SYLLABUS

Name: ***The use of biofuels in electric energy production (BioAIS-BF>SMs2UBp3O)***
Name in Polish:
Name in English: ***The use of biofuels in electric energy production***

Information on course:

Course offered by department: Faculty of Energy and Environmental Engineering
Course for department: Silesian University of Technology
Term: Winter semester 2022/2023
Cordinator of course edition: Dr hab. inż. Grzegorz Przybyła

Default type of course examination report:

ZAL

Language:

English

Course homepage:

https://platforma.polsl.pl/rie/course/view.php?id=1960

Short description:

The subject covers issues related to electricity generation technologies using the conversion the chemical energy of biofuel in a heat engines. Types of heat engines fuelled by different types of biofuels are presented. The construction and principle of operation of solutions used in industry are explained. Technologies of combustion of liquid and gaseous biofuels in the internal combustion engines (ICE) are detailed discussed. Properties of biofuels which are important from the point of view of application in a particular type of ICE are discussed. Aspects connected with energy efficiency (heat engine - electric generator) as well as the environmental impact of various technological solutions are discussed.

Description:

1. The lecture covers the following topics:
- Classification of heat engines according to the type of utilized biofuel (internal and external combustion reciprocating engines, gas microturbine).
- Characteristics of liquid and gaseous biofuels important for their using in reciprocating internal combustion engines.
- Construction and principles of work of a reciprocating internal combustion engine. Spark ignition engines, compression ignition engines, engines with HCCI combustion system.
- Thermodynamic cycle of internal combustion engines (Otto, Diesel, Seiliger - Sabathe), explanation of the most important parameters and their relation to the real engine cycle.
- In-cylinder pressure measurement technique for reciprocating internal combustion engines. Definitions of internal parameters.
- Characteristics of internal combustion engines, engine energy balance.
- Emission of harmful substances from internal combustion engines and methods of its reduction.
- Internal combustion engine driven electric power generator - load control.
- Electric generators - the main characteristics and principles of work.
- Technologies characteristics used in industry for electricity production with reciprocating internal combustion engines fuelled with biofuels (biogas plants, biomass gasification systems).
2. Laboratory classes include the following exercises:
- Disassembly and metrology the main engine components
- Experimental test of the main operating parameters of SI engine
- Experimental test of 3-way catalytic converter installed in the exhaust system of the SI engine
- Effect of ignition timing on the performance of SI engine genset
- Effect of air excess ratio changes on the performance of SI engine genset
- In-cylinder pressure measurements.

Bibliography:

1. Richard Stone, Introduction to Internal Combustion Engines ISBN-13: 978-0768004953, ISBN-10: 0768004950
2. Anju Dahiya, Bioenergy Biomass to Biofuels, ISBN 978-0-12-407909-0
3. Khanal, Samir K.; Surampalli, Rao Y.; Zhang, Tian C.; Lamsal, Buddhi P. , Tyagi, R. D.; Kao, C. M., Bioenergy and Biofuel from Biowastes and Biomass, Publisher American Society of Civil Engineers (ASCE), ISBN 978-0-7844-1089-9
4. S. Suresh, Anil Kumar, Ashish Shukla, Renu Singh, C.M. Krishna, Biofuels and Bioenergy (BICE2016), International Conference, Bhopal, India, 23-25 February 2016
5. Tasneem Abbasi S. M., Tauseef S. A., Abbasi, Biogas Energy, Springer ISBN: 978-1-4614-1040-9
6. Ibrahim Dincer and Calin Zamfirescu, Advanced Power Generation systems, ISBN 978-0-12-383860-5
7. Dominik Rutz, Rainer Jansson, Biofuel Technology Handbook, WIP Renewable Energies

Learning outcomes:

Knowledge - student knows and understands:
(1) Methods of calculating the quantities that characterise the chemical energy conversion process of biofuels (K2A_W01), K2A_W20 - Typical engineering technologies in the field of biotechnology.
(2) Methods of measurements and postprocessing of the experimental results in relation to the machine and installations (K2A_W01),
(3) Methods of determining the specific emission of electricity generation systems (K2A_W01, K2A_W20),
(4) Technologies for the use of solid, liquid and gaseous biofuels in electric energy generation systems (K2A_W20),
(5) Typical technologies used for heat engines to reduce the emission of harmful substances during biofuel combustion (K2A_W20, K2A_W01).

Skills - student is able to:
(6) The report preparation on experimental research and analyse the obtained results referring to the information available in the scientific literature (K2A_U01, K2A_U08),
(7) Conduct the experimental research, archive and post-process measurement data (K2A_U11, K2A_U08),
(8) Evaluate the suitability of biofuels with known physicochemical properties to power the heat engines (K2A_U21, K2A_U01),
(9) Perform an energy efficiency analysis of an electricity generation plant using heat engines (K2A_U08),
(10) Determine the specific emission of harmful substances during the electricity generation by combustion process of biofuels (K2A_U08, K2A_U11).

Assessment methods and assessment criteria:

Lectures – written test.
Laboratory – passed reports on experimental classes & written test.
Test - the tests can be organised stationery (in classroom) or online (by Distance Education Platform) – based on student decisions. Each test consists of 5 to 7 questions, including single-choice and multiple-choice questions (NOTE: marking the wrong answer in this type of question means negative points). The test will take place during the last class or a week after the end of the last class. Passing criterion, at least 41% of correct answers.
Final grade - basis for final grade = 0,6*Lectures + 0,4*Laboratories.

Information on course edition:

Default type of course examination report:

ZAL

Bibliography:

missing bibliography in English

Details of classes and study groups

lecture (30 hours)

Study groups details

Group number 1

Class instructors:

Dr hab. inż. Grzegorz Przybyła

laboratory classes (15 hours)

Study groups details

Group number 1

Class instructors:

Dr hab. inż. Grzegorz Przybyła

Element of course groups in various terms:

Course group description	First term	Last term
missing group description in English (BioAIS-BF>2(1))	2020/2021-Z	

Course credits in various terms:

Biotechnology, full-time master degree studies 3 sem. (BioAIS-SM3)

Type of credits	Number	First term	Last term
European Credit Transfer System (ECTS)	3	2020/2021-Z	