

Course Unit	Applied Hydraulics I			Field of study	Hydraulics and Hydric Resources	
Bachelor in	Civil Engineering			School	School of Technology and Management	
Academic Year	2023/2024	Year of study	3	Level	1-3	ECTS credits 6.0
Туре	Semestral	Semester	1	Code	9089-322-3104-00-23	
Workload (hours)	162	Contact hours	T - TP -	58 PL - To nd problem-solving; PL - Problem-	C - S - solving, project or laboratory; TC -	E - OT - O 2 Fieldwork; S - Seminar; E - Placement; OT - Tutorial; O - Other

Name(s) of lecturer(s)

Carlos Liberal Moreno Afonso

Learning outcomes and competences

At the end of the course unit the learner is expected to be able to:

- Distinguish the various types of flows and analyses the differents hidraulic scenarios; Recognize the influence of the layout of conduits in the proper functioning of flow and understand the phenomenon of cavitation and trapping air;

- Determine the discharge in conduits with standard consumption route;
 Distinguish the types of unsteady flows in pipes and know the various protection methods of prejudicial phenomena;
 Know the laws that govern the flow in open channels, classify the different types of flows and formulate solutions to the more usual hydraulic scenarios;
 Extend the fundamental equations of the fluid mechanics to flow by orifices and weirs and know the methods of measuring flowing water;
 Know the different types of turbines and pumps, explain its principles of operation, recognize the different types of facilities and formulate solutions to practical cases; cases

8. Know the laws that govern the ground-water flow and its applications.

Prerequisites

Before the course unit the learner is expected to be able to: 1. Make numerical calculation, differential, integral, vector, linear algebra and analytic geometry;

- Apply the knowledge of physics; Make good use of the scientific calculator;
- 4. Apply the concepts of General Hydraulic

Course contents

Steady Flows in Pipes; Unsteady Flows in Pipes; Hydraulic Machinery; Open Channels Flow; Flows by Orifices, Gates and Weirs. Hydraulic Measurements; Groundwater.

Course contents (extended version)

- 1. Steady flows in pipes

 - Permanent types of flows. Continuity equation. Energy and the Bernoulli equation.
 Output pipes into the atmosphere. Influence of the routing of pipes.
 Conduit systems. Branching pipes. Parallel pipes.
 Loss of energy due to friction and due to transitions and fittings. Hydraulic and energy grade lines
 Pipes with consumption of uniform route. Trapping air. Cavitation.
- Pipes with consumption of uniform route. Trapping air. Cavitation.
 Unsteady flows in pipes
 General considerations. Surge tank water-level oscillation. Description of phenomenon. Dimensioning.
 Water hammer. Description of the phenomenon. Transients caused by pumps. Design.
 Liquid-column separation. Control devices.

- Hydraulic machinery

 Specific speed. Operation of turbines on a permanent basis.

 - Specific speed. Operation of turbines on a permanent basis.
 General considerations. Types of turbines and pumps.
 General descriptions and conditions of installing turbines.
 Theory of elementary turbomachines. Similarity relations for turbomachines.
 Suction lift of reaction turbines. Type, speed of rotation and main dimentions. Miniturbines.
 Conditions of installing pumps. Specific speed. Diagrams of operation of pumps.
 Characteristic curves. Startup and pumps priming. Suction lift of pumps. Choice of pumps.
- Open channel flow

 Uniform flow. Simple sections, closed sections, mixed sections, composite sections.
- Onioffmiow. Simple sections, closed sections, mixed sections, composite sections.
 Steady-Nonuniforme flow. Bernoulli's theorem. Specific energy.
 Critical flow. Subcritical flow. Supercritical flow. Function h = h(Q) for E = Eo. Flow control.
 Types of water-surface profiles. Channel transitions.
 Quantitative evaluation of surface profiles. The hydraulic jump. Derivation of Depth relationships.
 Flows by orifices, gates and weirs. Hydraulic measurements
 General considerations. Orifices. Gates. Weirs. Hydraulic measurements. Level measurements. Pressure measurements. Velocity measurements. Flow rate measurements
- 6. Groundwater
 - General considerations. Darcy's law. Permeability. One-dimensional steady groundwater flow.
 Unconfined steady flow. Confined steady flow.

Recommended reading

- Apontamentos das Aulas Teóricas

- Apontamentos das Aulas Feorcas
 Quintela, A. C. Hidráulica. 13ª edição, 2014, Fundação Calouste Gulbenkian, Lisboa
 Lencastre, A. Hidráulica Geral. Edição do Autor, Lisboa
 Manzanares, A. Hidráulica Geral I e II. Técnica AEIST, Lisboa
 Marriott, M. J., Featherstone, R. E. e Nalluri, C. Civil Engineering Hydraulics. 5th ed., Wiley-Blackwell, 2009

Teaching and learning methods

The unit curriculum will be taught using expository lessons and practical classes for resolution of exercises.

Assessment methods

- All - (Regular, Student Worker) (Final, Supplementary, Special)

IPB - School of Technology and Management

Assessment methods	
- Final Written Exam - 100%	
Language of instruction	
Portuguese	

Electronic validation			
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15-10-2023	19-10-2023	29-10-2023	31-10-2023