11, 12 y 13 de Julho
Guimarães
Portugal

seminário anual de automação, eletrónica industrial e instrumentação

- **Início**
- **En español**

- **Mensagens**
- **Comités**
- **Revisores**
- **Patrocinadores**

- **Keynotes**
- **Mesa Redonda**
- **Áreas Temáticas**

- **Autores**

- **Ajuda**
- **Info**

About this proceedings

The CD / DVD / Memory Stick you are browsing was generated by means of the IES WIC Program Chair Tool system (PCT).

The PCT helps the program chair/s in the tasks of:

- placing sessions, panels, keynotes, reunions and tutorials
- allocating papers in oral, dialogue and poster sessions
- automaticaly generating an abstracts book and a conference guide
- automaticaly generating the proceedings CD / DVD / USB stick
- automaticaly generating helping documents, as door signs, check list for chairs, etc...
- automaticaly generating the files to be submitted to IEEE Xplore

Technical Help

This tool is mainly developed by Prof. Andrés A. Nogueiras Meléndez, of the University of Vigo, with the help and assistance of all the IEEE IES WIC members.

For technical help please contact:
Prof. Andrés A. Nogueiras Meléndez
Electronic Technology Department - University of Vigo - Vigo, Spain
Phone:
Fax: +34 986 811 987
Email: aaugusto at uvigo dot es

W3C HTML 4.01 | W3C CSS | OPENSUSE | APACHE | DB MYSQL | PHP POWERED | PDF

Development and evolution of materials for e-learning courses in Industrial Communications

Nuria Oliva, Elio Sancristobal, Francisco Mur, Gabriel Diaz, Manuel Castro

Electrical and Computer Engineering Department
UNED
Madrid, Spain
[noliva, elio, gdiaz, mcastro]@ieec.uned.es

Perfecto Mariño[1], Miguel Ángel Domínguez[1], Ricardo Mayo[2], Victor Sempere[3], Javier Sivestre[3], Pep Fuertes[4], Pau Marti[4], Jose Yepez[4]
University of Vigo[1], University of Oviedo[2], Polytechnic University of Valencia[3], Polytechnic University of Catalunya[4]
Spain
[pmarino, mdgomez]@uvigo.es, rmayo@uniovi.es, vsempere@dcom.upv.es, silbla@disca.upv.es, [Josep.M.Fuertes, pau.marti, jose.yepez]@upc.edu

Abstract— **This paper presents the development of materials for the teaching of e-learning subjects in Industrial Communications, firstly within the career of Industrial Engineering and the evolution of these materials with goals oriented to the new Degree and Master within official European Higher Education System (EHEA). These materials are based on two books covering all contents from the basics of communications to specific systems of industrial communication and on OCW materials in UNED OCW Portal. Recently we have incorporated an online application for continuous evaluation.**

Keywords: Industrial Communications, European Higher Education System, OCW, e-learning, continuous evaluation.

I. INTRODUCTION

There are two books about industrial application of communications, ***Industrial Communications: Basic Principles*** [1], and ***Industrial Communications: Distributed Systems and Applications*** [2], published in UNED Editorial, as a contribution from a group of professors from five Spanish Public Universities (Spanish University for Distance Education, Polytechnic University of Valencia, Polytechnic University of Catalunya, University of Vigo and University of Oviedo) coordinated by UNED with experience in collaborative to provide the most advanced knowledge within a profession in which, so far, communication has been one of the less developed areas. Both books have a common goal, cover the topics of industrial communications in a complementary way.

Industrial Communications are a booming area in the wide world of communications because they join in the same environment two important worlds: business issues and more specifically, issues related to the manufacturing industry and communications as full support for technology implementation within the companies.

These books, following the format of UNED Didactic Units were developed as the first serious and advanced material in the area of industrial communication in Spain.

A workgroup of professors from five Spanish public Universities worked together to prepare the books, because they are the most advanced groups in introducing these topics in educational curricula of Industrial Engineering as well as those with more experience in several research in this area. The coordination of the work was performed by UNED group, using the most advanced collaborative telematic and workgroup techniques to get a very well organized and integrated material.

Within the UNED, these Didactic Units were developed for two subjects in two different programs:

- Industrial Communications: in the fifth year of Industrial Engineering (five year program)

- Industrial Communications Networks: in the third year of Industrial Electronic Engineering (in a three year program)

The design of both books has been done considering the specific needs of each of the two courses and degrees, so that each student can find the specific material for different profile in each case. Those books are the first specialized books on those topics and fields in Spanish. Besides, this material can be used in future studies of Master and Degree in Industrial Engineering in new EHEA with minor adaptations.

II. TRADITIONAL MATERIAL: BOOKS

The first book, **Industrial Communications: Basic Principles** goal is to provide the reader the background needed to understand, learn and assimilate the communications, from the basics of analog and digital communications, encoding techniques, ways of transmission, protocols and standards, components and elements of local area networks, wide area networks and wireless networks, without forgetting safety. This first book builds a bridge to the second, establishing the

principles of industrial communications, real-time systems, fieldbuses and distributed systems.

This first book can be considered divided into the following main parts:

- Presentation of basic communication concepts: first four chapters of the book, introducing the basics of communication, data transmission and encoding techniques, protocols and models, with special attention to OSI and TCP/IP, describing the ways of transmission and concepts of multiplexing and modulation. Finally it covers all aspects related to media access.

- Networks: The next three chapters focus on the description of the networks present in industrial environments: local area networks, wide area networks, IP networks and wireless and mobile networks. It describes the general characteristics, topologies, transmission media, models and standards and devices on the networks. For each type of network, concepts about the applications in industrial environments are introduced: fieldbuses, backup and storage networks, etc.

- Safety and Quality of Service: Chapter eight is dedicated to study the security problems distinguishing between problems due to networks, operating systems, applications and communications devices. After analyzing these problems, the chapter presents the methods of defense, security policies, cryptography and cryptographic defense and security industry protocols. The chapter concludes by developing the concept of Quality of Service in networks, focusing on the importance of routers as a critical element.

- Industrial Communications, Real-Time Systems and Fieldbus: The last two chapters of the first book present the basic concepts developed in the second volume: differential characteristics of communication networks in industrial environments, messaging, scheduling policies, priorities, distributed systems and a first approach to fieldbuses.

The second book, **Industrial Communications: Distributed Systems and Applications**, presents a more applied point of view for a reader already "introduced" in communications, but interested in the world of Industrial Communications.

The second book has the following structure:

- Common concepts in industrial communications: As in the first volume, the first three chapters of this second introduces basic concepts of industrial processes, real-time systems, distributed systems and networks, models and standards that apply in industrial communications and, more specifically, on the fieldbuses.

- Fieldbus and Industrial Communications Networks more extended: The next six chapters describe fieldbuses and communication networks present in

industrial environments: PROFIBUS, WORLDFIP, CAN, buses and protocols used in building automation, Industrial Ethernet, distributed systems with sensors, actuators and SCADA systems and some of the physical links for connecting peripherals and computers to control and supervision functions.

- Other fieldbuses and communication applications and industrial control: the book ends with a chapter detailing the most important features of other fieldbuses and their applications in various industrial environments.

III. METHODOLOGY FOR DEVELOPING BOOKS

For developing the books we have always followed the methodological guidelines and recommendations for developing IUED basic texts [3].

In this context, each chapter maintains the following structure:

- Introduction and orientation to the study: This section introduces the chapter with the general ideas that will be developed and enshrines the chapter in the context of the book, relating it to other chapters or themes already considered or to be developed in later chapters. It also remarks important ideas for studying the concepts that compose the chapter.

- Objectives: Condenses the specific learning objectives that are intended to transmit in the chapter. It guides the student both on the objectives of the chapter, and on learning outcomes to be achieved.

- Concepts parts: These are the sections in which professors develop the contents of the chapter. They consist of subsections in which they develop different levels of detail of the content presented. Resources are accompanied by graphics and images (Figure 1.a.), graphs and tables (Figure 1.b., etc.) and helping elements, such as equations (Figure 2.a.) schemes (Figure 2.b.), etc.

- Conclusions: It contains a summary of the key aspects discussed in the chapter.

- Bibliography: List any books considered interesting for students to deepen the study of a topic.

- Evaluation: Each chapter has included a series of self-assessment questions, whose solutions have been collected in an Appendix at the end of each book. In many of the chapters also have interspersed various topics and exercises, both practical and theoretical, to help students to know their assimilation level in a structured way.
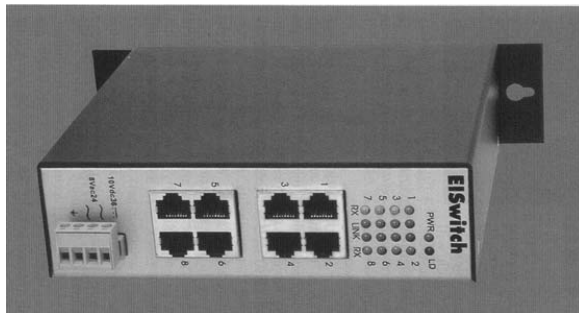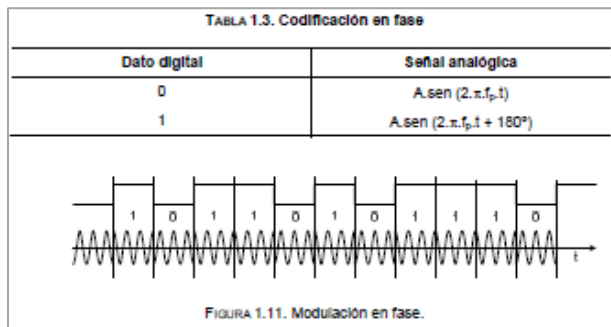
Figure 1a. Image

TABLA 1.3. Codificación en fase	
Dato digital	Señal analógica
0	A.sen (2.π.f$_p$.t)
1	A.sen (2.π.f$_p$.t + 180°)

FIGURA 1.11. Modulación en fase.

Figure 1b. Tables and Charts

$$\min T_{TR} = na \cdot (T_{TC} + high\ T_{MC}) + k \cdot low\ T_{MC} + mt \cdot RET\ T_{MC}$$

Figure 2a. Equations

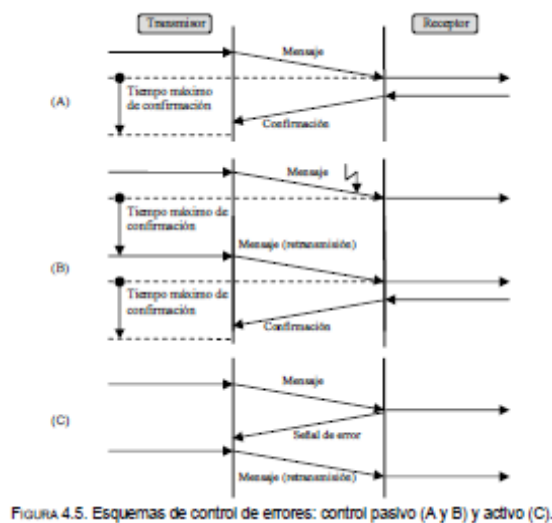FIGURA 4.5. Esquemas de control de errores: control pasivo (A y B) y activo (C).

Figure 2b. Schematic

IV. OCW

As a result of the first year of teaching the subjects mentioned in the Communication Networks in UNED, we have been developed as a supplement to Didactical Units, the first

OCW of UNED Industrial Engineering School, which is hosted on the UNED OCW server [4]:

http://ocw.innova.uned.es/ocwuniversia/ingenieria-industrial/redes-de-comunicaciones-industriales

The course published in the UNED OCW Portal, like all those published in this environment, is a course available to anyone who wants to form freely in this area of knowledge.

The OCW courses don't require any registration, are freely accessible, don't require payments and they haven't start and end date. But UNED don't recognize any type of qualification for these courses.

All courses published on UNED OCW Portal start from subjects in regulated courses, careers, masters and experts.

The professor group provides support material for the study of matter of interest to the student. Specifically, the OCW Communications Network was generated from the material originally used in the on-site tutorials given at the UNED Affiliated Centre of Madrid and it has been used as support material in online courses of the UNED subjects. So, this material have as added value, that are materials prepared specifically to assist UNED students in preparing and overcoming these subjects, providing guidance for monitoring and studying the books proposed as a basic text. But also allows to incorporate additional material year after year is giving to students, such as FAQs, proposals for widening, additional exercises, etc., all of them designed to facilitate the study of these matters, so that the user who access to OCW, in this case, has updated material used as support in the teaching of subjects in real time.

Open Course Ware is NOT a virtual campus or CMS which can take any study or degree but it's a tool that allows the free publication of material, so it's necessary to comment briefly how to manage copyright. The material in this course, like the rest of the materials published on the UNED OCW Portal, are under terms of a creative commons license [5], and can only be used for noncommercial purposes, and always provided that cite its source and its author.

V. ADAPTATION OF MATERIALS TO THE EHEA

For developing courses materials, teachers have worked on the adaptation of existing materials and media in the traditional UNED methodology, to task-based environments and competences acquisition, in accordance with the EHEA methodology.

A. Adaptation of books to EHEA

The workflow model for the design of teaching materials in the environment EHEA is shown in Figure 3.

The model in Figure 3 is a flow chart with three main phases: Analysis, Design and Evaluation.

- Analysis: Professional context must be considered. The contents must be determined by the professional environment in which students will have to apply the knowledge, skills and competences acquired upon completion of the study subjects. There may be several possible professional environments, but it is important

to identify and develop courses to prepare students for most common environments. Once defined and identified the professional environment, the skills that are necessary to meet the demands of that environment must be identified. After that it's important to define the objectives of the training aims to help students to acquire the competencies identified, enabling them to develop their job correctly in the professional environment defined.

This is not a recapitulation of knowledge to acquire, we try to include complex cognitive skills such as analysis, synthesis and evaluation, or even organizational skills and critical thinking. It must be defined five to ten learning goals that are neither too broad nor too detailed.

Finally, the learning outcomes must be defined. The fundamental difference between Objectives and Learning Outcomes, is at the specification level. Learning Outcomes should be brief but clear and must define the specific results expected from students. For further evaluation to be effective, the Learning Outcomes should be clearly articulated before deciding on methods and measures to apply. The Learning Outcomes must specify the behavior that will serve as proof that the learning objective has been achieved.

Learning outcomes are described in terms of what skills, knowledge and skills a student must show in each defined context.

Figure 3. Workflow Model for EHEA material design

The basic texts presented in this paper have already considered these factors, so it is not necessary to review the analysis phase, at least from a conceptual point of view, although it may require some corrections in writing any section.

- Design: The Learning Outcomes that have been included in the analysis phase, really serve as a bridge between this phase and the rest.

  Learning Outcomes guide to the teacher toward the kind of learning activities that should be considered to obtain the results, and evaluation forms that allows to prove the assimilation of concepts, providing the necessary consistency between outcomes, activities and evaluation procedures.

  The tasks should be designed to help students achieve the learning outcomes defined. Correct task design must consider:

  o Design tasks with "real" application in the professional context.

  o Gradually increasing the complexity of the task.

  o Propose different types of activities and tasks to increase knowledge transfer.

  o Training routines necessary for the resolution of problems.

  o Gradual reduction in support provided to students as it is completing the task.

  o Promote self-directed learning.

  o Provide feedback mechanisms to inform the student of evolution in real time.

At this stage, the basic texts require more adjustments. Although there are theoretical development exercises and various theoretical schemes with implementation proposals, the practical part is underdeveloped. However, the group of teachers who worked in the basic texts is currently preparing to adapt practices in on-site labs and e-labs.

- Evaluation: After designing the tasks, activities to measure skills acquired by students must be developed. The main characteristics of this type of evaluation methodologies are:

  o Evaluation of reality.

  o Consistency between learning outcomes and assessment activities.

  o Use of reliable assessment tools.

  o Consistent scoring criteria.

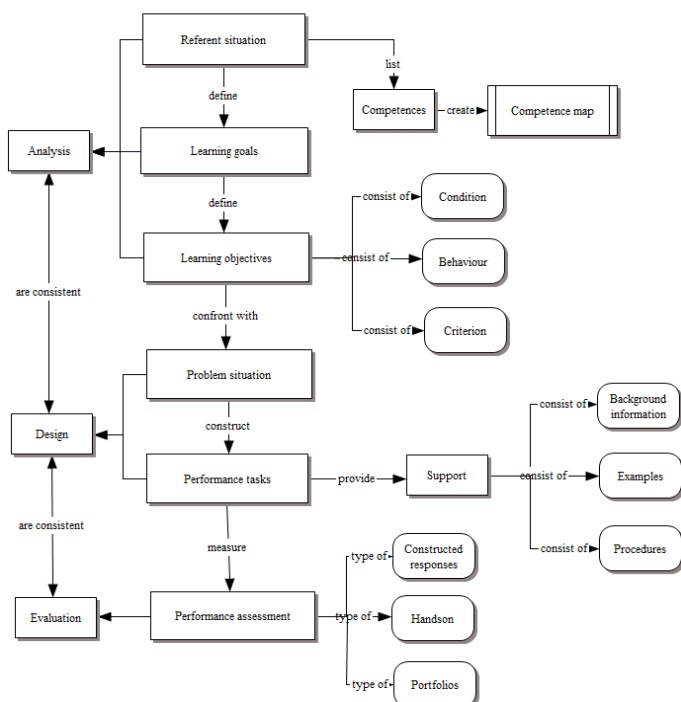 o Define whether the individual score for each activity or global task.

The assessment designed for the basic texts and incorporated at the end of each chapter, meets these characteristics and it is consistent with the final evaluation of

the subject for UNED students. However, an on-line application for self-assessment has been developed recently.

B. OCW Adaptations to EHEA

As indicated before, OCW material is generated from the basic texts, so it is necessary introduce same adaptations mentioned for these, but with some differences because the OCW student's objective is not the same as a student from a university degree course. In this sense, now in the OCW sections are not incorporated any assessment method, it is not the purpose of the course to overcome any final test to demonstrate the acquisition of knowledge and skills and, therefore, it is not considered interesting its inclusion.

For next course OCW material will be updated with new entries as:

- Fundamentals on Real Time Systems.
- Programming on Real Time Systems.
- Real time Java as an open programming system.
- Domotic, Inmotic and Digital Home:
    o Zigbee, X10, etc.
    o Connecting systems and communications for Digital Home
    o Network Protocols applied to Digital Home: USB, Ethernet, TCP/IP, WiFi, Bluetooth.
    o Audio and video protocolos applied to Digital Home: HAVI, MHP, MPEG.

New entries are being prepared at this moment by the same professor groups that are writing new books, so OCW contents will be coherent with new material and, in this way, OCW can be considered as additional material for new degree students.

VI. New Developments

Currently, advances in communication and computer networks and the evolution of programming languages have promoted the development of new e-learning material and tools. As a consequence, students and teachers are able to work more collaboratively, establishing a more meaningful dialogue. This new learning process helps the students to progress and eases to diminish the workload of teachers.

In this context, UNED teachers group has developed a self-assessment on-line application.

The new tool offers instant feedback for any new formative assessment. The feedback for each question is pre-loaded and the student gets an explanation, or a clue, on how to improve his own learning process. Besides, the tool allows getting information of the students' performance. This ensures effective monitoring of the students progress.

Students can choose between answering questions of each chapter or between simulate an exam. Teachers introduce questions in application from past courses real exams. So, students have similar questions as they will find in their own exams and this is the real added value of the application because, every year it will be updated with real exams questions and students always know the level that is required in the subjects.

Besides this, application incorporates statistics that can help teachers to evaluate the difficult of the questions and, consequently, improve teaching and materials in those areas that students get worst results.

The goal of the tool is to ensure a more effective dialogue between the teachers and students through constructive, continuous feedback. The tool must place the students at the heart of their own assessment process. They will be then aware of which level they are working at and will be able to identify which steps they need to take to reach the next level.

VII. Conclusions

Finally, note again that these materials are the first methodological approach to one of the most recent and advanced engineering area, Industrial Communications, presenting as an effort for its realization the joint collaboration of five Spanish public Universities. We consider that the results mark a milestone in the teaching materials in this area.

Besides, as most of the material that is developed within the teaching profession is in constant evolution, adapting and improving processes that will result in the main objective of equipping students for new materials that help them acquire knowledge and skills needed in later professional life.

References

[1] Castro M. y otros. Comunicaciones Industriales. Principios Básicos. Ed. UNED, Madrid, 2007.

[2] Castro M. y otros. Comunicaciones Industriales. Sistemas Distribuidos y Aplicaciones. Ed. UNED, Madrid, 2007.

[3] Instituto Universitario de Educación a Distancia, IUED UNED. http://portal.uned.es/portal/page?_pageid=93,489793,93_20500245&_dad=portal&_schema=PORTAL. Accessed on 15th, January, 2012.

[4] UNED OCW Portal course "Industrial Comunications Networks". http://ocw.innova.uned.es/ocwuniversia/ingenieria-industrial/redes-de-comunicaciones-industriales. Accessed on 5th, May, 2012.

[5] Licencia Creativa Commons. http://creativecommons.org/licenses/by-nc-nd/2.5/es/. Accessed on 15th, January, 2012.