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AN INTERACTIVE TOOL FOR TEACHING METROLOGY

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Abstract: this project was meant to be a study supporting material different from the current available ones to graduating students and technicians in the metrology field. Its setup was based on personal experiences from its elaborators. When deciding the contents and formatting of this project, it was agreed that it should contain the subjects: metrology history and terminology, number treatments, measurements, calibration and uncertainty estimates. It should also point out notions of nanotechnology. We were careful not to turn this project into a simple transcription of study notes from textbooks to a computer screen, so definitions and concepts a bit more difficult to understand were reviewed and illustrated with animations and / or interactive exercises. A growing order of difficulties was obeyed, beginning with its supporting chapter and concluding with some complex calculation of uncertainty measurements. Accessing it from remote locations will be possible in a near future. During its elaboration, this project was positively evaluated by several collaborators from different fields, from engineering students to technicians. The users were pleased with its contents and formatting what gave us the confidence that we were innovative and in the right track to become a reference supporting material for metrology studying and researching.

Keywords: metrology, measurement, interaction.

1. INTRODUCTION

The objective of this project is to aid metrological technicians when it comes to taking decisions based on observation and studying of some examples showed here. As a complement to the traditional methods of teaching at schools, this material can, depending on the needs of the teacher that utilizes it, be accessed at the end of classes as a review material.

All the texts were developed in a concisely way and the animations, illustrative drawings and interactions make their understanding easier. This project aims to present real and interesting metrological applications to the professionals in this field.

2. CONTENTS

This project is divided into 8 chapters, a supporting chapter, containing the International Vocabulary of Metrology, and seven others as follows:

Chapter 1 – General Concepts (Introduction, definition)

Chapter 2 – International Unit System – SI (Base and supplement units, prefixes, units in use with the SI)

Chapter 3 – Treatment of number (Writing manners, scientific notation, rounding concepts, mathematical operations)

Chapter 4 – Measurements (Processes, types of measurements system, types of errors, characteristics of measurement instruments, specification of instruments)

Chapter 5 – Calibrations (Instrument validation, traceability, calibration process, calibration intervals)

Chapter 6 – Notions of Nanotechnology (A general approach, numeric examples, current situation and future projections)

Chapter 7 – Uncertainty measurement (Uncertainty sources and components, uncertainty types A and B, combined standard uncertainty, degrees of freedom, expanded uncertainty, uncertainty evaluation, propagation of uncertainties in modules).

3. ACCESS TO THE MATERIAL

This CD material entitled “An interactive tool for teaching metrology” utilizes in its content multimedia and Internet tools. The teaching method known as non synchronized *e-learning*, in which communication between the teacher and the user is not done in real time, is used to evaluate the presented topics and to clarify possible questions that might come up during its use.

This interactive metrology course, with its visual examples, facilitates the understanding of several metrological concepts and, at the same time, aids people that still do not have professional experiences in metrology laboratories centers or industries. It is very easy to be accessed and it obeys an order of complexity that grows on each chapter or item studied.

4. SEQUENCE TO USE THIS METROLOGY COURSE

The CD that contains the interactive course must be inserted into the CD-Rom drive of your computer. It will load and start automatically. If, for any reason, it does not start right away, the "metrologia.exe" file must be found with the available searching tools and executed. At the first screen of this course, the name of the user and his password should be typed in the required fields (for this particular event the name and the password can both be your name), before going any further. If one of these fields is not filled, the software will not function (Figure 1).

Figure 1 – Access screen to the interactive course

The second page of this project contains the description of the covered subjects and in which chapter they can be located. Clicking on the arrow in the lower right part of the screen, one can initiate the browsing process. By the written summary in here, it is possible to choose which chapter to study in this screen (Figure 2).

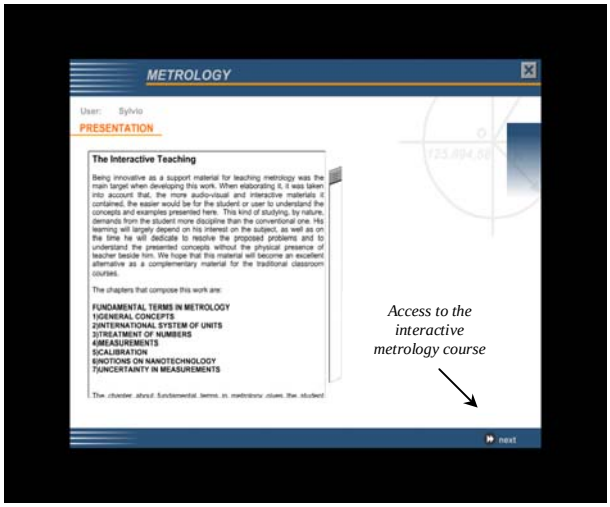

Figure 2 – Presentation screen and the icon to access the chapters

An animation or even more information can be obtained by clicking the mouse on the signal (+) circled in blue, every time it appears on the screen.

It is also possible, opening the *menu* in the right upper corner of the monitor, to select the desired chapter or skip, for instance, from chapter "X" to chapter "Y", if it suits you (Figure 3).

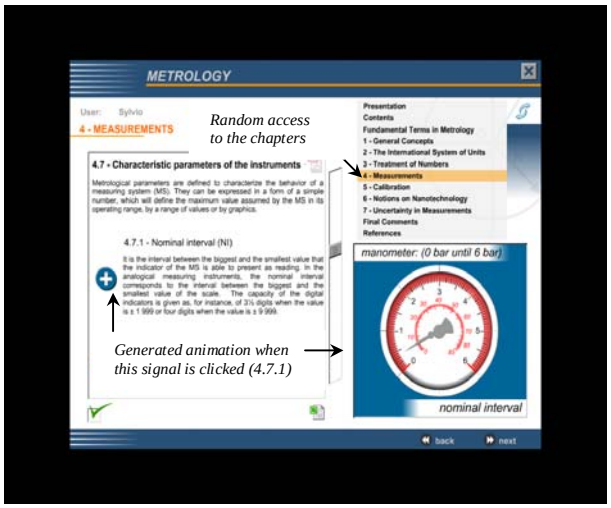

Figure 3 – Random access to chapters and animation generation

All the topics covered in the chapters contain a short description of the proposed subject, showed in the main screen. These descriptions can be more detailed if the files with *pdf* extensions, located in the right side of each item of the selected chapter, are opened. The entire course is also available in the *pdf* extension and its access is immediate, should anyone need, in the first screen of the course. This *pdf* file contains all the information presented and it can be printed out as a supporting material to the traditional way of teaching, if necessary (Figure 4).

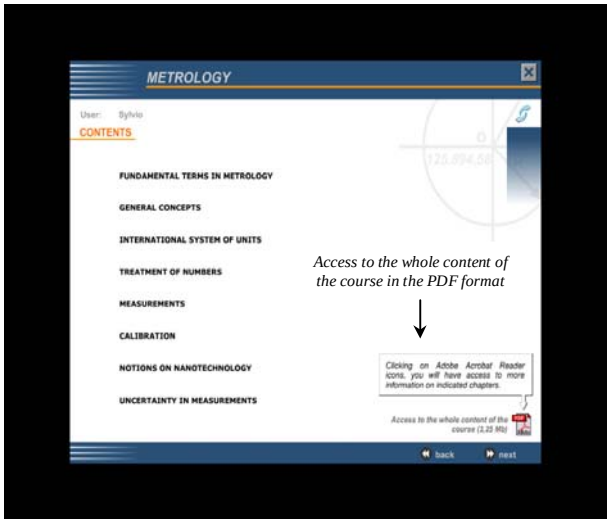

Figure 4 – Icon to access the files with "pdf" extensions

In addition to that, in some chapters, there are proposed exercises elaborated to be used with Microsoft Excel® spreadsheets. They are located in the lower right part of the monitor.

The proposed exercises are already solved and aim to aid the user to comprehend and solve similar problems.

Some cells, in red font, can be altered. By doing so, the user will notice what will happen to the system when some or all the entering data are altered (Figure 5).

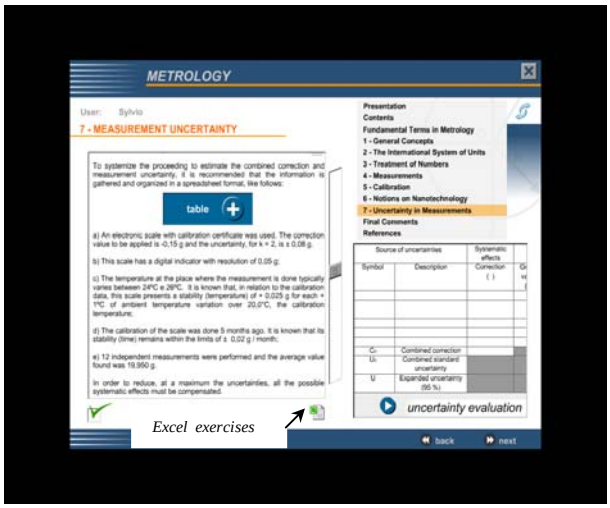

Figure 5 – Icon to access the Excel interactive exercises

5. CONCLUSION

Despite having no intention of replacing traditional classes, this project aims, nevertheless, to become an excellent alternative in complementing the traditional way of teaching in an innovative and stimulating manner. At the end of this interactive course it is expected that the user will be able, for instance:

- to properly utilize metrological terminology;
- to be aware and give preference to the units of the International System;
- to correctly accomplish number treatments and mathematic operations;
- to be able to understand different types of measurements and its errors;
- to know how to use results of calibrations;
- to classify types of errors;
- to estimate uncertainties in measurements and calibrations.

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