Politechnika Krakowska im. Tadeusza Kościuszki

Karta przedmiotu

obowiązuje studentów rozpoczynających studia w roku akademickim 2018/2019

Wydział Mechaniczny

Kierunek studiów: Energetyka | Profil: Ogólnoakademicki

Forma sudiów: stacjonarne | Kod kierunku: E

Stopień studiów: II

Specjalności: Maszyny i urządzenia energetyczne (Energy systems and machinery), module: Energy systems

1 Informacje o przedmiocie

Nazwa przedmiotu	Power Plant Technology
Nazwa przedmiotu w języku angielskim	
Kod przedmiotu	WM ENERG oIIS B7 18/19
Kategoria przedmiotu	Przedmioty podstawowe
Liczba punktów ECTS	3.00
Semestry	1

2 Rodzaj zajęć, liczba godzin w planie studiów

Semestr	Wykład	Ćwiczenia	Laboratorium	Laboratorium komputerowe	Projekt	Seminarium
1	15	15	15	0	0	0

3 Cele przedmiotu

Cel 1 The students will apply previously acquired knowledge in thermodynamics to real cases within the field of thermal power engineering. The students will also learn to understand the function of the components and be able to dimension components of the thermal power plants. This course will provide skills to use different tools for analysis of components and systems for electricity and heat production.

Cel 2 The students will be able to distinguish different types of power stations properly and evaluate their basic parameters: parameters of water, electric power, efficiency and specific fuel consumption. They will also know the methods of increasing the efficiency of such structures.

4 Wymagania wstępne w zakresie wiedzy, umiejętności i innych kompetencji

1 Thermodynamics, Heat Transfer and Fluid Mechanics

5 Efekty kształcenia

EK1 Wiedza The student must be able to describe and account for the function of the steam cycles and design belonging subcomponents; be able to account for the combustion process in boilers for different fuels and calculate and present the heat transfer areas in written form; be able to account for the function principle of the nuclear plants and calculate and present for the belonging subcomponents in written form; be able to calculate and present the efficiency level of the components and systems for any given system layout.

EK2 Umiejętności The student must be able to use T-S, h-S, T-Q diagram for analysis of thermal power plants; be able to use the efficiency concept for analysis and comparison of different system layouts; be able to calculate and account for the combustion process in industrial boilers and calculate the heat transfer surfaces; be able to carry out engineering studies of thermal power plants and evaluate the reliability of the results in group

EK3 Kompetencje społeczne The student must be able to actively participate in discussions regarding the relevant problems within the field of thermal power engineering; be able to present analysis of calculation results from component and system analysis in written form

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6 Treści programowe

Wykład		
Lp	Tematyka zajęć Opis szczegółowy bloków tematycznych	Liczba godzin
W1	Introduction: Conventional and non-conventional sources of energy and their availability. Structure of primary energy sources (coal, oil, natural gas, nuclear, hydroelectricity, solar and other renewable). Depletion of energy sources and impact exponential rise in energy consumption on economies of countries and on international relations. Types of power plants: general layout of thermal power plant, brief description of different parts/systems and their functions, advantages and limitations.	1
W2	Coal fired steam power plant: Introduction; General layout of modern coal fired steam power plant; Power plant cycle (fuel handling, combustion equipment, ash handling, dust collectors, steam generators, steam turbines and condensers, cooling towers). The Carnot vapor cycle. Rankine cycle: the ideal cycle for vapor power cycles (energy analysis, deviation of actual vapor power cycles from idealized ones). Thermal efficiency of the rankine cycle. Methods of increase the efficiency of the Rankine cycle (lowering the condenser pressure, superheating the steam to high temperatures, increasing the boiler pressure, feed water regenerative heating) advantages and limitations. Gross and net power plant efficiency. Cooling systems of steam condensers. Cogeneration CHP plants types and utilization factor.	3

Wykład		
Lp	Tematyka zajęć Opis szczegółowy bloków tematycznych	Liczba godzin
W3	Gas turbine power plant: An overview of gas turbines major components, materials, fuel systems; Gas turbine cycle open cycle and closed cycle (theoretical cycle and irreversibilities, thermal efficiency and method of it increase);	2
W4	Combined-cycle plant: Thermodynamic principles; System layouts; Combined-cycle plants for cogeneration; IGCC power plant technology; Typical combined-cycle plants under operation; Comparison of the combined-cycle plant with other types of thermal power stations	2
W5	Nuclear Power Generation: Basics of nuclear physics; Nuclear reactors (classification, types of reactors, site selection). Nuclear fuel cycle, method of uranium enriching; Application of nuclear power plant. Nuclear power plant safety systems; by-product of nuclear power generation; Economics of nuclear power plant; Future of nuclear power.	3
W6	Power Generation Based on Internal Combustion Engines: Combustion process in IC engines; Thermodynamic cycle for diesel and spark ignition engines; Applications of diesel engine in distributed power generation; Advantages and disadvantages; Types of diesel plants, general layout.	2
W7	Hydro Power Generation: Principles of operation; General arrangement and operation of hydro-electric power plant; Classification and site selection; Different components and their functions; Types of dams; Types, characteristics and selection of hydro-turbines, Advantages of Hydro-electric power plants;	2

Ćwiczenia		
Lp	Tematyka zajęć Opis szczegółowy bloków tematycznych	Liczba godzin
C1	Carnot vapour power cycle analysis. Calculations of performance parameters: thermal efficiency, heat added in cycle, work ratio, back work ratio, turbine work, compression (pumping) work.	1
C2	Rankine cycle analysis. Determining thermodynamic propertiesof working fluid. Calculations of ideal Rankine cycle efficiency. Assuming irreversibilities and losses in cycle during efficiency calculations. Parametric analysis for performance improvement in Rankine cycle	2
C3	Thermodynamic analysis of ideal and actual Rankine reheat cycle. Influence of the live and reheated steam parameters on thermal efficiency.	2
C4	Thermodynamic analysis of regenerative Rankine cycle. Heat balance for open and closed feed water heaters.	2
C5	Steam turbine arrangement for reheat and regenerative. Calculations of steam turbine isentropic efficiency.	2
C6	Heat utilization in combined heat and power plant. Utilization factor.	1

Ćwiczenia		
Lp	Tematyka zajęć Opis szczegółowy bloków tematycznych	Liczba godzin
C7	Brayton cycle analysis. Calculations of performance parameters: thermal efficiency, heat added in cycle, work ratio, back work ratio, gas turbine work, compressor work.	2
C8	Analysis of thermal performance for combined cycle power plants.	1
C9	Thermodynamic analysis of ideal and actual cycle for power generation system with internal combustion enginess. Influence of the pressure ratio and combustion temperatiure on thermal efficiency.	1
C10	Hydro power plants: calculations of available head, pressure losses in channels. Hydro turbine selection.	1

Laboratorium		
Lp	Tematyka zajęć Opis szczegółowy bloków tematycznych	Liczba godzin
L1	Visiting condensing power plant learning about its operation, powerplant layout. Colecting measurement data from the DCS system. Calculation power plant efficiency and performance parameters	15

7 Narzędzia dydaktyczne

N1 Lectures

N2 Classes

N3 Laboratories

8 Obciążenie pracą studenta

Forma aktywności	Średnia liczba godzin na zrealizowanie aktywności
Godziny kontaktowe z nauczycielem akademickim, w tym:	
Godziny wynikające z planu studiów	45
Konsultacje przedmiotowe	5
Egzaminy i zaliczenia w sesji	5
Godziny bez udziału nauczyciela akademickiego wynikające z nakładu pracy studenta, w tym:	
Przygotowanie się do zajęć, w tym studiowanie zalecanej literatury	20
Opracowanie wyników	5
Przygotowanie raportu, projektu, prezentacji, dyskusji	10
Sumaryczna liczba godzin dla przedmiotu wynikająca z całego nakładu pracy studenta	**90**
Sumaryczna liczba punktów ECTS dla przedmiotu	3.00

9 Sposoby oceny

Ocena formująca

F1 Class exercices

F2 The compulsory project assignments have to be presented written as well as orally in classes, where all group members are required to participate actively

Ocena podsumowująca

P1 The examination is carried out individually and in group.

Warunki zaliczenia przedmiotu

W1 Passing the exam

Ocena aktywności bez udziału nauczyciela

B1 The compulsory project assignment

Kryteria oceny

Efekt kształcenia 1

Na ocenę 3.0	The student must be able to describe and account for the function of the steam cycles and design belonging subcomponents; be able to account for the combustion process in boilers for different fuels and calculate and present the heat transfer areas in written form; be able to account for the function principle of the nuclear plants and calculate and present for the belonging subcomponents in written form; be able to calculate and present the efficiency level of the components and systems for any given system layout.
Na ocenę 4.0	The student must be able to describe and account for the function of the steam cycles and design belonging subcomponents; be able to account for the combustion process in boilers for different fuels and calculate and present the heat transfer areas in written form; be able to account for the function principle of the nuclear plants and calculate and present for the belonging subcomponents in written form; be able to calculate and present the efficiency level of the components and systems for any given system layout.
Na ocenę 5.0	The student must be able to describe and account for the function of the steam cycles and design belonging subcomponents; be able to account for the combustion process in boilers for different fuels and calculate and present the heat transfer areas in written form; be able to account for the function principle of the nuclear plants and calculate and present for the belonging subcomponents in written form; be able to calculate and present the efficiency level of the components and systems for any given system layout.
Efekt kształcenia 2	
Na ocenę 3.0	The student must be able to use T-S, h-S, T-Q diagram for analysis of thermal power plants; be able to use the efficiency concept for analysis and comparison of different system layouts; be able to calculate and account for the combustion process in industrial boilers and calculate the heat transfer surfaces; be able to carry out engineering studies of thermal power plants and evaluate the reliability of the results in group
Na ocenę 4.0	The student must be able to use T-S, h-S, T-Q diagram for analysis of thermal power plants; be able to use the efficiency concept for analysis and comparison of different system layouts; be able to calculate and account for the combustion process in industrial boilers and calculate the heat transfer surfaces; be able to carry out engineering studies of thermal power plants and evaluate the reliability of the results in group
Na ocenę 5.0	The student must be able to use T-S, h-S, T-Q diagram for analysis of thermal power plants; be able to use the efficiency concept for analysis and comparison of different system layouts; be able to calculate and account for the combustion process in industrial boilers and calculate the heat transfer surfaces; be able to carry out engineering studies of thermal power plants and evaluate the reliability of the results in group
Efekt kształcenia 3	
Na ocenę 3.0	The student must be able to actively participate in discussions regarding the relevant problems within the field of thermal power engineering; be able to present analysis of calculation results from component and system analysis in written form

Na ocenę 4.0	The student must be able to actively participate in discussions regarding the relevant problems within the field of thermal power engineering; be able to present analysis of calculation results from component and system analysis in written form
Na ocenę 5.0	The student must be able to actively participate in discussions regarding the relevant problems within the field of thermal power engineering; be able to present analysis of calculation results from component and system analysis in written form
Efekt kształcenia 4	
Na ocenę 3.0	The student must be able to actively participate in discussions regarding the relevant problems within the field of thermal power engineering
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10 Macierz realizacji przedmiotu

Efekt kształcenia	Odniesienie danego efektu do szczegółowych efektów zdefiniowanych dla programu	Cele przedmiotu	Treści programowe	Narzędzia dydaktyczne	Sposoby oceny
EK1		Cel 1 Cel 2	W1 W2 W3 W4 W5 W6 W7 C1 C2 C3 C4 C5 C6 C7 C8 C9 C10	N1 N2	F1
EK2		Cel 1	W2 W3 W4 W5 W6 W7 C1 C2 C3 C4 C5 C6 L1	N1 N2 N3	F1 F2
EK3		Cel 1 Cel 2	W1 W2 W3 W4 W5 W6 W7 C1 C2 C3 C4 C5 C6 C7 C8 C9 C10 L1	N1 N2 N3	F1 F2
EK4		Cel 1 Cel 2	W1 W2 W3 W4 W5 W6 W7 C1 C2 C3 C4 C5 C6 C7 C8 C9 C10 L1	N1 N2 N3	F1 F2 P1

11 Wykaz literatury

Literatura podstawowa

[1] Tomei G.L. (Ed.) — *Steam. Its generation and use*, Charlotte, 2015, The Babcock & Wilcox Company

[2] El-Wakil M.M. — *Powerplant Technology*, New York, 1984, McGraw-Hill, Inc

[3] Onkar S. — *Applied Thermodynamics*, New Delhi, 2009, New Age International Lmtd. Publishers

[4] Boyce M.P. — *GasTurbine Engineering Handbook*, Houston, 2002, Gulf Professional Publishing

[5] Kok K — *Nuclear Engineering Handbook*, Boca Raton, 2009, CRC Press

Literatura uzupełniająca

[1] Cengel Y., Boles M. — *Thermodynamics: An Engineering Approach. 8th Edition*, New York, 2015, McGraw-Hill

12 Informacje o nauczycielach akademickich

Osoba odpowiedzialna za kartę

dr inż. Tomasz, Krzysztof Sobota (kontakt: tomasz.sobota@pk.edu.pl)

Osoby prowadzące przedmiot

1 dr inż. Tomasz Sobota (kontakt: tsobota@mech.pk.edu.pl)

13 Zatwierdzenie karty przedmiotu do realizacji

(miejscowość, data) (odpowiedzialny za przedmiot) (dziekan)

Przyjmuję do realizacji (data i podpisy osób prowadzących przedmiot)

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