Code: 1714 **Measurement Methods and Procedures**
Degree: 1st cycle – Environmental Engineering
Curricular Year: 2nd **Semester Course: 1st**
Credits: 6 ECTS **Compulsory**
Language: Portuguese/English
Responsible: Miguel Pedro de Freitas Barbosa Mourato
Other lecturer(s): -
Web Site: http://www.isa.utl.pt/home/node/4015

1. Contact hours:
Lectures 28 **Practicals/Laboratory** 42 **Others** 14 **Total** 84

2. Objectives:

To convey to the students the importance of appropriated measurements in environmental studies. Introduction to the basic aspects related to the theory of error and the different measurement techniques used in environmental analysis. This is followed by a full discussion of the problematic related to measurement in the different areas of physics and chemistry of analytical and environmental relevance.
Focus on structured and practical knowledge enabling students to harvest data necessary for their professional life as well as the proper way to understand and report this data.

3. Programme:

INTRODUCTION TO METROLOGY
Theory of error. Error propagation. Characteristics of measurement. Instrumental response. General constitution of an instrument. Instrumental calibration. Indirect measurement. Calibration curves.
CHEMICAL ANALYSIS – METHODS AND TECHNIQUES
An introduction to the work in the laboratory. Laboratory safety. The importance of a lab notebook.
Interpretation and execution of an experimental protocol. Writing and experimental protocol.
Basic techniques for measuring weight and volumes.
Titration and pH determination.
The analytical process. Validation of a method. Potentiometry and voltammetry.
Spectrometry; spectrometric methods: atomic absorption and emission spectrophotometry, UV and visible spectrometry, infrared spectrometry.
Chromatographic methods: gas chromatography, HPLP.
Mass spectrometry, HPLC-MS, GC-MS
Advanced spectrometric techniques.
Environmental analysis.
QUICK ANALYTICAL METHODS.

4. Bibliography:

Main Bibliography

Skoog, D, Holler, F, Nieman, T 1998, Principles of Instrumental Analysis, 5th Ed, Brooks-Cole
B. Marshall & F.I. Woodward (eds). Instrumentation for Environmental Physiology. Cambridge University Press, New York.
Fritschen, L.J., & L.W. Gay. 1979. Environmental instrumentation. Springer-Verlag, New York.
Strangeways, I. 2003. Measuring the Natural Environment. 2nd Edition. Cambridge University Press, New York, 544 pp.
Simões, J.A. et al., 2000, "Guia do Laboratório de Química e Bioquímica", Lidel.

Other Bibliography

Barceló, D., 2000, *Sample handling and trace analysis of pollutants – Techniques, applications and quality assurance*, **Vol. 21**, Elsevier Science, Amsterdam
Dean, J. R., 1998, *Extraction methods for environmental analysis*. John Wiley & Sons, UK.
Harris, D. G., 2003, "Quantitative Chemical Analysis", 2003, H. W. Freeman & Comp.
Christian, D1994, Analytical Chemistry, 5th ed., Wiley.

5. Assessment:

Continous assessment includes homework, laboratory reports, in-class quizzes, after each laboratory experiment and mid-term tests (based on the lectures). A final examination is mandatory only for

students that have not reached a final classification of 10 out of 20 (in the continuos assessment).

6. Estimated Workload:	168	Hours
7. Last Update:	12/7/2010	