Last update: 14-10-2019

820325 - GETF - Thermal and Fluid Dynamic Power Generation

Coordinating unit: 295 - EEBE - Barcelona East School of Engineering
Teaching unit: 729 - MF - Department of Fluid Mechanics
Academic year: 2019
Degree: BACHELOR'S DEGREE IN ENERGY ENGINEERING (Syllabus 2009). (Teaching unit Compulsory)
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ECTS credits: 6 Teaching languages: Catalan

Teaching staff

Coordinator: JOAN GRAU BARCELÓ

Others: Primer quadrimestre:
MARCEL GARCIA COROMINAS - M11, M12
JOAN GRAU BARCELÓ - M11, M12, M13
PEDRO RUFES MARTINEZ - M11, M12, M13

Requirements

MECÀNICA DE FLUIDS - Prerequisit
TERMODINÀMICA I TRANSFERÈNCIA DE CALOR - Precorequisit

Degree competences to which the subject contributes

Specific:

CEENE-190. (ENG) Analizar los principios de operación de centrales termofluidodinámicas.

CEENE-13. Analyse the principles of operation of generators and boilers.

Transversal:

3. EFFICIENT ORAL AND WRITTEN COMMUNICATION - Level 2. Using strategies for preparing and giving oral presentations. Writing texts and documents whose content is coherent, well structured and free of spelling and grammatical errors.

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

To know the operation and the dimensioning of heat engines and hydraulic and heat transfer equipment commonly used in industry.

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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%

Content

-1. Thermal generation: Combustion. Steam boilers. Solar thermal energy applications.

Learning time: 36h

Theory classes: 12h
Laboratory classes: 2h 30m
Self study : 21h 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.

- 2. Hydraulics machines. Turbomachines and volumetrics machines

Learning time: 27h 30m

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

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

- 3. Heat transfer equipment. Heat exchangers. Cooling towers. Psicrometry.	Learning time: 26h 30m Theory classes: 6h Laboratory classes: 4h 30m Self study : 16h

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.

- 4. Gas power plant generation cycles. Alternative compressors and turbomachines. Gas turbines. Combustion engines.	Learning time: 15h Theory classes: 6h Self study : 9h

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.

- 5. Steam power plant 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.

- 6. Refrigeration cycles and heat pumps.	Learning time: 20h Theory classes: 6h Laboratory classes: 2h Self study : 12h

Description:
Steam compression refrigeration cycles. Refrigerants and its properties. Cascade and multi-stage steam compression systems. Absorption refrigeration cycles. Heat pumps. Other refrigeration technologies: gas turbines and adsorption cycles.

Related activities:
Laboratory: Heat pump

Specific objectives:
After completing this section, the student will recognize different refrigeration cycles and equipent and the required criteria to perform basic design tasks.

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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.
The students will be carried out an interdisciplinar project together with other subjects of the specialty.
Partials tests: 20%
Exercises / problems: 10%
Practices: 15%
Final test: 25%
Generical competence: 5%
Interdisciplinar project: 30 %
A necessary condition to pass the subject is attending all practices and the completion and delivery of the reports.
The subject have a reevaluation test, following the conditions defined in the academic regulations. The students will be able to access the re-assessment test that meets the requirements set by the EEBE in its Assessment and Permanence Regulations (https://eebe.upc.edu/ca/estudis/normatives-academiques/documents/eebe-normativa-avaluacio-i-permanencia-18-19-aprovat-je-2018-06-13.pdf)

Bibliography

Basic:

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Agüera Soriano, J. Mecánica de fluidos incompresibles y turbomáquinas hidráulicas. 5ª ed. Madrid: Ciencia 3, DL 2002. ISBN 8495391015.

Moran, M. J.; Shapiro, H. N. Fundamentos de termodinámica técnica. 2ª ed. Barcelona [etc.]: Reverté, cop. 2004. ISBN 8429143130.

Llorens, Martín; Miranda, A. L. Ingeniería térmica. Barcelona: Marcombo, cop. 2009. ISBN 9788426715319.