ADVANCED COAL TECHNOLOGIES
(6 ECTS credits) *Compulsory*

Responsible person:

Jan Górski, D.Sc., Assoc Prof.

Learning outcomes:

These lectures will provide an overview of current and planned technologies for the continued use of coal in power generation. It will provide the information about the backgrounds of CCS systems and some leading technologies including their prospects for commercialization.
The aim of this course is to give the students a better understanding the technical aspects and new ideas in the future more clean power generation technologies based on accessible fossil fuel resources. The class-room lectures will be supplemented by practical exercises and projects based on computer laboratory simulation tools (ASPENPlus, Thermofluids).

After completion of the course students should be able to:

- Examine new technologies for coal-fired power generation
- Identify policy considerations for coal use
- Examine new technologies for clean coal
- Analyze commercial viability of new technologies
- Compare technologies in clean coal to technologies in energy alternatives
- Identify future scenarios for coal use

Course main content:

The course is built of three parts:

Part 1: First part consists of 30 hours of lectures

During introductory lectures students will be acquainted with the most important issues in the thermodynamic backgrounds of modern fossil-based energy power generation systems and practical aspects of implementation some new technologies that reduce emissions.

Lectures will concern the following subjects:

- Fossil fuels combustion – environmental and economy factors
- Coal chemistry, conversion and combustion
- Review of recent energy conversion technologies
- Pre- and post-combustion carbon capture and sequestration
- Adsorption and absorption technologies for post- and pre-combustion capture
- Pre-combustion capture technologies
- Fischer-Tropsch (F-T)and chemical looping combustion (CLC) processes
- Integrated gasification combined cycle (IGCC) technologies
- Advanced combustion technologies – fluidized bed and oxy-coal technologies
- Polygeneration and synthetic fuels production
- Clean coal - environmental and economy aspects

Part 2: Home and classroom problems

In this course there are exercises in the form of classroom and home problems that are solved by groups of three students each. Some of the selected problems will be coupled to the computer laboratory simulation software.

The list of issues contained in the training class includes:

1. Thermodynamics and kinetics of coal combustion
2. Air pollution monitoring and emissions control
3. Classical coal-based power generation technologies
4. Coal conversion to liquid and gaseous fuels
5. Amine absorption and membrane separation methods
6. Recent integrated gasification combined cycles (IGCC)
7. Fluidized combustion and oxy-combustion technologies
8. The fuels synergy systems and polygeneration concepts
9. Environmental and economy aspects of clean coal
10. Exergy analysis in coal chemistry and technologies.

Part 3: Computer laboratory exercises

These PC laboratory exercises are carried out by groups of two students each. By this the students are able to practice with the engineering software tools (ASPENPlus, Thermofluids and others), and solve some applied problems such:

1. Thermodynamic and process analysis and the selection of coal-based CHP power-plant.

2. Application of amine technology for post-combustion carbon capture and separation.

3. Effectiveness and economy penalties for analyzed carbon capture technology.

In this part each student will prepare an individual project (topics for analysis the other particular cases are accessible for demand).

In the preparatory period the students are consulted (on campus or, on demand by distance e-learning). The main topics on teaching material will be available at the following website: http://home.agh.edu.pl/~jgorski

Admission requirements:

bachelor's work must be completed; basic knowledge of: thermodynamic and fluid mechanics, heat and mass transfer, chemistry or chemical process engineering, mathematics and IT including numerical methods and basic engineering software use.

Literature:

1. Miller B.G.: Clean Coal Engineering Technology. Butterworth-Heinemann, 2010.

2. Williams A. et all: Combustion and Gasification of Coal. Taylor & Francis, 2000.

3. Yantovski E., Górski J., Shokotov M.: Zero Emissions Power Cycles. CRC Press, 2009.

4. Annon: The Future of Coal. MIT Report, 2007 (online at: http://web.mit.edu/coal/)

Examination:

A written test at the final meeting in classroom lectures.

Individually prepared and accepted project.

The final grade will be averaged between credits obtained from the three main two parts of the course.