Last update: 22-07-2019

220211 - Energy Technology

Coordinating unit: 205 - ESEIAAT - Terrassa School of Industrial, Aerospace and Audiovisual Engineering
Teaching unit: 724 - MMT - Department of Heat Engines
Academic year: 2019
Degree: MASTER'S DEGREE IN INDUSTRIAL ENGINEERING (Syllabus 2013). (Teaching unit Compulsory)
ECTS credits: 5 Teaching languages: Catalan, Spanish

Teaching staff

Coordinator: Yolanda Calventus

Others: Lluís Miquel Domènech, Gustavo Rausch, Ivette Rodríguez, Joaquim Rigola

Prior skills

Knowledge of thermodynamics. Knowledge of heat engines: cycles with steam turbine, gas turbine and reciprocating internal combustion engines. Elementary knowledge of the different energy sources and energy transformations.

Degree competences to which the subject contributes

Specific:

1. Knowledge and skills for the design and analysis of heat engines and machines, hydraulic machines and installations of heating and cooling industry.
3. Have adequate knowledge of the scientific and technological aspects of: mathematical methods, analytical and numerical engineering, electrical engineering, energy engineering, chemical engineering, mechanical engineering, continuum mechanics, electronics, industrial automation, manufacturing, materials, quantitative methods management, industrial computing, urban planning, infrastructure, etc..
4. Student capacity to use their knowledge in new and multidisciplinary situations.

5. Knowledge and skills to plan and design electrical and fluid, lighting, air conditioning and ventilation, energy saving and efficiency, acoustics, communications, home automation, intelligent buildings and facilities security.
6. Extension of some specific technology areas such as Materials Science and Metallurgical Engineering, Construction Engineering, Systems Engineering, Automation and Computer Engineering, Electrical Engineering, Electronics Engineering, Mechanical Engineering, Chemical Engineering, Textile and Paper, Statistics and Operations Research, Graphic Expression in Engineering, Physics and Nuclear Engineering, Language and Systems, Heat Engines, Applied Mathematics, Fluid Mechanics and Turbo machines, Business Administration, Engineering Design, Strength of Materials and Structures, Aerospace Engineering.
7. Knowledge and skills for understanding, analyzing, managing and exploiting different sources of energy.

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Teaching methodology

The course is organized :
1 - Classes in large groups . These classes in the theory classes , some classes of problems develop and assessments for the first and second exams. Expository method is that the teacher considers more suitable to achieve the objectives in the course. Problems were also solved.
2 - Classes in medium groups : In these classes will carry out laboratory classes and also sessions for solving problems that the teacher proposed to the students for their resolution and they are a part of autonomous learning .
ATENEA support platform is used in the two types of classes as described . It will be used as transmitter and communicator with students.
a) Teacher to students :
1 - Scheduling activities and information
2 - Learning Material
3 - Assesment activities
b) Student to teachers :
1 - Questions and comments
c) Between Students
1 - Use the FORUM as a place for information and discussion

Learning objectives of the subject

- Acquire in-dept knowledge of the different sources of renewable and non-renewable energy.
- Ability to obtain usable energy with maximum energy efficiency and minimum environmental impact possible.
- Acquire the ability to work with methods and technologies for the efficient use of energy based on thermodynamic criteria.

Study load

Total learning time: 125h	Hours large group:	30h	24.00%
	Hours medium group:	15h	12.00%
	Hours small group:	0h	0.00%
	Guided activities:	0h	0.00%
	Self study:	80h	64.00%

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Content

Content 1: Energy efficiency in industry

Learning time: 18h

Theory classes: 6h
Practical classes: 2h
Self study : 10h

Description:
1.1 Introduction
1.2 Review of the CHP concept
1.3 Parameters of efficiency cogeneration
1.4 Energy savings
1.5 Plants matched to power and heat demands
1.6 Cogeneration Technologies

Related activities:
Theory/large sessions and exercises/medium sessions
Report of the subject

Specific objectives:
- Give an overview of the energy efficiency in industry
energy and primary energy saving
- Define cogeneration and its main applications in the secondary and tertiary sectors
- Apply to practical problems and evaluate the different efficienct criteria in cogeneration and discern what plant will be the most suitable to install.
- Calculate for each type of plant the energy saving, according to the different electrical or thermal adjustings.

Content 2: Exergy and Thermoeconomical Analysis of power plants

Learning time: 26h

Theory classes: 6h
Practical classes: 3h
Self study : 17h

Description:
2.1 Introduction: exergy analysis
2.2 Flow exergy
2.3 Exergy rate balance for control volumes at steady state. Determining exergy destruction
2.4 Fuel chemical exergy
2.5 Exergy parameters for evaluating plants: Exergetic efficiency. Exergy analysis diagrams
2.6 Destroyed exergy Percentage
2.7 Availability efficiency criteria in CHP plants
2.8 Thermoeconomical analysis

Related activities:
Theory/large sessions and exercises/medium sessions

Specific objectives:
- Apply the exergy analysis for improving the power plants
- Evaluating criteria

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Content 3: Biomass

Learning time: 7h

Theory classes: 2h
Self study : 5h

Description:
3.1 What is Biomass
3.2 Sources of Biomass
3.3 Classification of Biomass
3.4 Biomass transformation processes

Related activities:
Theory classes
Report of the subject

Specific objectives:
Learn the fundamental characteristics of biomass and its transformation processes

Content 4: Solar energy

Learning time: 18h

Theory classes: 4h
Practical classes: 2h
Self study : 12h

Description:
4.1 Introduction to solar thermal energy. Theoretical background. Solar-energy concepts.
4.2 Solar thermal systems in buildings and their equipment.
4.3 Flat-plate collectors. Efficiency of a flat-plate collector.
4.4 Thermal energy storage for solar thermal systems.
4.5 Characterisation and performance of a low-temperature solar thermal system.
4.6 CTE. Passive systems in buildings. Energy-efficiency techniques for reducing heating and cooling loads in buildings.

Related activities:
Theory/large sessions and exercises/medium sessions.
Report of the subject

Specific objectives:
- To know the main techniques used in solar thermal energy and their role in energy efficiency in buildings.

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Content 5: Thermal energy storage

Learning time: 13h

Theory classes: 3h
Practical classes: 2h
Self study : 8h

Description:
5.1 Introduction to thermal energy storage (TES) in buildings. Role of TES.
5.2 Main techniques and characteristics. Integration of TES in buildings: seasonal heat storage, massive storage, cood storage. Performance and evaluation of TES.

Related activities:
Theory/large sessions and exercises/medium sessions
Report of the subject

Specific objectives:
Introduction to thermal storage techniques and their integration in buildings

Content 6: Solar thermal electricity

Learning time: 13h

Theory classes: 3h
Practical classes: 2h
Self study : 8h

Description:
6.1 Introduction to concentrated solar power (CSP).
6.2 Main advantages of CSP plants. Main technologies and characteristics.
6.3 Examples of CSP plants.
6.4 Performance and evaluation of a CSP plant.

Related activities:
Theory/large sessions and exercises/medium sessions
Report of the subject

Specific objectives:
To know the main techniques for solar thermal electricity and how it works.

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Content 7: Hydroelectric and wind energy

Learning time: 15h

Theory classes: 3h
Practical classes: 2h
Self study : 10h

Description:

7. Hydroelectric and wind generation
7.1 Hydroelectric generation
7.1.1 Introduction. Hydropower potential.
7.1.2 Fundamentals of Hydraulic Engineering. Flow in pipes and open channels.
7.1.3 Water resources. Discharge measurements. Runoff coefficient .
7.1.4 Hydraulic Structures. Dams.
7.1.5 Electromechanical equipment. Hydraulic turbines.
7.1.6 Environmental impact.

1.2 Wind energy
1.2.1 Introduction.
1.2.1.1 Advantages of wind power.
1.2 .1.2 History of wind power use.

1.2.2 Wind power exploitation
1.2.2.1 Nature and types of wind.
1.2.2.2 Wind power (and power of a wind turbine)
1.2.2.3 Performance. Betz Limit
1.2.2.4 Variability of the wind speed
1.2.2.5 Power curve of a wind turbine

Related activities:

Theroy/large group sessions and practical/medium group sessions.
Laboratory experiment

Specific objectives:

- Ability to analyze the behavior of a hydroelectric plant and evaluate the variables involved in the calculation thereof potnecia
- Ability to perform a fluid dynamic and energetic study of a wind system

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Content 8: Geothermal Energy

Learning time: 15h

Theory classes: 3h
Practical classes: 2h
Self study : 10h

Description:

8.1 Geothermal Energy.
8.1.1. The Earth's crust .
8.1.2 . Evolution of the Earth's crust .
8.1.3. Source of heat .
8.1.4 . Energy transport in geothermal systems

8.2 Geothermal systems : general characteristics
8.2.1. Geothermal and Hydrothermal Systems .
8.2.2 . Geochemistry of geothermal fluids .
8.2.3 . Geothermometers .

8.3 Exploitation of geothermal systems
8.3.1. Features of the exploited geothermal systems .
8.3.2 . Exploitation of Geothermal Energy .
8.3.3. Types of Geothermal Power Plants .
8.3.4. Environmental impact of geothermal exploitation .

Related activities:

Theory/large sessions and practical/medium sessions.
Laboratory experiment

Specific objectives:

- Ability to analyze the behavior of a geothermal system
- Ability to evaluate the behavior of a fossil fuel power station and its environmental impact

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Planning of activities

ACTIVITY 1: THEORY CLASSES

Hours: 61h
Theory classes: 26h
Self study: 35h

Description:
Large group methodology
Expository and participatory classes
The subject is organized in 8 different contents
Exercises will be solve with the large group

Support materials:
Basic bibliography
Lecture notes (available in ATENEA)
List of proposed exercises (ATENEA)

Descriptions of the assignments due and their relation to the assessment:
Activity 1 and activity 2 will be both evaluated in first and second partial exams.

Specific objectives:
At the end of this activity, the student should be able to master the skills worked, consolidate and correctly apply them to problems involving real situations.

ACTIVITY 2: EXERCISES CLASSES

Hours: 29h
Practical classes: 11h
Self study: 18h

Description:
Medium group methodology
For each content, problems will be solved in class for students to acquire the necessary guidelines to carry out this resolution

Support materials:
Basic bibliography
Teacher notes (ATENEA)
List of proposed exercises (ATENEA)

Descriptions of the assignments due and their relation to the assessment:
Activity 1 and activity 2 will be both evaluated in first and second partial exams.

Specific objectives:
After completing this activity, students should be able to apply theoretical knowledge to solving real technical problems.

ACTIVITY 3: PRACTICAL CLASSES

Hours: 5h
Practical classes: 4h
Self study: 1h

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Description:
Medium group methodology
For contents 7 and 8, laboratory experiments or computational practice will be carried out

Support materials:
Basic Bibliography
Lecture Notes (ATENEA)
Statement of activity

Descriptions of the assignments due and their relation to the assessment:
A report of this activity will be given to evaluate
The rating practices (NL) will be 15% of the overall course grade

Specific objectives:
Upon completion of this activity students should be able to:
- Deal with experimental data and draw conclusions
- Prepare a report of the work done

ACTIVITY 4: FIRST PARTIAL EXAM

Hours: 9h
Theory classes: 2h
Self study: 7h

Description:
Development of the partial examination of the subject of contents explained during this period
It includes theoretical and practical aspects
The students who pass this exam can remove theses contents

Support materials:
Statement papers

Descriptions of the assignments due and their relation to the assessment:
The hand-in will be the result of the exam.
It represents 30% of the final course grade

Specific objectives:
The exam must demonstrate that the student has acquired and assimilated the concepts and fundamentals related to the corresponding contents

ACTIVITY 5: SECOND PARTIAL EXAM

Hours: 12h
Theory classes: 2h
Self study: 10h

Description:
Individual and writing assessment about the contents explained during the corresponding period
The exam is theoretical and practical (solving exercises)
In this exam it will be established the mechanism to redirect students who have not passed the first partial exam.

Support materials:
Statement papers

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Descriptions of the assignments due and their relation to the assessment:
The hand-in will be the result of the exam.
It represents 40% of the final course grade

Specific objectives:
The exam must demonstrate that the student has acquired and assimilated the concepts and fundamentals related to evaluated contents

ACTIVITY 6: Report of the subject	Hours: 9h Self study: 9h

Description:
Students in groups of 3 or 4 will select, in agreement with professors, a report title that should develop from a list proposed by professors. This report must follow an scheme which will be discussed and fixed conveniently by professors.

It represents 15% of the final course grade

Support materials:
Bibliography recommended

Descriptions of the assignments due and their relation to the assessment:
Each group must upload the report in Athena in pdf format.

Specific objectives:
The aim of this activity is students delve into a topic of the subject that has a special interest for them. It also seeks to promote discussion among members of the group, to learn how to structure and develop the report and how to manage the information resources.

Qualification system

- First partial exam N1P: 30%
- Second partial exam N2P: 40%
- Activities (Laboratory) NL: 15%
- Subject report NT: 15%

In the second partial exam it will be established he mechanism to redirect students who have not passed the first partial exam.

Regulations for carrying out activities

1 -. First partial exam will be made without using books, notes or other
teaching material except Book of Tables and Charts, and occasionally made a form that each student will do if the teacher says.
2 -. Concerning practices report students will deliver a report to the teacher

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Others resources:

Hyperlink

www.energiza.org

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www.acogen.es

www.gencat.cat/icaen/

Computer material

Apunts de l'assignatura Tecnologia Energètica, mòdul d'Energia Solar Tèrmica