

METROLOGY (CMM)

Code: 322070

Main Scientific Area: Mechanics and industrial processes

Lecturer: Pedro Emanuel Gonçalves Lagrifa

Language of Instruction: Portuguese

Regime: S1

Contact Hours: 30h Total Workload: 53h

ECTS: 3,0

Objectives

Students who successfully complete this curricular unit will be able to:

- Recognize the importance of metrology.
- Identify the structure of the Portuguese Quality System.
- Understand the hierarchical chains of measurement standards.
- Understand and apply the rules for tracking and calibrating measuring instruments.
- Apply basic statistics to measurement and control of instruments.
- Identify the different unit systems used in metrology and their respective units.
- Convert units from different systems.
- Identify the main factors that generate errors in a measurement and propose or take corrective actions.
- Identify and characterize the most used instruments in dimensional and geometric control.
- Understand the importance of dimensional and geometric tolerance.
- Select the most appropriate type of adjustment for each application. -Interpret correctly, within the dimensions of a technical drawing, tolerances relating to the “dimension”, “geometry” and “surface states” of the parts.

Learning Outcomes

The syllabus of this curricular unit will allow students to acquire a set of

skills in the area of metrology:

- Students must identify the unit systems and carry out conversions between them.
- Students must be able to carry out correct readings with measuring instruments used in industry metalworking (and others).

- Students should be able to appropriately select equipment for carrying out measurements and control of the parts produced.
- Students should know measuring and control equipment such as CMM (MMC) and understand their capabilities and limitations in an industrial environment.

Course Contents

- Metrology in Portugal
- Historical evolution of metrology in the world and in Portugal
- The decimal metric system – historical evolution
- Portuguese Quality System
- National metrology subsystem
 - - Scientific metrology
 - - Industrial metrology
 - - Legal metrology
- International Metrology Vocabulary – VIM
- Management of measuring instruments
- Hierarchical chains of measurement standards
 - - International Standards
 - - Primary standards
 - - Secondary standards
 - - Work standards
- Calibration of measuring instruments
- Unit systems
- Introduction
- Quantity and measurement
- Measurement types
- International System of Units - SI
 - - Composition of the International System of Units – SI

- Base or fundamental units
- - Derived units
- - Supplementary units
- - Multiples and submultiples. Rules for writing
- - Units in use with the SI system
- - English unit system (Imperial System or Imperial Units)
- Relationship between units of different systems
- Factors influencing measurement
- Measurement errors
- - Types of measurement errors
- - Measurement errors. Factors
- - Errors attributable to the environment
- - Errors attributable to the measuring instrument
- - Errors attributable to the operator
- Parallax
- - Pressure variation
- - Incorrect placement of equipment
- - Incorrect positioning of the measuring tips
- - Incorrect choice of measuring instrument
- - Errors attributable to defects in the shape of the part to be measured
- Basic statistics applied to measurement
- Introduction
- Terminology and form
- Normal distribution
- Statistical measures
- - Statistical measures of central tendency - Mean, mode and median

· - Statistical measures of variability or dispersion - Amplitude, mean deviation, variance, standard deviation, error

standard of each measurement, standard error of the mean or measurement uncertainty, Absolute measurement uncertainty

· Probability of occurrence

· Types of measuring and control instruments: characteristics

- Scales or graduated rulers

· - Linear patterns – block patterns, cylindrical patterns and staggered patterns

· - Calipers

· - Graminhos

· - Micrometers

· - Comparator

· - Sutas

· - Angular blocks

· - Sine ruler

· - Brackets

· - Optical planes

· - Tolerance limit gauges (Pass/No-Pass type)

· - Scantillions

· - Other measuring and checking instruments

· Special equipment

· - MMC coordinate measuring machine

· - Introduction to measurement with MMC

· - Contact measurement system

· - Optical measurement system

· - Constructive solutions

· - Probes and types of styli

- - Profile projector
- - Rugosimeter
- The vernier
- - Introduction
- - Types of verniers (straight, circular and drum)
- - Nature of the vernier
- - Procedures for measuring with a vernier
- Practical applications of measurements with measuring equipment

Recommended Bibliography

Metrologia Dimensional na Indústria Metalomecânica, de Nuno Boavida Edição: FCA

Learning and Teaching Methods

It is intended that after a theoretical presentation, combined with practical examples, students will be able to proceed independently, initially in a group, and later individually using the metrological control tools available.

Assessment Methods

Learning results will be assessed individually through a theoretical test with the study of curricular unit. Practical work will also be considered.

Theory test - 80%

Practical Work - 20%