820741 - EHM - Hydropower and Ocean Energy

Coordinating unit: 240 - ETSEIB - Barcelona School of Industrial Engineering
Teaching unit: 729 - MF - Department of Fluid Mechanics
Academic year: 2019
Degree: MASTER'S DEGREE IN ENERGY ENGINEERING (Syllabus 2013). (Teaching unit Optional)
MASTER'S DEGREE IN ENERGY ENGINEERING (Syllabus 2013). (Teaching unit Optional)
ECTS credits: 5 Teaching languages: Spanish, English

Teaching staff
Coordinator: Eduard Egusquiza

Prior skills
Background in Fluid Mechanics and Hydraulic machinery

Learning objectives of the subject
Introduction. Understand the electricity demand and generation, the variations in the consumption and the characteristics of the main types of power plants generating energy. Know the advantages and disadvantages of hydro power compared with other types of power plants.
Hydraulic systems. Be aware of the main types of water power systems comparing conventional hydro (peak), run-of-river (base) and pump-storage. Understand the operation of a water power plant. Know the main components of a typical water power system and the evolution of the mechanical energy in it. Use properly and calculate the terms head, power and efficiency. Learn how to calculate the energy produced by a hydropower unit.
Hydropower units. Know the main components of a hydropower unit understanding the operation depending on head and guide-vane opening using hill charts. Know the main types of hydraulic turbines (reaction and action machines) with their main characteristics and performance.
Energy transfer. Understand the basics of the energy transfer in a hydraulic turbine from the Euler equation. Understand the main flow characteristics in terms of velocity pressure and dissipation. Learn how to calculate the average velocity fields and the energy converted into mechanical energy by the turbine depending on operating conditions.
Cavitation. Understand the basics of cavitation phenomena and the main types of cavitation than may occur in hydraulic turbines. Calculation of the setting levels.
Transients. Understand the start-up and cost-down transients with the associated problems of run-away speed and water hammer.
Marine energy. Know the methods to extract energy of the seas using tidal plants, marine current turbines and wave energy converters. Know the main types of devices and operating principles.
Maintenance. Know the typical maintenance types, the main types of damage and the methods for monitoring the units. Understand the basics of vibrations generated and its use for the surveillance of the machine condition.
# Study load

<table>
<thead>
<tr>
<th>Total learning time: 125h</th>
<th>Hours large group: 0h 0.00%</th>
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<tbody>
<tr>
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<td>Hours medium group: 30h 24.00%</td>
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<td>Hours small group: 0h 0.00%</td>
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<td>Guided activities: 10h 8.00%</td>
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<td>Self study: 85h 68.00%</td>
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## Content

| Water power and marine energy | Learning time: 2h  
Theory classes: 1h  
Guided activities: 1h |
|------------------------------|----------------------|

### Description:
- Introduction
- Energy generation and demand
- Advantages and importance of hydropower
- Types of systems
- Dam systems
- Run-of-river
- Pumped storage
- Hydraulic system components
- Trash-racks
- Valves
- Penstock
- Draft tube
- Energy transfer basics
- Energy transfer
- Head, discharge, power, efficiency
- Hydropower unit components
- Turbine and generator
- Shaft, coupling
- Bearings and seals
- Types of turbines
- Classification
- Francis
- Kaplan
- Pump-turbines
- Marine energy
- Energy from the seas
- Tidal energy. Tidal plants. Examples
- Comparison with wind turbines. Advantages and disadvantages.
- Waves. Wave devices: Russell, Pelamis, sea snakes, Wells turbines
- Maintenance and vibrations.
- Main types of damage. Maintenance types
- Vibration generation: main excitation forces and machine response
- Protection of machine. Brief analysis of standards
- Basics of vibration analysis

### Bibliography