Course Unit	Hydrology and Hydraulics			Field of study	Earth Sciences		
Bachelor in	Environmental Engineering			School	School of Agriculture		
Academic Year	2022/2023	Year of study	2	Level	1-2	ECTS credits	6.0
Type	Semestral	Semester	1	Code	9099-309-2103-00-22		

Workload (hours)	162	Contact hours	T	TP	PL	TC	S	E	OT	O
			30	-	30	-	-	-	20	-

T - Lectures; TP - Lectures and problem-solving; PL - Problem-solving, project or laboratory; TC - Fieldwork; S - Seminar; E - Placement; OT - Tutorial; O - Other

Name(s) of lecturer(s): Amilcar António Teiga Teixeira, Tomás de Aquino Freitas Rosa Figueiredo

Learning outcomes and competences

At the end of the course unit the learner is expected to be able to:
1. Sieze basic comcepts such as drainage basin, hydrologic cycle and water balance
2. Know the water cycle compnents (streamflow emphasized) in terms of concept, description, factors and assessemnt methods
3. Handle with hydrologic data and the basic methodologies to gather and treat such data
4. Apply basic theory for designing common structures in river hydraulics
5. Apply the built up critical capaciy when assessing methodologies followed in projects on River Hydraulics and Water Resources
6. Apply background aquired in data gathering and treatment, in view hydrologic base studies

Prerequisites

Before the course unit the learner is expected to be able to:
Basics of maths and physics at secondary school level

Course contents

Concepts: drainage basin, water cycle, water balance; study of the main water cycle compenents in terms of concept, factors, assessment methods: precipitation, interception, evaporation and evapotranspiration, infiltration and soil water, surface runoff; river gaging, hydrologic data treatment; basics in hydraulics; elementary problem solving in hydrostatics, pipe flow, open channel flow, in throughs and spillways

Course contents (extended version)

1. Introduction: programme context, obectives, structure (Hydrology/Hydraulics; Lectures/Practicals)
2. Part I - Hydrology Basic concepts (water cycle, watershed, water balance)
3. Components of the Water Cycle (Lectures) Precipitation
   - Formation, forms and types of Precipitation
   - Factors affecting geographical distribution of Precipitation
   - Point rainfall data: measurement (instruments and stations), sources, treatment
   - Areal rainfall data: gauges networks, spatial weighing and correlation, data missing and consistency
   - Characteristics and treatment of rainfall data series: annual, monthly, short duration extremes
4. Components of the Water Cycle (Lectures) Interception
   - Concepts, process, measurement
   - Compared effects of main vegetation types, Relative importance for the water cycle
5. Components of the Water Cycle (Lectures) Evaporation and Evapotranspiration
   - Concepts
   - Factors affecting Evaporation and Evapotranspiration
   - Measuring Evaporation and Evapotranspiration
   - Evaporation calculations by the water balance and the energy balance
   - Estimating reference and crop evapotranspiration
6. Components of the Water Cycle (Lectures) Water in soils: infiltration, redistribution, storage
   - Concepts
   - Infiltration: measurement, factors affecting infiltration, main infiltration formulas
   - Redistribution: changes in soil moisture profile after infiltration, Darcy Law for unsaturated flow
   - Water storage: moisture retetntion curve, field capacity, wilting point, factors affecting storage
7. Components of the Water Cycle (Lectures) Runoff
   - Concepts, formation, expression
   - Measurement of river discharge
   - Hydrometric data: exploration focused on annual and monthly values
   - Hydrograph: characteristics, streamflow components and separation, factors affecting hydrograph form
   - Floods: methods for estimating peak flow, synthetic hydrographs
8. Part II - Hydrauklics (Lectures and exercises) Basic theory; current practical cases; exercises on
   - Hydrostatic
   - Pipe flow
   - Open channel flow
   - Flow in hooses and spillways
9. Part III - Hydrology (Practicals) Practical activities on (12 assignments):
   - Watershed boundaries and physical characterization of a small catchment (2)
   - Reference evapotranspiration estimated with Thornthwaite, Blaney-Criddle and Penman methods (2)
   - Average rainfall over a catchment: the Thiessen and isohyets weighing methods (1)
   - Series of annual river discharge: statistics, Gauss, Galton, Pearson III distributions (3)
   - Application of monthly river discharge series for estimating reservoir storage
   - Application to a small catchment of empyrical formulas for estimating peak discharge (2)
   - Measurement of streamflow discharge and velocity (velocity-section method with propeller meter) (1)

Recommended reading

1. Gordon, N. D. , McMahon, T. A. e Finlayson, B. L. (1993) Stream Hydrology: An Introduction for Ecologists (reimp.). Wiley, Chichester, UK.
2. Lencastre, A. (1983) Hidráulica Geral. Hidroprojecto, Lisboa.
3. Lencastre, A. & Franco, F. M. (2006) Lições de Hidrologia, 3ª ed, reimp. Universidade Nova de Lisboa - Fundação, Monte da Caparica.
4. Linsley Jr. , R. K. , Kohler, M. A. e Paulhus, J. L. H. (1985) Hydrology for Engineers (International Student Edition, 3ª ed.). McGraw-Hill, Singapore.
5. Hipólito J.R. e Vaz A.C. (2017). Hidrologia e Recursos Hídricos. 3ª ed. IST Press

Teaching and learning methods

Lectures for theory, syllabus and references provided to students at semester start. Practicals for supervised activities, including field and lab work and exercises,

Teaching and learning methods

guidelines provided during semester. Tutorial support for students during semester, includind exams period

Assessment methods

1. Alternative 1 - (Regular) (Final, Supplementary, Special)
   - Practical Work - 40% (Practical Work - 40% (Practicals performed with positive assessement))
   - Final Written Exam - 60% (Final Written Exam - 60% (assessing all topics lectured, practical items with residual weigth))
2. Alternative 2 - (Student Worker) (Final, Supplementary, Special)
   - Final Written Exam - 100% (Final Written Exam - 100% (Exam assessing also practicals, 50%, minimum score 10/20))

Language of instruction

Portuguese, with additional English support for foreign students.

Electronic validation

Amilcar António Teiga Teixeira, Tomás de Aquino Freitas Rosa Figueiredo	Amilcar Manuel Lopes António	Artur Jorge de Jesus Gonçalves	Maria Sameiro Ferreira Patrício
05-12-2022	05-12-2022	08-12-2022	19-12-2022