Course guide
820121 - CHTEE - Hydraulic and Thermal Power Plants

Last modified: 27/05/2024

Unit in charge: Barcelona East School of Engineering
Teaching unit: 729 - MF - Department of Fluid Mechanics.

Degree: BACHELOR'S DEGREE IN ELECTRICAL ENGINEERING (Syllabus 2009). (Compulsory subject).

Academic year: 2024 **ECTS Credits:** 6.0 **Languages:** Catalan

LECTURER

Coordinating lecturer: Valero Pérez, Mario Miguel

Others: Primer quadrimestre:
ALFRED FONTANALS GARCIA - Grup: M11, Grup: M12, Grup: M13
RAUL GARCÍA SANJURJO - Grup: M11, Grup: M12

Segon quadrimestre:
DAIBEL DE ARMAS ORAMAS - Grup: T11
MARIO MIGUEL VALERO PÉREZ - Grup: T11, Grup: T12

REQUIREMENTS

TERMODINÀMICA I TRANSFERÈNCIA DE CALOR - Precorequisit

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

Type	Hours	Percentage
Hours large group	45,0	30.00
Self study	90,0	60.00
Hours small group	15,0	10.00

Total learning time: 150 h

CONTENTS

1. Hydraulic and thermal power plants

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

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.

Related activities:
Laboratory: Hydraulic transients

Full-or-part-time: 20h
Theory classes: 6h
Laboratory classes: 2h
Self study : 12h

2. Hydraulics machines. Turbomachines and volumetrics machines

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. Pump operation point. 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

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

Related activities:
Laboratory: Pelton turbine

Full-or-part-time: 30h
Theory classes: 9h
Laboratory classes: 3h
Self study : 18h

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

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.

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.

Related activities:
Laboratory: Solar Thermal Installation

Full-or-part-time: 27h 30m
Theory classes: 9h
Laboratory classes: 2h
Self study : 16h 30m

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

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.

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

Related activities:
Laboratory: Heat exchanger, experimental and numerical study

Full-or-part-time: 27h 30m
Theory classes: 9h
Laboratory classes: 2h
Self study : 16h 30m

5. Gas power generation cycles. Alternative compressors and turbomachines. Gas turbines. Combustion engines.

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.

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.

Related activities:
Laboratory: alternative compressor

Full-or-part-time: 20h
Theory classes: 6h
Laboratory classes: 2h
Self study : 12h

6. Steam power generation cycles. Steam turbines. Cogeneration

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

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.

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

Full-or-part-time: 25h
Theory classes: 6h
Laboratory classes: 4h
Self study : 15h

GRADING 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, the practical reports must have been completed and submitted. There will test reassessment. 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
First tests: 35%
Second tests: 35%
Exercises / problems: 10%
Practices: 15%
Generical competence: 5%

BIBLIOGRAPHY

Basic:
- White, Frank M. Mecánica de fluidos [on line]. 6a ed. Madrid [etc.]: McGraw-Hill, 2008Available on: https://discovery.upc.edu/permalink/34CSUC_UPC/11q3oqt/alma991003435529706711. ISBN 9788448191283.
- Moran, M. J.; Shapiro, H. N. Fundamentos de termodinámica técnica. 2ª ed. Barcelona [etc.]: Reverte, cop. 2004. ISBN 8429143130.
- Çengel, Y., Boles, M. Transferencia de calor y de masa : fundamentos y aplicaciones [on line]. 4a ed. México, D.F: McGraw-Hill Education, 2011 [Consultation: 23/11/2021]. Available on: http://www.ingebook.com/ib/NPcd/IB_BooksVis?cod_primaria=1000187&codigo_libro=10213. ISBN 9786071505408.
- Agüera Soriano, José. Mecánica de fluidos incompresibles y turbomáquinas hidráulicas. 5a ed. Madrid: Ciencia 3, DL 2002. ISBN 8495391015.