COURSE DESCRIPTION CARD - SYLLABUS

Course name
Advanced power generation technology [S2ZE1E>ZTWE]

Course

Field of study
Green Energy

Year/Semester
1/2

Area of study (specialization)
–

Profile of study
general academic

Level of study
second-cycle

Course offered in
English

Form of study
full-time

Requirements
compulsory

Number of hours

Lecture
30

Laboratory classes
15

Other (e.g. online)
0

Tutorials
15

Projects/seminars
0

Number of credit points

4,00

Coordinators

dr inż. Michał Gołębiewski
michal.golebiewski@put.poznan.pl

Lecturers

Prerequisites

Basic knowledge from thermodynamics, fluid mechanics, mechanics, gas cycles and steam cycles. Can use the scientific method for problem solving, experimenting, and making conclusions Knows the limitations of his or her own knowledge and skills, understands the non-technical aspects and results of engineering activity and their importance

Course objective

To acquaint students with the theoretical and practical problems related to the flow issues, materials issues and exploatation parameters of internal combustion gas engines, gas turbine, steam and gas systems, CHP systems, industral Heat Pumps, ORC systems, modern fuels: hydrogen and ammonia.

Course-related learning outcomes

Knowledge:
1.Student has expanded knowledge necessary to understand gas engines and specialist knowledge about construction, methods of designing, manufacturing, operating, safety systems as well as impact on the economy, society and the environment in the field of advanced power generation technology
2.Student has extended and deep knowledge in the field of advanced power generation technology

3.Student has deep knowledge of operational parameters impact on the efficiency of advanced power generation technology and functioning of energy systems

Skills:
1.Student is able to use his knowledge to find right sources and interpret founded information in order to solve both standard and non-standard problems related with advanced power generation technology
2.Student is able to solve research and engineering tasks requiring the use of engineering standards and norms as well as the use of technologies appropriate for advanced power generation technology, using experience gained in an professional environment engaged in engineering activities
3.Student use a foreign language at B2 + level (at European Language Training Description System) and specialized terminology related to advanced power generation technology

Social competences:
1.Student is ready to recognize the importance of knowledge in solving cognitive and practical problems and to seek expert opinions in case of difficulties in solving the problems on field of advanced power generation technology
2.Student is ready to fulfill social obligations as well as inspire and organize activities for the social environment
3.Student is ready to perform responsible professional roles, taking into account changing social needs, including:
− developement of the profession's achievements,
− maintainance the profession ethos,
− compliance of professional development with ethics principles and introduce actions to comply with these principles

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Lecture - the written examination. The evaluation of student knowledge will be held based on an answers on 5 questions from the material presented during the lectures.
Classes - final test and rewarding knowledge necessary for the accomplishment of the problems in the area of the subject
Laboratory - positively assessed reports on the performed laboratory exercises

Programme content

Construction of gas engines, internal combustion engines processes, exploitation of internal combustion gas engines, development trends in gas engines construction, works cycles, turbocharging, methods of ignition, diagnostic methods of engines, emission of toxic compounds, engine failures, combustion an unusual gases in engines, Construction and operation of gas turbines, Cooling systems, combustion chamber, methods of flame stabilization, The operating parameters of gas turbines, TIT temperature, cooling gas turbine elements, Gas power plant, CCGT units, simple cycle efficiency, manganese, Trends of development of gas turbines: industrial units and small units, circulating agents for ORC and Heat Pumps, hydrogen and ammonia combustion technologies.

Course topics

Lecture:
1. Classification of heat engines
2. Theoretical cycles of piston engines
3. Operating parameters of piston engines
4. Operating characteristics of piston engines
5. Emission of toxic substances in piston engines
6. Mechanical systems of piston engines
7. Directions of development of piston engines
8. Thermodynamic cycles of gas turbines
9. Gas turbine compressors
10. Combustion chambers of gas turbines
11. Gas turbine turbines
12. Cooling and bearing systems for gas turbines

13. Emission of toxic substances from gas turbines
14. Directions of development of gas turbines

Exercises:
1. Calculations of the basic parameters of piston engines
2. Calculations of thermodynamic cycles of piston engines I
3. Calculations of thermodynamic cycles of piston engines II
4. Calculations of thermodynamic cycles of gas turbines I
5. Calculations of thermodynamic cycles of gas turbines II
6. Calculations of steam and gas systems

Lab:
1. Measurement of basic operating parameters of a piston engine
2. Determining the indicated power of a gas engine
3. Measurement of emissions from a piston engine
4. Determining the balance of the steam and gas system
5. Determination of the efficiency of a gas turbine
6. Measurement of emissions of toxic substances from a gas turbine

Teaching methods

Lecture: multimedia presentation, illustrated with examples on the board.
Exercises: performing theoretical calculations on the board.
Laboratory: performing laboratory exercises

Bibliography

Basic:
1.Heywood J.B., Internal Combustion Engine Fundamentals
2.C.R. Ferguson and A.T. Kirkpatrick, Internal Combustion Engines Applied Thermosciences, Second
3.Stone R., Introduction to Internal Combustion Engines
4.Arthur H. Lefebvre, Dilip R. Ballal, Gas turbine. Combustion. Alternative Fuels and Emissions
5.Meherwan P. Boyce: Gas Turbine Engineering Handbook
6.Chmielniak T. Maszyny Przepływowe. Wydawnictwo Politechniki Śląskiej
7.Wajand J. A., Wajand J. T., Tłokowe Silniki Spalinowe Średnio- i Szybkoobrotowe
8.Serdecki W., Badania Silników Spalinowych. Laboratorium, Wydawnictwo Politechniki Poznańskiej
9.Kowalewicz A. Podstawy procesów spalania. WNT, Warszawa 2000

Additional:
1.Dobski, T.: Combustion Gases in Modern Technologies, 2scd Ed., Wydawnictwo Politechniki Poznańskiej
2.Skorek J. Kalina J.: Gazowe układy kogeneracyjne
3.Miller A.: Turbiny gazowe i układy parowo-gazowe
4.K. Niewiarowski: Tłokowe silniki spalinowe, WKiŁ, 1983
5.Kowalewicz A. Tworzenie mieszanki i spalanie w silnikach o zapłonie iskrowym. WKiŁ
6.R.S. Benson, N.D. Whitehouse: Internal Combustion Engines. Pergamon Press, 1979

Breakdown of average student's workload

	Hours	ECTS
Total workload	100	4,00
Classes requiring direct contact with the teacher	60	2,50
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	40	1,50