Unidade Curricular: Metrology

Área Científica: CE
Duração: Semestral
Horas de trabalho: 121.5
Horas de contacto: 45
ECTS: 4.5

Docente Responsável: Manuel José de Matos
Outros Docentes: Hugo Filipe Félix Antunes da Silva

Learning outcomes of the curricular unit
After attending this course with approval it is intended that students:
- Realize the objectives of the Technical and Scientific Metrology and its importance in the relations between
customers-suppliers and the society.
- Know the International Metrological Vocabulary.
- Have a clear understanding of National, European and International metrological systems.
- Know how to calculate uncertainties associated with measurements and calibrations.
- Know how to calibrate measuring equipment and make the calibration report and certificate of calibration.

Syllabus
1. Introduction to Metrology: History of Metrology in Portugal and in the world, the SI and its base and derivative units;
2. National, European Community and International Metrology Organizations;
3. Legal Metrology;
4. Industrial and Scientific Metrology; the advent of nanometrology;
5. Most widely used systems of measures and measurement techniques;
6. Statistics for metrology;
7. Uncertainty evaluation applied to metrology;
8. Calibration and management of measuring equipment;
9. Practical case studies: Calibration of measuring instruments and equipment, reporting and calibration certificates.

Demonstration of the syllabus coherence with the curricular unit's learning objectives.
Learning objectives are supported on specific syllabus. Each one of the learning objectives is associated with one or several syllabuses in which are included the knowledges that it is intended that students acquire.

Teaching methodologies (including evaluation)
The teaching methodology will be based on 4 phases:
1-The students will be confronted with real problems in the area of metrology and are invited to propose a solution.
2-The Knowledge related to the area of the proposed problem are transmitted. Knowledge are generally supported in operative tools and integrated into one of the programmatic objectives.

3- Students reformulate their proposed using the tools and knowledge acquired. Measurements or experiments considered relevant may be carried out.
4- Students will realize practical case studies involving calibrations of equipment that will be executed and reported based on the knowledge and tools transmitted in the classes (Final work-TF).
The assessment can be performed by continuous assessment (AC) or by final exam (EF, EF> = 9.5) always completed with the TF.
In AC students solve 3 to 5 practical problems (PP) and perform a written final test (TFE).
AC=0.2xPP+0.8xTFE (AC> = 9.5).
Final grade (NF)=0.65 (AC or EF) + 0.35 TF (NF>=9.5).

Demonstration of the coherence between the teaching methodologies and the learning outcomes

In this curricular unit is intended that students hold a comprehensive knowledge of matter related to Metrology. Being
matter grounded in tangible and in real cases, it was contemplated the solving of real cases that, whenever possible,
should be accompanied by processes of real measurements. When real situations proves to be difficult or impractical,
must be used simulated environments. Calculations and other procedures used in the metrological methods will, whenever
possible, replicated on student computers or in computer rooms.
The reports and calibration certificates to be prepared will be based on current standards

Mandatory consultation/existence bibliography:

1- The Metrology Handbook, Jay L. Bucher (Ed.), ASQP2004
2- International Vocabulary of Metrology – Basic and General Concepts and Associated Terms, 3rd ed. JCGM 200, 2012
3- N. V. Raghavendra, L. Krishnamurthy, Engineering Metrology and Measurements, Oxford U. Press2013
4- Calibration: Philosophy in Practice, Fluke Corp, 2nd ed.1994
5- Jay L. Bucher, The Quality Calibration Handbook: Developing and Managing a Calibration Program, ASQP2006
6- Evaluation of measurement data – Guide to the expression of uncertainty in measurement JCGM 100 2008
7- ISO/IEC 17025:2017 General requirements for the competence of testing and calibration laboratories
8- Guia para a aplicação da NP EN ISO/IEC 17025:2018 OGC001, IPAC2018
9- ISO 10012:2003 Measurement management systems—Requirements for measurement processes and measuring
equipment

On-line information:

IPQ www.ipq.pt
IOLM www.oiml.org
ISO www.iso.org
Eurachem www.eurachem.org
NIST www.nist.gov
NP www.npl.co.uk
AALA www.a2la.org
BIPM www.bipm.org