



IDENTIFYING DATA

Hydraulic turbomachines

Subject	Hydraulic turbomachines			
Code	V12G363V01504			
Study programme	Grado en Ingeniería en Tecnologías Industriales			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Mandatory	3rd	1st
Teaching language	English			
Department				
Coordinator	Conde Fontenla, Marcos			
Lecturers	Conde Fontenla, Marcos			
E-mail	mfontenla@uvigo.gal			
Web	http://moovi.uvigo.gal			
General description	<p>This syllabus presents information the Hydraulic Turbomachines course that belongs to the 3rd year of the degree in Industrial Technologies Engineering, 2020-2021, in accordance to the marked guidelines by the European Space of Upper Education.</p> <p>This is a first course in Hydraulic Turbomachines, focusing on the topics that are relevant to Industrial Technologies Engineering applications.</p> <p>The course is intended to acquire essential knowledge about the fundamental principles and performance of Hydraulic Turbomachines, studying the main parts of a turbomachines and their classification, the application of fundamental Euler's theorem, and the performance of both turbines and pumps with different arrangements in hydroelectric power plants and pumps stations, respectively. Finally, some brief comments are explained to acquire fundamental knowledge of fans, airfoils and positive displacement machines</p>			

Training and Learning Results

Code	
B3	CG3 Knowledge of basic and technological subjects that enable students to learn new methods and theories, and to adapt to new situations.
C8	CE8 Knowledge of the basic principles of fluid mechanics and their application to solving problems in the field of engineering. Calculation of pipes, channels and fluid systems.
C25	CE25 Applied knowledge of the basics of fluidmechanics systems and machines.
D2	CT2 Problem solving.
D9	CT9 Application of knowledge.
D10	CT10 Self learning and work.

Expected results from this subject

Expected results from this subject	Training and Learning Results		
Understand fundamentals of hydraulic machines	B3	C8 C25	D2 D9 D10
Acquire skills for sizing pumps facilities and fluid machines	B3	C8 C25	D2 D9 D10

Contents

Topic	
1.- Introduction	1.- Turbomachinery. Classification 2.- Hydraulic turbomachines 3.- Applications to the Industry 4.- General specifications

2.- Transfer of Energy	1.- Equation of conservation of the energy 2.- Hydraulic turbomachines applications 3.- Dimensionless parameters 4.- Power and efficiencies
3.- Similarity and Characteristic Curves	1.- Similarity in hydraulic turbomachines 2.- Practical application of similarity laws 3.- Comparison of hydraulic turbomachines 4.- Characteristic curves in hydraulic pumps 5.- Characteristic curves in hydraulic turbines 6.- Dimensionless coefficients. Specific speed and specific power
4.- Transfer of Work	1.- Fundamental equation of hydraulic turbomachinery: Euler's equations. Expressions 2.- One-dimensional (ideal) theory of hydraulic turbomachinery 3.- Two-dimensional (ideal) theory of hydraulic turbomachinery 4.- Real flow. Losses 5.- Cavitation in HTM
5.- Fluids machines of low pressure rise	1.-Classification 2.- Fans. Characteristic curves 3.- Wind turbines. Classification - Disk actuator theory.Betz's limit - Fundamentals Theory of Airfoils. NACA Airfoils - Blade element theory - Characteristic curves
6.- Positive displacement machines and hydraulic transmissions	1.- Types and classification 2.- Alternative and rotatory pumps. 3.- Hydraulic engines of positive displacement 4.- Transmissions and hydraulic couplings
Laboratory sessions	1. Introduction to the pneumatic systems: - detailed description of the pneumatic systems and his components. -Basic circuits. -Problems resolutions 2. Resolution of problems of of hydraulic turbomachines 3. Hydraulic turbines - Hill chart Francis Turbine 4. Resolution of problems of Positive displacemetn machines

Planning

	Class hours	Hours outside the classroom	Total hours
Lecturing	31.5	60.5	92
Laboratory practical	6	10	16
Problem solving	12	27	39
Essay questions exam	1	0	1
Essay questions exam	0.75	0	0.75
Essay questions exam	0.75	0	0.75
Essay questions exam	0.5	0	0.5

*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.

Methodologies

	Description
Lecturing	Readings solution of problems
Laboratory practical	Practices of pneumatic (see description in contents)
	Practices of HTM (see description in contents)
Problem solving	Calculation methods and techniques Interpretation of results Practical cases

Personalized assistance

Methodologies	Description
---------------	-------------

Problem solving	Personalized attention will be given to the students during class (throughout the possible questions that could arise) and during the specific timetable of the teacher for tutorships. Updated information of the tutorships timetables will be given to the students
Lecturing	Personalized attention will be given to the students during class (throughout the possible questions that could arise) and during the specific timetable of the teacher for tutorships. Updated information of the tutorships timetables will be given to the students
Laboratory practical	Personalized attention will be given to the students during class (throughout the possible questions that could arise) and during the specific timetable of the teacher for tutorships. Updated information of the tutorships timetables will be given to the students

Assessment					
	Description	Qualification	Training and Learning Results		
Laboratory practical	Assessment may include: - Problem solving - Practical reports - Oral/written practical questions	10	B3	C8 C25	D9 D10
Essay questions exam	Final written exam on the official date indicated by the school that may consist of: - Theoretical/practical questions - Exercise/problem solving - Topic to be developed Minimum required grade: 4 out of 10.	40	B3	C8	D2 D9 D10
(*)	N/A	-			
Essay questions exam	Partial written test that may consist of: Theoretical/practical questions Exercise/problem solving Topic to be developed	20	B3	C8 C25	D2 D9 D10
Essay questions exam	Partial written test that may consist of: Theoretical/practical questions Exercise/problem solving Topic to be developed	20	B3	C8 C25	D2 D9 D10
Essay questions exam	Partial written test that may consist of: Theoretical/practical questions Exercise/problem solving Topic to be developed	10	B3	C8 C25	D2 D9 D10

Other comments on the Evaluation

Global Evaluation:

In the two official editions, renouncement of continuous assessment will be carried out following the procedure and deadline established by the institution. The global evaluation methodology will consist of a single written exam on the official date set by the school, which will account for 100% of the grade, and all theoretical and practical contents of the subject will be evaluated.

Continuous Assessment: *Ordinary Call /First attempt.*

It will consist of different tests conducted throughout the course and a final exam on the official date previously set by the institution. In this final exam, a minimum grade of 4 out of 10 will be required to pass the subject. To pass, the final grade must be at least 5 out of 10. If the minimum grade is not achieved in the final exam, the student will be awarded a grade of 4.5.

Continuous Assessment: *Extraordinary Call / Second attempt.*

The student may decide within the established deadlines whether to maintain the grade from the practical component and partial tests of the continuous assessment (60%), or to choose the global evaluation. The exam will be held on the official date previously set by the institution. In this final exam, a minimum grade of 4 out of 10 will be required to pass the subject. To pass, the final grade must be at least 5 out of 10. If the minimum grade is not achieved in the final exam, the student will be awarded a grade of 4.5.

Ethical Behavior: It is expected that the student demonstrates appropriate ethical behavior, paying particular attention to what is indicated in Articles 39, 40, 41, and 42 of the Regulations on evaluation, grading, and quality of teaching and the

student learning process at the University of Vigo (approved on April 18, 2023).

Sources of information

Basic Bibliography

Viedma A., Zamora B., **Teoría y Problemas de máquinas hidráulicas**, 3ª Ed., Horacio Escarabajal Editores., 2008

Mataix, C., **Turbomáquinas Hidráulicas**, Editorial ICAI, 1975

Mataix, C., **Mecánica de Fluidos y Máquinas Hidráulicas**, Editorial del Castillo S.A., 1986

Srinivasan, K.M., **rotodynamic Pumps**, New Age International Publishers, 2008

Complementary Bibliography

Hernández Krahe, J. M, **Mecánica de Fluidos y Máquinas Hidráulicas.**, UNED, 1998

Krivchenko, G, **Hydraulic Machines: Turbines and Pumps**, 2ª ed., Lewis, 1994

Creus, A., **Neumática e Hidráulica.**, Marcombo Ed., 2011

Karassik, I. J., **Pump Handbook**, 2ª ed., Nueva York, McGraw-Hill., 1986

Recommendations

Subjects that it is recommended to have taken before

Physics: Physics 1/V12G360V01102

Physics: Physics 2/V12G360V01202

Mathematics: Calculus 2 and differential equations/V12G360V01204

Fluid mechanics/V12G360V01403

Other comments

Recommends to the student:

Attend to class

Spend the hours outside the classroom studying the subject
