Last update: 15-06-2018

820121 - CHTEE - Hydraulic and Thermal Power Plants

Coordinating unit: 295 - EEBE - Barcelona East School of Engineering

Teaching unit: 729 - MF - Department of Fluid Mechanics

Academic year: 2018

Degree: BACHELOR'S DEGREE IN ELECTRICAL ENGINEERING (Syllabus 2009). (Teaching unit Compulsory)
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ECTS credits: 6 Teaching languages: Catalan

Teaching staff

Coordinator: Fontanals Garcia, Alfred

Others: Grau Barceló, Joan
Rufes Martinez, Pedro

Requirements

Prerequisite: Fluid Mechanics (MF) and Thermodynamics and Heat Transfer (TTC)

Degree competences to which the subject contributes

Specific:

1. Design power stations.

Transversal:

4. SELF-DIRECTED LEARNING - Level 2: Completing set tasks based on the guidelines set by lecturers. Devoting the time needed to complete each task, including personal contributions and expanding on the recommended information sources.

Teaching methodology

The course content will develop a methodology and participatory exhibits when taught the theoretical content. Students will work individually to make the understanding, analysis and synthesis of theory. In addition, teamwork will be necessary to address complex problems (theoretical and laboratory).

Learning objectives of the subject

Conocer las diferentes tipologías de centrales de producción eléctrica. Conocer la fuente energética y la tecnología utilizable para su aprovechamiento en una central eléctrica

Study load

Total learning time: 150h	Hours large group:	45h	30.00%
	Hours medium group:	0h	0.00%
	Hours small group:	15h	10.00%
	Guided activities:	0h	0.00%
	Self study:	90h	60.00%

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Content

1. Hydraulic and thermal power plants

Learning time: 20h

Theory classes: 6h
Laboratory classes: 2h
Self study : 12h

Description:
Characteristics of hydroelectric plants. Constituent elements, types. Characteristics of power plants. Constituent elements, types. Sea power, wind farms and solar power

Related activities:
Laboratory: Hydraulic transients

Specific objectives:
Understand the different types of power plants, both thermal and hydro. Identifying the constituent elements. Knowing the different energy sources used in power plants.

2. Hydraulics machines. Turbomachines and volumetrics machines

Learning time: 30h

Theory classes: 9h
Laboratory classes: 3h
Self study : 18h

Description:
Classification of fluid machines. Turbomachinery: basic functional description of the elements, principles of operation and operating environments. Characteristic curve of a real centrifugal pump. Similarity laws for pumps and turbines. Hydraulic turbines and wind turbines. Volumetric machines: types. Description of functional elements. Characteristic curves of pumps and volumetric motors. Selection criteria

Related activities:
Laboratory: Pelton turbine

Specific objectives:
Get classification criteria of the hydraulic machines. Knowing the kinematics of flow in the impeller of turbomachines and their influence on energy transfer in the impeller. Understand the different types of pumps, their essential functional elements and their application areas. Understand the different types of turbines, their essential functional elements and their operating environments. Knowing how to use the similarity to redesign pumps and turbines similar to other existing

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3. Thermal generation: Combustion. Steam boilers. Solar thermal energy applications.

Learning time: 27h 30m

Theory classes: 9h
Laboratory classes: 2h
Self study : 16h 30m

Description:
Fuels' properties and classification. Normatives. Mass and energy balances in combustion. Steam boilers. Seasonal efficiency. Thermal uses of solar radiation. Greenhouse effect. Solar concentrators. Solar-thermal panles. Solar-thermal heat production systems.

Related activities:
Laboratory: Solar Thermal Installation

Specific objectives:
After completing this section, the student will recognize different heat generation systems, including the use of fuels and solar radiation in thermal systems. The student will also be able to perform basic design tasks for heat generation systems.

4. Heat transfer equipment. Heat exchangers. Cooling towers. Psicrometry.

Learning time: 27h 30m

Theory classes: 9h
Laboratory classes: 2h
Self study : 16h 30m

Description:
Heat exchanger classification. Energy balances and overall coefficients. Efficiency. Heat transfer area calculation. Selection and sizing criteria. Heat transfer involving phase changes. Moist air thermodynamics. Mass and energy balances in psicrometric systems. Psicrometric processes and diagrams. Cooling towers.

Related activities:
Laboratory: Heat exchanger, exerimental and numerical study (2 sessions)

Specific objectives:
After completing this section the student will understand the operation and basic design principles of heat exchangers, the thermodynamics of moist air and its application to the design of cooling towers

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5. Gas power generation cycles. Alternative compressors and turbomachines. Gas turbines. Combustion engines.	Learning time: 20h Theory classes: 6h Laboratory classes: 2h Self study : 12h

Description:
Alternative compressors. Diagrams. Adiabatic compressors. Rotative compressors. Gas turbines. Brayton cycle. Simple and imroved cycles. Efficiencies. Semi-ideal gas calculation method. Internal combustion engines. External combustion engines.

Related activities:
Laboratory: alternative compressor

Specific objectives:
After completing this section, the student will recognize different gas power generation cycles and equipments and the required criteria to perform basic design tasks.

6. Steam power generation cycles. Steam turbines. Cogeneration	Learning time: 25h Theory classes: 6h Laboratory classes: 4h Self study : 15h

Description:
Steam turbines. Rankine cycle. Overheating and reheating. Regenerative cycles. Open and closed reheaters. Other steam cycles. Cogeneration.

Related activities:
Laboratory: Thermal power plant I and II (2 sessions)

Specific objectives:
After completing this section, the student will recognize different steam power generation cycles and equipment and the required criteria to perform basic design tasks.

Qualification system

The evaluation will be conducted through written tests in the partials and final tests. The exercises and problems will be assessed from the delivery of material by students. Practices will be assessed based on attendance and activity performed in the laboratory together with the preparation and delivery of practice reports. To pass the course will have completed and passed the practice. There will test reassessment.
First tests: 35%
Second tests: 35%
Exercises / problems: 10%
Practices: 15%
Generical competence: 5%

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Bibliography

Basic:

White, Frank M. Mecánica de fluidos. 6ª ed. Madrid [etc.]: McGraw-Hill, 2008. ISBN 978-84-4816-603-8.

Gerhart, Philip M. Fundamentos de mecánica de fluidos. 2ª ed. Argentina [etc.]: Addison-Wesley Iberoamericana, 1995. ISBN 0-2016-0105-2.

Çengel, Yunus A.; Cimbala, John M.. Mecánica de fluidos : fundamentos y aplicaciones. México, D.F.: McGraw-Hill, cop. 2006. ISBN 9701056124.

Complementary:

Franzini, Joseph B. Mecánica de fluidos con aplicaciones en ingeniería. 9ª ed. Madrid [etc.]: McGraw-Hill, 1999. ISBN 84-4812-474-X.