ISEL
INSTITUTO SUPERIOR DE ENGENHARIA DE LISBOA

ISEL ADEM
Área Departamental de Engenharia Mecânica

Sheet course ()

Course	MSc IN MECHANICAL ENGINEERING		
Unit	Hydraulic Machines	Mandatory	☐
		Optional	☒
Unit scientific area	Thermofluids and Energy	Category	B

Unit category: B - Basic; C - Core Engineering; E - Specialization; P - Complementary.

Year: 1st	Semester: 2nd		ECTS: 5,0			
Contact time	Total:	T:	TP: 45,0	PL:	S:	OT:

T - Lectures; TP - Theory and practice; PL - Lab Work; S - Seminar; OT - Tutorial Guidance.

Unit Director	Title	Position
Jorge Mendonça e Costa	Ph.D.	Associate Professor

Learning Objectives (knowledge, skills and competences to be developed by students)

(max. 1000 characters)

Theoretical approach of hydraulic machines and analysis of project, installation and operation aspects, providing a thorough insight of this type of equipment. Introduction to the dimensional analysis techniques for the elaboration of non-dimensional parameters applicable in physical modeling.

Syllabus

(max. 1000 characters)

DIMENSIONAL ANALYSIS AND MODEL THEORY

Physical properties and dimensions, Dimensional Homogeneity, Buckingham theorem.

Geometric, kinematic and dynamic similarity. Examples.

HYDRAULIC MACHINES THEORY

Transport equations. Energy equation. Euler equation of Turbomachines.

HYDRAULIC TURBINES

Impulse (Pelton) and Reaction (Francis and Kaplan) Turbines – Mechanical components, Velocity Triangles, Efficiencies, Characteristic curves. Nondimensionalisation of physical parameters, Specific speed, Cavitation.

Tidal power stations. Bulb turbines, Reversible Pump turbines, mini or small scale turbines.

HYDRAULIC PUMPS

Positive displacement and rotordynamic pumps. Centrifugal pumps. Scrolls and diffusers. Pumping stations.

Velocity Triangles, Efficiencies, Characteristic curves, Operating point. Nondimensionalisation, Specific speed. Cavitation in pumps. Pumps combined in series and parallel, design and installation.

Application of computational fluid mechanics to the study of hydraulic machines.

Demonstration of consistency of the syllabus with the objectives of the course

(max. 1000 characters)

The syllabus encompasses the curricular unit objectives. A good balance is achieved between the depth with which the different subjects are treated and the contact time with the students.

Teaching methodology (evaluation included)

(max. 1000 characters)

The teaching methodology foresees theoretical and practical lectures supported on the bibliographic references suggested for the curricular unit (UC), powerpoint presentations, complementary support material for the UC is provided in the Moodle platform (resolution of practical examples, etc.).

The laboratory sessions include testing two types of hydraulic turbines (e.g. Pelton and Francis turbines).

The evaluation (assessment) comprises:

1 Exam;

1 Project to be discussed with the students.

The final score will be obtained according to the following weighing applied to the partial scores:

1/2 – Exam

1/2 – Project

Demonstration of consistency of teaching methods with the learning objectives of the course

(max. 3000 characters)
The objective of providing students with a solid theoretical and practical knowledge on hydraulic machines builds on a dual approach encompassing a theoretical and practical component delivered in class and a hands-on approach. The latter, to be developed by students, is an equipment design project (radial pump, turbine, etc.) based on commercial software, allowing a better integration of acquired concepts.

Main Bibliography

(max. 1000 characters)

White, Frank M. FLUID MECHANICS - McGraw-Hill;

Wright, Terry FLUID MACHINERY – Performance, analysis and design - CRC Press

Mohinder Nayyar PIPING HANDBOOK - McGraw-Hill.

Dixon, S.L. FLUID MECHANICS AND THERMODYNAMICS OF TURBOMACHINERY - BH

Denton, John (ed.) DEVELOPMENTS IN TURBOMACHINERY DESIGN – PE Publishing