1 | 0,75 | T | Z | | P | K | Ob |
| 53 | ESN0523 | Power engineering metrology | 2 | | | | | K1ENG_W24 | 30 | 90 | 3 | 1,5 | T | E | | | K | Ob |
| 54 | ESN0523 | Power engineering metrology | | | 2 | | | K1ENG_U32 | 30 | 60 | 2 | 1,5 | T | Z | | P | K | Ob |
| 55 | ESN0041 | Research and testing of machines and devices | 1 | | | | | K1ENG_W27 | 15 | 30 | 1 | 0,5 | T | Z | | | K | Ob |
| 56 | ESN0041 | Research and testing of machines and devices | | | 1 | | | K1ENG_U35 | 15 | 30 | 1 | 0,75 | T | Z | | P | K | Ob |
| 57 | ESN0111 | Ecology | 2 | | | | | K1ENG_W19<br>K1ENG_K02 | 30 | 60 | 2 | 1 | T | Z | | | K | Ob |
| 58 | ESN0171 | Power engineering and environmental | 1 | | | | | K1ENG_W29<br>K1ENG_K02 | 15 | 30 | 1 | 0,5 | T | Z | | | K | Ob |
| 59 | ESN1370 | Engineering diploma seminar | | | | | 1 | K1ENG_U01<br>K1ENG_U03<br>K1ENG_U05<br>K1ENG_K01<br>K1ENG_K04 | 15 | 30 | 1 | 0,75 | T | Z | | P | K | Ob |
| | | Total | 47 | 16 | 18 | 5 | 1 | | 1305 | 3000 | 100 | 60,5 | | | | | | |

### 4.1.3.1 *Obligatory main-field-of-study* module (optionally in English)

| 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 | ESN0761 | Fundamentals of Fluid Mechanics | 2 | | | | | K1ENG_W10 | 30 | 60 | 2 | 1 | T | Z | | | K | Ob |
| 2 | ESN0761 | Fundamentals of Fluid Mechanics | | 1 | | | | K1ENG_U14 | 15 | 30 | 1 | 0,75 | T | Z | | P | K | Ob |
| 3 | ESN0471 | Fluid Mechanics | 1 | | | | | K1ENG_W10 | 15 | 60 | 2 | 1 | T | E | | | K | Ob |
| 4 | ESN0471 | Fluid Mechanics | | 1 | | | | K1ENG_U14 | 15 | 30 | 1 | 0,75 | T | Z | | P | K | Ob |
| 5 | ESN0801 | Basics of Thermodynamics | 2 | | | | | K1ENG_W11 | 30 | 60 | 2 | 1 | T | Z | | | K | Ob |
| 6 | ESN0801 | Basics of Thermodynamics | | 1 | | | | K1ENG_U16 | 15 | 30 | 1 | 0,75 | T | Z | | P | K | Ob |
| 7 | ESN1191 | Thermodynamic | 1 | | | | | K1ENG_W11 | 15 | 60 | 2 | 1 | T | E | | | K | Ob |
| 8 | ESN1191 | Thermodynamic | | 1 | | | | K1ENG_U16 | 15 | 30 | 1 | 0,75 | T | Z | | P | K | Ob |
| 9 | ESN0876 | Heat Transfer | 2 | | | | | K1ENG_W21 | 30 | 60 | 2 | 1 | T | Z | | | K | Ob |
| 10 | ESN0876 | Heat Transfer | | 2 | | | | K1ENG_U28 | 30 | 60 | 2 | 1,5 | T | Z | | P | K | Ob |
| 11 | ESN1043 | Combustion and Fuels | 2 | | | | | K1ENG_W18 | 30 | 90 | 3 | 1,5 | T | E | | | K | Ob |

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 12 | ESN1043 | Combustion and Fuels | | 1 | | | | K1ENG_U25<br>K1ENG_U26 | 15 | 30 | 1 | 0,75 | T | Z | | P | K | Ob |
| 13 | ESN1043 | Combustion and Fuels | | | 1 | | | K1ENG_U25<br>K1ENG_U26 | 15 | 30 | 1 | 0,75 | T | Z | | P | K | Ob |
| 14 | ESN0731 | Fundamental Mechanics and Strength of Materials | 1 | | | | | K1ENG_W12 | 15 | 30 | 1 | 0,5 | T | Z | | | K | Ob |
| 15 | ESN0731 | Fundamental Mechanics and Strength of materials | | 1 | | | | K1ENG_U18 | 15 | 30 | 1 | 0,75 | T | Z | | P | K | Ob |
| 16 | ESN0461 | Mechanics and Strength of Materials | 2 | | | | | K1ENG_W12 | 30 | 90 | 2 | 1 | T | Z | | | K | Ob |
| 17 | ESN0461 | Mechanics and Strength of Materials | | 2 | | | | K1ENG_U18 | 30 | 90 | 2 | 1,5 | T | Z | | P | K | Ob |
| 18 | ESN0652 | Fundamentals of Control Systems | 2 | | | | | K1ENG_W14 | 30 | 90 | 3 | 1,5 | T | E | | | K | Ob |
| 19 | ESN0652 | Fundamentals of Control Systems | | 1 | | | | K1ENG_U19 | 15 | 30 | 1 | 0,75 | T | Z | | P | K | Ob |
| 20 | ESN0652 | Fundamentals of Control Systems | | | 2 | | | K1ENG_U20 | 30 | 60 | 2 | 1,5 | T | Z | | P | K | Ob |
| 21 | ESN0661 | Fundamentals of Electronics | 1 | | | | | K1ENG_W15 | 15 | 30 | 1 | 0,5 | T | Z | | | K | Ob |
| 22 | ESN0661 | Fundamentals of Electronics | | | 1 | | | K1ENG_U21 | 15 | 30 | 1 | 0,75 | T | Z | | P | K | Ob |
| 23 | ESN0681 | Fundamentals of Electrical Engineering | 2 | | | | | K1ENG_W16 | 30 | 60 | 2 | 1 | T | Z | | | K | Ob |
| 24 | ESN0681 | Fundamentals of Electrical Engineering | | 1 | | | | K1ENG_U22 | 15 | 30 | 1 | 0,75 | T | Z | | P | K | Ob |
| 25 | ESN0623 | Basics of Machine Design I | 2 | | | | | K1ENG_W22 | 30 | 60 | 2 | 1 | T | Z | | | K | Ob |
| 26 | ESN0623 | Basics of Machine Design I | | | | 1 | | K1ENG_U30 | 15 | 60 | 2 | 1,5 | T | Z | | P | K | Ob |
| 27 | ESN0643 | Basics of Machine Design II | 2 | | | | | K1ENG_W22 | 30 | 90 | 3 | 1,5 | T | E | | | K | Ob |
| 28 | ESN0643 | Basics of Machine Design II | | | | 1 | | K1ENG_U30 | 15 | 60 | 2 | 1,5 | T | Z | | P | K | Ob |

[1]BK – number of ECTS points assigned to hours of classes requiring direct contact of teachers with students
[2]Traditional – enter T, remote – enter Z
[3]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)
[4]University-wide course /group of courses – enter O
[5]Practical course / group of courses – enter P. For the group of courses – in brackets enter the number of ECTS points assigned to practical courses
[6] KO – general education, PD – basic sciences, K – field-of-studies, S – specialization
[7] Optional – enter W, obligatory – enter Ob

## 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 | | | | |
| 47 | 16 | 18 | 5 | 1 | 1305 | 3000 | 100 | 60,5 |

# 4.2 List of optional modules

## 4.2.1 List of general education modules

### 4.2.1.1 Liberal-managerial subjects modules *(min. 4 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 | HSN100100BK | Humanities | 2 | | | | | K1ENG_W30 K1ENG_K02 K1ENG_K06 | 30 | 60 | 2 | 1 | T | Z | O | | KO | W |
| 2 | HSN100100BK | Humanities | 1 | | | | | K1ENG_W31 K1ENG_K02 K1ENG_K06 | 15 | 30 | 1 | 0,5 | T | Z | O | | KO | W |
| 3 | ZSN100100BK | Management since | 1 | | | | | K1ENG_W30 K1ENG_K05 | 15 | 30 | 1 | 0,5 | T | Z | O | | KO | W |
| | | Total | 4 | | | | | | 60 | 120 | 4 | 2 | | | | | | |

### 4.2.1.2 *Foreign languages* 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[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 | JZL100707BK | Foreign language B2.1 | | 4 | | | | K1ENG_U06 | 60 | 60 | 2 | 1,5 | T | Z | O | P | KO | W |
| 2 | JZL100708BK | Foreign language B2.2 | | 4 | | | | K1ENG_U06 | 60 | 90 | 3 | 2,25 | T | Z | O | P | KO | W |
| | | Total | | 8 | | | | | 120 | 150 | 5 | 3,75 | | | | | | |

### 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 | WFW000000BK | Sporting classes | | 2 | | | | K1ENG_K03 | 30 | 30 | 1 | 1 | T | Z | O | P | KO | W |
| | | Total | | 2 | | | | | 30 | 30 | 1 | 1 | | | | | | |

[1]BK – number of ECTS points assigned to hours of classes requiring direct contact of teachers with students
[2]Traditional – enter T, remote – enter Z
[3]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)

[4]University-wide course /group of courses – enter O
[5]Practical course / group of courses – enter P. For the group of courses – in brackets enter the number of ECTS points assigned to practical courses
[6] KO – general education, PD – basic sciences, K – field-of-studies, S – specialization
[7] Optional – enter W, obligatory – enter Ob

**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 | | | | |
| 4 | 10 | | | | 210 | 300 | 10 | 6,75 |

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

### 4.2.3.1 Moduł *Advanced Project methods* 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 | ESN0064 | CATIA | | | 2 | | | K1ENG_U13 | | | | | T | Z | | P | K | W |
| 2 | ESN1022 | Solid Edge | | | 2 | | | K1ENG_U13 | | | | | T | Z | | P | K | W |
| 3 | ESN0246 | Grafika 3D | | | 2 | | | K1ENG_U13<br>K1ENG_U05<br>K1ENG_K06 | | | | | T | Z | | P | K | W |
| | | Total | | | 6 | | | | 30 | 90 | 3 | 2,25 | | | | | | |

### 4.2.3.2. *Individual Engineering Project module (min. 4 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 | ESN1350 | Individual Engineering project | | | | 4 | | K1ENG_U01<br>K1ENG_U03<br>K1ENG_U04<br>K1ENG_K01 | 60 | 120 | 4 | 1 | T | Z | | P | K | W |
| | | Total | | | | 4 | | | 60 | 120 | 4 | 1 | | | | | | |

### 4.2.3.3 *Training module* *(min. 4 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 | ESN1410 | Training | | | | | | K1ENG_U03 K1ENG_K04 K1ENG_K05 | | 120 | 4 | 0 | T | Z | | P | K | W |
| | | Total | | | | | | | | 120 | 4 | 0 | | | | | | |

### 4.2.3.4. Engineer diploma dissertation module *(min. 15 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 | ESN1420 | Engineer diploma dissertatnion | | | | | | K1ENG_U01 K1ENG_U03 K1ENG_U04 K1ENG_U05 K1ENG_K01 K1ENG_K04 K1ENG_K06 | | 450 | 15 | 2 | T | Z | | P | | W |
| | | Total | | | | | | | | 450 | 15 | 2 | | | | | | |

[1]BK – number of ECTS points assigned to hours of classes requiring direct contact of teachers with students
[2]Traditional – enter T, remote – enter Z
[3]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)
[4]University-wide course /group of courses – enter O
[5]Practical course / group of courses – enter P. For the group of courses – in brackets enter the number of ECTS points assigned to practical courses
[6] KO – general education, PD – basic sciences, K – field-of-studies, S – specialization
[7] Optional – enter W, obligatory – enter Ob

### 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 | | | | |
| 2 | 4 | | 90 | 780 | 26 | 5,25 | 10 | 6,75 |

## 4.2.4 List of specialization modules

### 4.2.4.1 *Specialization subjects* Thermal Power Engineering *module* *(min. 34 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 | ESN0410 | Turbomachinery | 2 | | | | | S1ENC_W02 | 30 | 90 | 3 | 1,5 | T | E | | | S | W |
| 2 | ESN0410 | Turbomachinery | | 2 | | | | S1ENC_U02 | 30 | 60 | 2 | 1,5 | T | Z | | P | S | W |
| 3 | ESN0410 | Turbomachinery | | | | 1 | | S1ENC_U03 | 15 | 30 | 1 | 0,75 | T | Z | | P | S | W |
| 4 | ESN0850 | Pumps and pumping systems | 2 | | | | | S1ENC_W01 | 30 | 60 | 2 | 1 | T | Z | | | S | W |
| 5 | ESN0850 | Pumps and pumping systems | | 1 | | | | S1ENC_U01 | 15 | 30 | 1 | 0,75 | T | Z | | P | S | W |
| 6 | ESN0310 | Energy Conversion | 2 | | | | | S1ENC_W07 | 30 | 60 | 2 | 1 | T | Z | | | S | W |
| 7 | ESN0310 | Energy Conversion | | | 1 | | | S1ENC_U08 | 15 | 30 | 1 | 0,75 | T | Z | | P | S | W |
| 8 | ESN0075 | Refrigeration and Cryogenics | 2 | | | | | S1ENC_W03 | 30 | 90 | 3 | 1,5 | T | E | | | S | W |
| 9 | ESN0075 | Refrigeration and Cryogenics | | | 2 | | | S1ENC_U04 | 30 | 60 | 2 | 1,5 | T | Z | | P | S | W |
| 10 | ESN0211 | Gas technologies | 1 | | | | | S1ENC_W05 | 15 | 30 | 1 | 0,5 | T | Z | | | S | W |
| 11 | ESN0211 | Gas technologies | | 1 | | | | S1ENC_U05 | 15 | 30 | 1 | 0,75 | T | Z | | P | S | W |
| 12 | ESN0834 | Heat pumps and solar collectors | 1 | | | | | S1ENC_W06 | 15 | 30 | 1 | 0,5 | T | Z | | | S | W |
| 13 | ESN0834 | Heat pumps and solar collectors | | | 1 | | | S1ENC_U06 | 15 | 30 | 1 | 0,75 | T | Z | | P | S | W |
| 14 | ESN0834 | Heat pumps and solar collectors | | | | 1 | | S1ENC_U07 | 15 | 30 | 1 | 0,75 | T | Z | | P | S | W |
| 15 | ESN0685 | Basics of air-conditioning | 2 | | | | | S1ENC_W04 | 30 | 60 | 2 | 1 | T | Z | | | S | W |
| 16 | ESN0011 | Energy audit | 1 | | | | | S1ENC_W11 | 15 | 30 | 1 | 0,5 | T | Z | | | S | W |
| 17 | ESN0011 | Energy audit | | | 1 | | | S1ENC_U12 | 15 | 30 | 1 | 0,75 | T | Z | | P | S | W |
| 18 | ESN0971 | Heat distribution networks | 1 | | | | | S1ENC_W10 | 15 | 30 | 1 | 0,5 | T | Z | | | S | W |
| 19 | ESN0971 | Heat distribution networks | | 1 | | | | S1ENC_U11 | 15 | 30 | 1 | 0,75 | T | Z | | P | S | W |
| 20 | ESN0340 | Boilers and Small Power | 2 | | | | | S1ENC_W09 | 30 | 60 | 2 | 1 | T | Z | | | S | W |
| 21 | ESN0340 | Boilers and Small Power | | 1 | | | | S1ENC_U10 | 15 | 30 | 1 | 0,75 | T | Z | | P | S | W |
| 22 | ESN0240 | Energy management | 2 | | | | | S1ENC_W08 | 30 | 60 | 2 | 1 | T | Z | | | S | W |
| 23 | ESN0240 | Energy management | | 1 | | | | S1ENC_U09 | 15 | 30 | 1 | 0,75 | T | Z | | P | S | W |
| | | Total | 18 | 7 | 5 | 2 | | | 480 | 1020 | 34 | 20,5 | | | | | | |

### 4.2.4.1 *Specialization subjects* Thermal Power Engineering *module* (optionally in English):

| 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 | ESN0321 | Energy Conversion | 2 | | | | | S1ENC_W07 | 30 | 60 | 2 | 1 | T | Z | | | S | W |
| 2 | ESN0321 | Energy Conversion | | | 1 | | | S1ENC_U08 | 15 | 30 | 1 | 0,75 | T | Z | | P | S | W |
| 3 | ESN0078 | Refrigeration and Cryogenics | 2 | | | | | S1ENC_W03 | 30 | 90 | 3 | 1,5 | T | E | | | S | W |
| 4 | ESN0078 | Refrigeration and Cryogenics | | | 2 | | | S1ENC_U04 | 30 | 60 | 2 | 1,5 | T | Z | | P | S | W |

[1]BK – number of ECTS points assigned to hours of classes requiring direct contact of teachers with students
[2]Traditional – enter T, remote – enter Z
[3]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)
[4]University-wide course /group of courses – enter O
[5]Practical course / group of courses – enter P. For the group of courses – in brackets enter the number of ECTS points assigned to practical courses
[6] KO – general education, PD – basic sciences, K – field-of-studies, S – specialization
[7] 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[1] |
|---|---|---|---|---|---|---|---|---|
| lec | cl | lab | pr | sem | | | | |
| 18 | 7 | 5 | 2 | | 480 | 1020 | 34 | 20,5 |

## 4.3 Training module (Faculty Council resolution on principles of crediting training – attachment no. 1)

| **Name of training** | | | |
|---|---|---|---|
| **Number of ECTS points** | **Number of ECTS points for BK classes[1]** | **Number of ECTS points** | **Number of ECTS points for BK classes[1]** |
| 4 | 0 | Opinion from training tutor and a report from practice | ESN1410 |

| **Training duration** | **Training objective** |
|---|---|
| 4 weeks | ○ to familiarize with the methods of operation of equipment and production, and the procedures and methods of work organization,<br>○ to confront knowledge with the practice and<br>○ to use knowlege for solving attributed tasks |

## 4.4 Diploma dissertation module

| **Type of diploma dissertation** | inżynier | |
|---|---|---|
| **Number of diploma dissertation semesters** | **Number of ECTS points** | **Code** |
| **1** | **15** | **ESN1420** |
| **Character of diploma dissertation** | | |
| **experimental / design** | | |
| **Number of BK[1] ECTS points** | **2** | |

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

| **Type of classes** | **Ways of verifying assumed educational effects** |
|---|---|
| lecture | e.g. examination, progress/final test |
| class | e.g. progress/final test |
| laboratory | e.g. pretest, report from laboratory |
| project | e.g. project defence |
| seminar | e.g. participation in discussion, topic presentation, essay |
| training | e.g. report from training |
| 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 BK[1])

**116,75 ECTS points**

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

| | |
|---|---|
| Number of ECTS points for obligatory subjects | 34 |
| Number of ECTS points for optional subjects | 0 |
| Total number of ECTS points | 34 |

**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.<br>including laboratory classes and project | 57<br>28 |
| Number of ECTS points for optional subjects<br>including laboratory classes and project<br>*including diploma dissertation* | 46<br>14<br>*15* |
| Total number of ECTS points | 103 |

**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)

**50 ECTS points**

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

**70 ECTS points**

**11. Range of diploma dissertation**

**1. Zagadnienia teoretyczne**

1.1. Podstawowe równania mechaniki płynów – zasada zachowania masy, pędu i energii.
1.2. Równanie Bernoulliego dla płynu doskonałego i jego zastosowanie.
1.3. Przepływy laminarne i turbulentne. Rozkłady prędkości przepływu w przewodzie.
1.4. Charakterystyka przepływu w pojedynczym przewodzie i szeregowym systemie hydraulicznym. Rozkład energii wzdłuż rurociągu – wykres Ancony
1.5. Pierwsza i druga zasada termodynamiki (entropia, zjawiska odwracalne i nieodwracalne).
1.6. Przemiany charakterystyczne gazu doskonałego. Równanie stanu gazu. Gaz wilgotny.
1.7. Przemiany charakterystyczne pary wodnej (układ p-v, T-s oraz i-s).
1.8. Siłownia parowa (Obieg Clausiusa – Rankine'a). Metody podwyższenia sprawności obiegu C-R.
1.9. Przewodzenie i przenikanie ciepła. Promieniowanie cieplne – podstawowe prawa. Rodzaje wymiany ciepła – podstawowe równania je opisujące. przekazywanie ciepła.
1.10.Spalanie paliw stałych, ciekłych i gazowych - specyfika spalania, stechiometria
1.11 Charakterystyka podstawowych regulatorów o działaniu ciągłym
1.12. Sprężanie gazów, określenie sprawności sprężania, poprawa sprawności obiegu

**2. Zagadnienia konstrukcyjno-technologiczne**

2.1. Kotły rusztowe (wodne i parowe) w energetyce komunalnej i przemysłowej
2.2. Kotły parowe dużej wydajności - podział kotłów ze względu na konstrukcję komory paleniskowej i parametry pracy
2.3. Turbiny parowe i turbiny gazowe – rodzaje i konstrukcje turbin, zasada działania, sprawność stopnia
2.4. Typy palników stosowanych w kotłach małej mocy
2.5. Sposoby zabezpieczenia kotłów małej mocy przed zbyt niską temperaturą wody powrotnej
2.6. Wymienniki ciepła w procesach przemysłowych (rodzaje, budowa, zasada pracy, zastosowania)

2.7. Klimatyzatory i systemy klimatyzacyjne
2.8. Pompy ciepła
2.9. Kolektory słoneczne i fotoogniwa
2.10. Techniki redukcji zanieczyszczeń pyłowych i gazowych w spalinach emitowanych do atmosfery
2.11. System elektroenergetyczny i jego elementy składowe
2.12. Sprężarkowy jednostopniowy system ziębniczy ( elementy składowe, ograniczenia,wymagania)

**3. Zagadnienia eksploatacyjne**

3.1. Metody pomiaru ciśnienia, temperatury i przepływu płynu
3.2. Charakterystyki wentylatora, punkt pracy, metody regulacji parametrów pracy wentylatora
3.3. Charakterystyki pomp wirowych, metody regulacji i zasady doboru pomp do układu pompowego.
3.4. Rozruch i odstawianie bloku energetycznego – ogólne zasady
3.5. Pomiary energetyczne silników lub urządzeń cieplnych, ocena niepewności pomiarów – na wybranym przykładzie.
3.6. Zagadnienia dotyczące budowy i eksploatacji siłowni cieplnych - konwencjonalnych
3.7. Zasady eksploatacji sieci cieplnych
3.8. Oddziaływanie elektrowni konwencjonalnych na środowisko
3.9. Wpływ techniki spalania i rodzaju paliwa na emisję zanieczyszczeń do atmosfery
3.10. Wytwarzanie tlenu na potrzeby energetyki w technologii *oxy-fuel*,
3.11. Zasady bilansowania cieplnego pomieszczeń
3.12. Zasady określania zużycia gazu przez grupy odbiorców

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

| *No.* | *Course code* | *Name of course* | *Crediting by deadline of... (number of semester)* |
|---|---|---|---|
| | 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. 2)