

POLI ESCOLA SUPERIOR TECNOLOGIA GESTÃO TÉCNICO GUARDA	SUBJECT DESCRIPTION	MODELO PED.013.03
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Course	Energy and Environment					
Subject	Soil Pollution					
Academic year	2023-2024	Curricular year	2nd	Study period	2nd semester	
Type of subject	Compulsory	Student workload (H)	Total: 140	Contact: 60	ECTS	5,0
Professor(s)	Ana Maria Morais Caldas Antão					
<input checked="" type="checkbox"/> Area/Group Coordinator <input type="checkbox"/> Head of Department	(select)	Rui Pitarma Cunha Ferreira				

PLANNED SUBJECT DESCRIPTION

1. LEARNING OBJECTIVES

Realizing the importance of soil pollution (s.l.) has in today society. Acquire some basic concepts of soil mechanics that are important in the understanding of the behavior of contaminants in the soil (s.l.). Provide concepts and features of the main pollutants, sources, and backgrounds. Aware of the soil erosion problem globally and nationally. Know the main methods of decontamination of soils. Provide ideas on groundwater and its features. Acquire some understanding of hydrogeology. Know the main processes of groundwater contamination and decontamination.

2. PROGRAMME

Theoretical program

- The main processes of soil formation and transport. Types and characteristics of changing rocks: their importance in the composition, characteristics, and behavior of the soil phase diagram of a soil. Physical properties of a soil. Some notions on the Geotechnical behavior of soils. Soil classifications. Munsell's chart.
- Soil pollution and the environmental policy of the European Union. Specific legislation.
- The soil-water system. Main properties. Main causes and processes that contribute to the degradation of soil quality (erosion, chemical degradation and physical degradation). Pollution-generating sources and types of contaminants expected. Contaminant transport mechanisms: advection, diffusion and dispersion. Radioactive contamination – some notions.
- The water in the soil and rocks. Some basic concepts of hydrogeology in steady state flow. The Retardation Factor.
- Contamination of groundwater-contamination modes, the behavior of different contaminants, monitoring of aquifers. The database of SNIRH
- Notion of risk and vulnerability of aquifers. Risk analysis (indices DRASTIC and AVI). The main aquifer systems and their features. The concept of protective perimeters (national laws). Decontamination

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of soils and aquifers. Main techniques: advantages and disadvantages. Classification of groundwater and its protection. Applicable law. Some notions about toxicology and risk quantitative analysis.

Practical Program

- Determination of some physical indices of soils.
- Exercises about soil classification (UCS, USDA and Munsell classification).
- Application exercises determination of the limits of consistency and particle size analysis of soils.
- Exercises about soil-water in permanent regime.
- Exercises about permeability, flow and transmissibility of an aquifer.
- Exercises of risk analysis in scenarios of exposure to contamination.
- Practical applications about contamination of soils and aquifers (DRASTIC and AVI index). Simulation of the contamination in soils using specific software (BIOSCREEN). Exercises about remediation technologies for contaminated soils.

3. COHERENCE BETWEEN PROGRAMME AND OBJECTIVES

This is a subject where it is focused the problem of soil contamination (s.l.), being so required some concepts taught geology at UC. For understanding the phenomenon, are provided to student's theoretical concepts with examples of various case studies the international, national and European level. You should also know the main causes and processes that contribute to the degradation of soil quality and its importance in the international panorama and quantify it. In the end the student must learn to relate the contamination, with the type of industry, the type of soil and underground water in a perspective of decontamination. You should also know the characteristics of the main groundwater reserves of continental Portugal. You should know which national legislation and the EU in this sector.

4. MAIN BIBLIOGRAPHY

Mandatory

- ANTÃO, A.M. (2007) –*Poluição dos Solos - Engenharia do Ambiente*”. Sebenta IPG, ISSN1645-8281.
- ANTÃO, A.M. (2007) –*Poluição dos Solos – Noções de Hidrogeologia I*”. Sebenta IPG, ISSN1645-8281.
- ANTÃO, A.M. (2007) –*Poluição dos Solos – Noções de Hidrogeologia II*”. Sebenta IPG, ISSN1645-8281
- ANTÃO, A. M. (2006) – *Algumas noções e conceitos sobre alteração de rochas*. Sebenta IPG. ISSN 1645-8281
- ANTÃO, A.M. (2010) - *Protocolos para determinação da MO com o kit de campo LaMotte*.
- ANTÃO, A.M. (2010) - *Protocolos para determinação da MO através da LOI*.
- ANTÃO, A.M. (2006 a 2017) – Fichas de exercícios vários.
- APA (2019) - *Solos Contaminados – Guia Técnico. Análise de Risco e critérios de aceitabilidade do risco*.
- APA (2019) - *Solos Contaminados – Guia Técnico. Plano de Amostragem e Plano de Monitorização do Solo*.
- APA (2019) - *Solos Contaminados – Guia Técnico. Valores de referência para o Solo*.

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- COTHERN R.B. & SMITH, J. (1987) – “*Environmental Radon*”. Plenum Press.
- CUSTODIO, E. e LLAMAS, M. (2001) – “*Hidrologia subterrânea*”. Tomo 1 e 2. Edições Ómega, Barcelona.
- DOMENICO PATRICK. A – “*Physical and chemical hydrogeology*”.
- ESTEVES DA COSTA, F. (1985) – “*Avaliação das disponibilidades de águas subterrâneas/Esboço*”. Geonovas, Vol. 8/9:143-140.
- FERNANDES, M. MATOS (2011) – “*Mecânica dos Solos. Conceitos e Princípios Fundamentais*”. Vol1. 2ª edição. FEUP edições.
- FETTER, C.W. (1999) – “*Contaminant hydrogeology*”. 2nd Edição. Prentice Hall.
- LAGREGA, M. et al. (2001) – “*Hazardous Waste Management*”. 2nd Edição. McGraw-Hill Int.
- LOBO FERREIRA, J.P., OLIVEIRA, M. e CIABATTI, P. (1995) – “*Desenvolvimento de um inventário das águas subterrâneas de Portugal*”. Vol I, II e III. LNEC, Lisboa.
- MIRSAL, Ibrahim A. (2008) – “*Soil Pollution. Origin, Monitoring & Remediation*”. Springer. 2nd Edition.
- PERK, Marcel van der (2006) – “*Soil and water contamination*”. London: Taylor & Francis,
- SMITH, E. (1997) – “*Environmental Science. A Study of Interrelationships*”. 6ª edição, WCB McGraw-Hill.
- WHITE, R.E. (2006) – “*Principles and Practice of Soil Science*”. 4ª edição, Blackwell Publishing.
- YONG, R.N. (2001) – “*Geoenvironmental engineering: contaminated soils, pollutant fate and mitigation*”. CRC Press.

Optional

- BELL, F.G. (1998) – “*Environmental Geology. Principles and practice*”. Edições Blackwell.
- BOTELHO DA COSTA, J. (1985) – “*Caracterização e constituição do solo*”. 3ª Edição, Fundação Calouste Gulbenkian, Lisboa
- DURRANI, Saeed A., ILIC, RADOMIR (1997) - *Radon measurements by etched track detectors*. London: World Scientific.
- HOWARD et al. (1991) – “*Handbook of Environmental Degradation Rates*”. Lewis Publishers
- VARENNES, A. (2003) – “*Produtividade dos Solos e Ambientes*”. Escolar Editora

“Sites”

- SOIL SURVEY STAFF, NATURAL RESOURCES CONSERVATION SERVICE, UNITED STATES DEPARTMENT OF AGRICULTURE. Soil Series Classification Database
<http://soils.usda.gov/soils/technical/classification/scfile/index.html>.
- ATLAS DO AMBIENTE, <http://www2.apambiente.pt/atlas/din/viewer.htm>
- AGENCY FOR TOXIC SUBSTANCES AND DISEASE REGISTRY,
<http://www.atsdr.cdc.gov/toxprofiles/index.asp>
- INTEGRATED RISK INFORMATION SYSTEM (IRIS)
<http://cfpub.epa.gov/ncea/iris/index.cfm?fuseaction=iris.showSubstanceList>
- BLACKSMITH INSTITUTE, <http://www.blacksmithinstitute.org/>
- (CERCLA), SUPERFUND, <http://www.epa.gov/superfund/policy/cercla.htm>
- CETESB, <http://www.cetesb.sp.gov.br/>
- EUROPEAN ENVIRONMENT AGENCY (EEA), <http://www.eea.europa.eu/>
- UNITED STATES ENVIRONMENTAL PROTECTION AGENCY (USEPA),
<http://www.epa.gov/epahome/learn.htm>,
<http://nepis.epa.gov/Exe/ZyNET.EXE?ZyActionL=Register&User=anonymous&Password=anonymous&Client=EPA>
<http://www.epa.gov/Athens/learn2model/part-two/onsite/retard.html>
- THE ENVIRONMENTAL DIRECTORY, <http://www.webdirectory.com/>
- EURONATURA, <http://www.euronatura.pt/>

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- ISRIC - WORLD SOIL INFORMATION, <http://www.isric.org/>

5. TEACHING METHODOLOGIES (INCLUDING EVALUATION)

Expository with presentation of some case studies. Theoretical and practical exercises accomplished by laboratory tests. Evaluation made by frequency/examination and by various typologies works (bibliographic search + exercises for resolution and delivery + abstract of a scientific paper/applied to the soil pollution+ laboratory tests reports). The works are made or presented by students and are valid during evaluation for frequency and normal exam, not counting for the exam of appeal. The works are required for the approval in the discipline, being valid also for the examination of the normal season. The work carried out in the previous year may be validated for this year if the student expresses it.

$$\text{Evaluation} = [\text{WORKS (7)} + \text{FREQ. or EXAM (13)}] = 20$$

The examination of appeal does not include the work carried out during the ongoing assessment.

COHERENCE BETWEEN TEACHING METHODOLOGIES AND OBJECTIVES

It is intended to raise students' awareness to the problem of pollution of soils and groundwater in a perspective of sustainable development of societies. For this is promoted to bibliographical research and web graphics through the submission of papers. The laboratory classes serve to a first contact with the soil (s.l.), and subsequent analysis of the quantification of several important parameters in the equation of pollution/contamination. It is intended that students, as future professionals have critical spirit and analysis of the values of the properties of soils and their influence in the process of decontamination. Finally, it is intended with the presentation of a summary of a scientific paper by the students, enhance their ability of summary and synthesis in the presentation of a given problem.

6. CONTACTS AND OFFICE HOURS

Laboratory of Geotechnics I.

DATE

19 de february de 2024

SIGNATURES

Professor

Ana Maria Antão