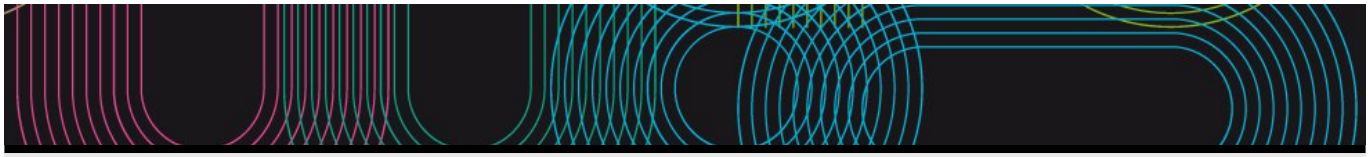

IDENTIFYING DATA				
Hydraulic turbomachines				
Subject	Hydraulic turbomachines			
Code	V12G363V01504			
Study programme	Degree in Industrial Technologies Engineering			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Mandatory	3rd	1st
Teaching language				
Department				
Coordinator	Meis Fernández, Marcos			
Lecturers	Meis Fernández, Marcos			
E-mail	mmeis@uvigo.es			
Web				
General description	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. This is a first course in Hydraulic Turbomachines, focusing on the topics that are relevant to Industrial Technologies Engineering applications. 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			

Competencies	
Code	
B3	CG3 Knowledge in basic and technological subjects that will enable them to learn new methods and theories, and equip them with versatility 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 Problems resolution.
D9	CT9 Apply knowledge.
D10	CT10 Self learning and work.

Learning outcomes			
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 Airfols. 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	32	60	92
Laboratory practical	6	7	13
Problem solving	12	18	30
Essay questions exam	3	0	3
Problem and/or exercise solving	0	12	12

*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		
Essay questions exam	Proof written that it will be able to consist of: - theoretical questions - practical questions - Resolution of exercises/problems - Short covering of a topic	80	B3	C8	D2 D9 D10
Problem and/or exercise solving	Resolution of exercises proposed, including: -Short reports/exercises proposed	20	B3	C8	D2 D9 D10
(*)	-	-			

Other comments on the Evaluation

Continuous evaluation: represents 20% of the grade, which consists of solving some proposed exercises. Except official renounce of the student, the course is followed under continuous assessment mode.

Continuous assessment grading is not saved year after year

Final exam (first call): 80% of the total mark, which consists of theoretical question, practical questions, resolution of exercises/problems or short covering of a topic

July final exam (second call): represents 100% of the grade (continous evaluation is not considered)

Ethical Commitment: In case of noticing a non ethical behaviour (copy, plagiarism, utilisation of unauthorised electronic devices,and others) it will be considered that the student does not gather the necessaryrequirements to pass the course. In this case, the global qualification iof the present academic course will be failed (0.0)

Sources of information

Basic Bibliography

Viedma A., Zamora B., **Teoría y Problemas de máquinas hidráulicas**, 3º 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

Contingency plan

Description

EXCEPTIONAL PLANNING

Given the uncertain and unpredictable evolution of the health alert caused by COVID-19, the University of Vigo establishesan extraordinary planning that will be activated when the administrations and the institution itself determine it, consideringsafety, health and responsibility criteria both in distance and blended learning. These already planned measures guarantee,at the required time, the development of teaching in a more agile and effective way, as it is known in advance (or well inadvance) by the students and teachers through the standardized tool.

ADAPTATION OF THE METHODOLOGIES

Teaching methodologies maintained: Lecturing and tutoring. In any case, if it is needed, they will be substituted by distance learning, using CAMPUS REMOTO or any other available platform

Teaching methodologies modified: Laboratory. This will be substituted by explanatory videos or additional teaching material to explain the different topics

Non-attendance mechanisms for student attention (tutoring): Telematic technology will be used, such as CAMPUS REMOTO or any other available platform, to get in contact with the students

Modifications (if applicable) of the contents: None

Additional bibliography to facilitate self-learning: None

Other modifications: Assessment criteria does not change.

ADAPTATION OF THE TESTS

If it is needed, final exam will be substituted by 2 or 3 continuous evaluation tests. These tests can comprise test questions (true or false or several choices) or exercise to solve through Faitic or Campus Remoto in a limited period of time