FACULTY OF ELECTRICAL ENGINEERING

# SUBJECT CARD

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|---|---|
| Name in Polish: | **Scentralizowane i zdecentralizowane technologie wytwarzania energii** |
| Name in English: | **Centralized and decentralized electricity generation technologies** |
| Main field of study (if applicable): | **Electrical Engineering** |
| Specialization (if applicable): | **Renewable Energy Sources** |
| Level and form of studies: | **2nd level, full-time** |
| Kind of subject: | **obligatory** |
| Subject code: | **ELR052519** |
| Group of courses: | **NO** |

| | Lecture | Classes | Laboratory | Project | Seminar |
|---|---|---|---|---|---|
| Number of hours of organized classes in University (ZZU): | 30 | | 15 | | |
| Number of hours of total student workload (CNPS): | 90 | | 30 | | |
| Form of crediting: | examination | | crediting with grade | | |
| For group of courses mark (X) final course: | | | | | |
| Number of ECTS points: | 3 | | 1 | | |
| including number of ECTS points for practical (P) classes : | | | 1 | | |
| including number of ECTS points for direct teacher-student contact (BK) classes: | 2.10 | | 0.70 | | |

## PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knows energy conversions applied in electric power generation, heat and cold
2. Knows principles of energy production using fossil fuels and renewable resources
3. Knows theoretical principles of thermodynamic processes in electric power generation, heat and cold
4. Knows basic operation rules of equipment for electric power, heat and cold production with power system and energy storage devices

## SUBJECT OBJECTIVES

C1. Be familiar with using of primary energy resources for electricity, heat and cold production
C2. Be familiar with thermodynamic cycles using in energy production and know the ways of improving their efficiency
C3. Be familiar with technologies of electricity, heat and cold production with use of renewable sources
C4. Be familiar with methods for technical and economic assessment of electrical energy, heat and cold production devices

## SUBJECT LEARNING OUTCOMES

*relating to knowledge:*

| | |
|---|---|
| PEU_W01 | Has knowledge on thermal engine cycles and energy conversion processes |
| PEU_W02 | Has knowledge on construction of technology plants for electric energy, hot and cold production; energy balancing of these plants |
| PEU_W03 | Has knowledge on cost assessment of electricity, heat and cold production |

*relating to skills:*

| | |
|---|---|
| PEU_U01 | Be familiar on creating energy balance of electric energy production plant in analytical form and Sankey chart |
| PEU_U02 | Be able to interpret energy characteristics of electric energy production plants and calculate basic technical indices |
| PEU_U03 | Be able to calculate electricity costs in various types of power plants |

*relating to social competences:*

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|---|---|
| PEU_K01 | Is aware of necessity of self-reliant information retrieval and creative using of obtained information |

| PROGRAMME CONTENT | | |
|---|---|---|
| **Form of classes - lecture** | | **Number of hours:** |
| Lec 1 | Lecture introduction. Energy and civilization. World and domestic energy balance. Primary and useful energy carriers. 1-, 2- and 3-step energy conversion processes in energy production | 2 |
| Lec 2 | Conventional coal fired steam power plants. Cycle efficiency improvement. Levelized costs of electricity for convenctional steam power plants | 2 |
| Lec 3 | Combined heat and power generation. Conventional CHP steam plants. Levelized electricity and heat production costs in CHP plants | 2 |
| Lec 4 | Gas and combined gas-steam electric power plants: construction, operation and application | 2 |
| Lec 5 | Nuclear power: characteristics. Physical basis of nuclear reactions occurring in energy reactors. Nuclear power plants: construction of the reactor, basic systems, safety for the environment | 2 |
| Lec 6 | Electric power and CHP plants with Organic Rankine Cycle (ORC) | 2 |
| Lec 7 | Electricity and heat storage technologies - overview. Energy storage device in energy production plants | 2 |
| Lec 8 | Hydro energy - overview. Water power plants: physical principles. Run-off river, pounded and pump-storage plants | 2 |
| Lec 9 | Hydro energy resources assessment. Hydro turbines: types and selection. Hydro energy and hydro power plant development | 2 |
| Lec 10 | Wind energy: characteristics. Wind turbines: construction, operation, power characteristics. Assessment of electricity production by a wind turbine. Levelized costs of electricity for wind farms | 2 |
| Lec 11 | Biomass and biogas fired CHP plants: fuels, construction and operation | 2 |
| Lec 12 | Using solar energy for electricity generation, heating and preparing of hot domestic water. Electricity and heat production costs in solar systems | 2 |
| Lec 13 | Geothermic and geothermal electric power and heat plants. Heat pump: construction and operation | 2 |
| Lec 14 | Fuel cells: operation principles and energy balance, technical solutions | 2 |
| Lec 15 | Energy technologies in distributed generation: present status and future directions. Summary of the lecture | 2 |
| | Total hours: | **30** |

| **Form of classes - laboratory** | | **Number of hours:** |
|---|---|---|
| Lab 1 | Introduction: form of exercise reports, processing of simulation/measurement results and conclusions, safety rules. | 1 |
| Lab 2 | Energy balance of thermal power plant | 2 |
| Lab 3 | Energy balance of CHP plant | 2 |
| Lab 4 | Annual energy production (AEP) in wind power plants | 2 |
| Lab 5 | PV generation: statistical analysis and energy production efficiency | 2 |
| Lab 6 | Fuel cells: modeling and energy balance | 2 |
| Lab 7 | The costs of electricity, heat and cold production in separated and combined systems | 2 |
| Lab 8 | Analysis of technical and economic efficiency of renewable energy sources | 2 |
| | Total hours: | **15** |

| **TEACHING TOOLS USED** |
|---|
| N1. Information lecture in form of multimedia presentation |
| N2. Laboratory made in traditional way |

| **EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT** | | |
|---|---|---|
| **Evaluation**<br>*F – forming (during semester)*<br>*P – concluding (at semester end)* | **Educational effect number** | **Way of evaluating educational effect achievement** |
| $F1_{(W)}$ | PEU_W01<br>PEU_W02<br>PEU_W03<br>PEU_K01 | Writing exam |
| $P_{(W)}$ | P=F1 | |
| $F1_{(L)}$ | PEU_U01<br>PEU_U02<br>PEU_U03<br>PEU_K01 | Average of notes for entry tests |
| $F2_{(L)}$ | PEU_U01<br>PEU_U02<br>PEU_U03<br>PEU_K01 | Average of notes for reports |
| $P_{(L)}$ | P=0.4F1+0.6F2 | |

## PRIMARY AND SECONDARY LITERATURE

### PRIMARY LITERATURE:

[1] Paska J., Wytwarzanie energii elektrycznej, OWPW, Warszawa 2018.
[2] Paska J., Rozproszone źródła energii, OWPW, Warszawa 2017.
[3] Pawlik M. , Strzelczyk F. , Elektrownie, WNT, Warszawa 2009.
[4] Lewandowski W., Klugmann-Radziemska E., Proekologiczne odnawialne źródła energii. Kompendium, PWN, Warszawa 2017.
[5] Marecki J., Podstawy przemian energetycznych, WNT, Warszawa 2013.
[6] Paska J., Ekonomika w elektroenergetyce. OWPW, Warszawa 2007.

### SECONDARY LITERATURE:

[1] Chmielniak T., Technologie energetyczne, PWN, Warszawa 2010.
[2] Chmielniak T. J. i inni, Turbiny gazowe . Wyd. Zakład Narodowy im. Ossolińskich PAN, Warszawa 2001
[3] Bartnik R., Rachunek efektywności techniczno-ekonomicznej w energetyce zawodowej. OWPO, Opole 2008
[4] Szargut J., Ziębik A., Podstawy energetyki cieplnej. PWN, Warszawa 2000.
[5] Michałowski S., Plutecki J., Energetyka wodna , WNT, Warszawa 1976.
[6] Maroński R., Siłownie wiatrowe OWPW, Warszawa 2016.
[7] Skorek J., Kalina J., Gazowe układy kogeneracyjne. WNT, Warszawa 2005.

## SUBJECT SUPERVISOR

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