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AN OPEN AND DISTANCE LEARNING APPROACH TO AN ELECTROMAGNETIC INTERFERENCE AND COMPATIBILITY COURSE FOR UNIVERSITY-INDUSTRY PARTNERSHIP IN ROMANIA

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Abstract: The paper presents the preliminary results of the research and the study devoted to exploring the methodology for the design of an Open and Distance Learning (ODL) course on Electro-Magnetic Compatibility (EMC) and Interference

In the context of the introducing an ODL system for Continuing Engineering Education in Romania. General Association of Engineers from Romania (AGIR), in cooperation with the Iasi Polytechnic "Gh Asachi" University and the Romanian Academy--Iasi Branch (the Institute for Theoretical Informatics. Iasi) proposed to the Romanian Government. represented by the Ministry of Education, the creation of the Iasi Regional Centre for Distance Education (CRED-I) which has objectives design and launchement of distance learning programs for CEE. as well as research and development in Distance Education

After the presentation of the research study context the basic concepts of EMC are explained Course description and methodology are outlined by considering the process of individual learning A special section of the paper advocate in favour of the process of autonomous learning by using visual capabilities of the computers The advantages of the Interactive Multi-Media Computer Systems are analized Principles of the contemporary cognitive learning theory are considered. An approach for designing and producing Open and Distance Learning materials. based on the Gagne's principles of instructional design. is proposed

Paper ends with CRED-I management activities to be improved in order to develop multimedia courses including ODL on EMC course

Preliminary results were used to fundament the Project which describes CEE by using ODL system The authors and their institutions and organizations hope that until December 1994 the CRED-I will be financed both from PHARE and from governmental sources

INTRODUCTION:

In Romania today, as in other Eastern and Central European post-communist countries, the transition process towards a market economy is difficult because of lack of: experience, know-how, expertise, and education. In the industrial sector, especially, engineers must be prepared to work and to act in different conditions than in a command economy. The society itself needs new infrastructures, especially in modern communication and information processing technologies, based on modern technologies, including computers. In order to ensure the economical relaunchment, the source of social welfare, the post-communist societies need transfer of technology, i.e. technological education. In other words, Continuing Engineering Education (CEE) by using Open and Distance (ODL) systems is able to and has to contribute to the success of the socio-economic reform, now taking place in Romania. PHARE funds and Romanian governmental funds will be very useful to cover some of the higher costs to start this important activity, so necessary in the context of the European integration.

The proposal made to the Romanian Government, especially to the Romanian Ministry of Education, by the General Association of Engineers from Romania (AGIR), in cooperation with the Iasi Polytechnic "Gh. Asachi" University and the Romanian Academy--Iasi Branch (including the Institute for Theoretical Informatics), to start the CEE Process by using an ODL system seems to be successful. Based on the previous experience of: the Iasi Polytechnic "Gh. Asachi" University, the Institute for Theoretical Informatics (the Romanian Academy--Iasi Branch), and the Iasi National Institute of Inventics, a Regional Center for Distance Education (CRED-I) will start its activity very soon.

The activity of the newly created organization will be in: Research, Development, and Production of ODL materials for CEE in Romania, under the authority of both Romanian Ministry of Education and Romanian Association of Professional Engineers (AGIR, General Association of Engineers from Romania).

CRED-I will run the following activities:

- designing and arranging distance learning programs;
- production of teaching materials;
- research and development in distance education;
- training and consulting services;
- information services.

The CRED-I educational publications will include: textbooks, other written materials, audio- and video- materials, as well as Computer-Aided Learning and Instruction materials.

This paper will present, to the audience of the 3rd World-Congress on Engineering Education, Cairo, November 14-18, 1994, having the theme: "Quality of Engineering Education: An International Perspective", the preliminary results of the research devoted to methodological aspects of the design of an ODL course in "Electro-Magnetic Compatibility (EMC) and Interference" to be produced inside of an CEE University-Industry partnership program.

In fact, in the framework of a national and international cooperation, the objective of the research activity is to evaluate the Computer-Aided Learning and Instruction methodology to be used in Autonomous Learning to increase quality and efficiency of the knowledge transfer in an electrical engineering subject: Electro-Magnetic Compatibility.

The presentation starts with the introducing the research study. Then, the basic concepts of EMC and Interference are explained, EMC being an important subject of the contemporary electrical engineering profession. Course description and teaching methodology are showed, covering the entire material of the EMC topic and ensuring the efficiency of the knowledge transfer process inside student's individual learning activity.

A special section of the paper advocate in favour of teaching/learning by using visual capabilities of computer. Computer simulations are very useful for: animated graphics phenomena, visualization of abstract and highly mathematical subjects, simulating laboratory experiments.

By considering principles of contemporary cognitive learning theory, the advantages of the Interactive Multi-Media Computer Systems (IMMCS) are analyzed. An approach based on the Gagne's principles of instructional design is proposed to be used in realizing Open and Distance Education (ODE) materials.

Paper ends with proposed CRED-I management activities to develop a multimedia (ODL for CEE) course on EMC.

IMPORTANCE OF THE RESEARCH STUDY:

The entry into force of the EEC Directive 336/89 on the electro- magnetic compatibility on 1 January 1992 gave a big boost to regulatory activity within the context of national and European markets. An amending directive, published in April '92, extends the transitional period for implementation from 1.01.1993 onwards. Many manufacturers and users of electrical and electronic equipment are now faced with legal obligations in a field where their previous interest may have been only peripheral. To place their products on the market or to take equipment into service, certain actions must be taken in respect of design, construction, manufacture, certification and installation in order to satisfy the minimum market entry requirements.

In the process of transition towards a market economy, Romania must reconsider the engineering education process in order to produce a new type of engineer with new skills and attitudes. They should understand the inter-relationship between various engineering fields; principles of scientific investigation and methodology of engineering design should be well mastered. So, the use of computer in engineering education is a must.

In order to promote the application of Computer-Assisted Instruction and evaluate the impact of adequate courseware on various fields of engineering education, Iasi Polytechnic "Gh. Asachi" University (including Faculty of Electrical Engineering) established since 1990 a dedicated framework of co-operation with: the Institute of Computer Science (Romanian Academy, Iasi Branch), the International Center for Engineering Education

(ICEE, Iasi), the Center of Fuzzy Systems and Artificial Intelligence, and the RENEL (Romanian Electric Network)-Iasi Centre for Continuing Professional Development. An important support, including 12 PCs donation from the Swiss Federal Institute of Technology Lausanne, Switzerland, is provided by the Computer Science (Laboratory for Computer-Aided Learning) and Electrical Engineering Departments.

Initiated research activity is to find better methods to develop CAL (Computer-Aided Learning) programs with a special emphasis on simulation and exercising activities in EMC. Tools and methods for knowledge-based authoring facility in the particular development of an interactive and multi-media courseware in EMC are explored.

ELECTRO-MAGNETIC INTERFERENCE AND COMPATIBILITY. BASIC CONCEPTS:

Electromagnetic interference (EMI) is defined to exist when undesirable voltages or currents are present to influence adversely the performance of an electric/electronic circuit or system. Electro-magnetic compatibility (EMC) is the capability of the equipments or systems to be operated in their intended operational environment at designed levels of efficiency without causing or receiving degradation owing to unintentional EMI. EMC is the result of an engineering planning process applied during the life cycle of the equipment. The process applied during the life cycle of the equipment. The process involves careful considerations of frequency allocation, design, procurement, production, site selection, installation, operation, and maintenance.

The cause of an EMI problem is an unplanned coupling between a source and a receptor by means of metallic paths. Radiated interference occurs by means of near- and far- field coupling. The control of EMI is best achieved by applying good interference control principles during the design process: the selection of signal levels, impedance levels, frequencies, and circuit configurations that minimize conducted and radiated interference.

For optimum control, three major methods of EMI suppression should be incorporated early in the design process: grounding, shielding, and filtering. Grounding is the process of electrically establishing a low impedance path between two or more points in a system. Associated with grounding is bonding, which is the establishment of a low impedance path between two metal surfaces. Shielding is the process of confining radiated energy to the bounds of a specific volume or preventing radiated energy from reaching a specific volume. Filtering is the process of eliminating conducted interference by controlling the spectral content of the conducted path.

Lighting interactions with overhead wires such as power distribution lines are a major source of EMC problems, resulting in: inferior power quality, power outages, and damaged electronics.

EMC COURSE. DESCRIPTION AND METHODOLOGY:

The principle goal of an EMC course is to develop an awareness of how the fields constituting the electromagnetic environment arise and of the mechanisms by which these fields couple into the circuitry of an electrical system to give rise to EMI.

Considerable thought must be given to the topic organization so that the maximum amount of material can be covered and in the same time provide for maximum student retention of the material. An introduction to the topic of EMC concerns the various coupling mechanisms by which interference can be transferred-radiated and conducted emissions, and crosstalk. The important criterion of electrical dimensions of the system in wavelengths as opposed to physical dimensions is discussed so that the student is encouraged early on to view the problem in this important perspective. Virtually all EMC units are given in decibels as are test equipment inputs and their outputs as well as the regulatory limits are. So it is important that the student learn and master this language.

Motivation is an important factor in a student's retention of the material, and a student can readily appreciate the significance of not being able to sell his/her design in the marketplace unless it passes the EMC tests, regulations, and international requirements.

Also, the student must appreciate the non ideal behavior of passive and active components if he/she is to become effective in incorporate EMC in a design. The standard passive components (resistors, capacitors, inductors, common-mode chokes, ferrite beads, wires, and Printed Circuit Board (PCB) lands) are studied with respect to their frequency-dependent, non-ideal behavior.

The basic notions of the processing of signals by linear systems in both time- and frequency- domain must be reviewed. The fundamentals of electromagnetic field theory must be presented and firmly understood by the student in order to comprehend the mechanism of radiated and conducted emissions, as well as to discern how to control it. The Maxwell 's equations and the boundary conditions; uniform plane waves and the sinusoidal steady-state field equations must be exposed. The fundamentals of antennas (the elementary or Hertzian dipole, the half-wave dipole, biconical, and log-periodic antennas which is used as measurement antennas; antenna-factor) must be also argued.

A means of predicting the radiated electric fields: the Friis transmission equation must be explored. Current numerical techniques such as the method of moments (MOM) provide one with the ability to analyse complicated radiating structures.

The most important aspect in understanding the radiation potential of currents is to be able to view those currents as being composed of differential- and common- mode components. The susceptibility of circuits to radiated emissions is important to determine in order to guarantee the functional performance of the product in noisy environments. The blockage of the conducted emissions is a matter of properly constructing an adequate power- line filter to be placed at the point where the a.c. power cord exits the product. The design of the power supply filter is an important consideration; there are specific configurations currently used.

The switching power supply should be discussed with a view toward reducing the conducted emission through component selection and snubber circuits. Also LISN (Line Impedance Stabilization Network) must be exposed. Because of the increasing spectral content of digital circuits, signals couple via crosstalk with increasing efficiency, the student must know those terms.

The basics of shielding theory must be presented. There are a large number of products where tightly shielded enclosures can be used to contain radiated emissions. Even in these products, any cable that exits this shield must be properly filtered or else currents on that cable will radiate internal signals causing the shield to be ineffective.

The topic of Electrostatic Discharge (ESD) is becoming an increasingly important part of digital circuit design due to the increasing vulnerability of integrated circuits to electromagnetic fields caused by discharges due to static charge buildups or the personnel using that product.

System configuration (effects of: inductance of conductors and decoupling) such as: card placement and layout, line filter placement, cable routing, etc. are an automatic part of the design process and are critical to the EMC performance of the product.

TEACHING/LEARNING USING VISUAL CAPABILITIES OF COMPUTERS:

The computational and graphics capabilities of modern computers provide invaluable learning aids for students in fields area courses by permitting a simultaneous complementary approach to the traditional purely analytical one. So, abstract mathematics no longer need be the sole method of analysis in electromagnetism. By using computer technology, disciplines as: numerical analysis, algorithm development, programming, and similar areas can become productive contributors to the discipline of electromagnetism as well. Animated graphics of dynamic phenomena, visualization of abstract and highly mathematical subjects, and the ability to mimic often unavailable and expressive laboratory experiments are among the benefits of computer-based engineering education.

There are two complementary options for computer simulations: the generated-solution mode and the stored-solution mode (each of which might employ a combination of still graphics and animated sequences). The real-time (generated-solution) mode is preferable if the time needed for the system to respond is short enough to constitute an interactive environment in which the user could change parameters used in the computational model and see those changes reflected in the display in an acceptable amount of time (maximum a minute). There should be a minimum of constraints on the values of the parameters, thus permitting the user to closely simulate the phenomenon and to experience the greatest degree of interactivity. For solutions and graphical displays that cannot be achieved in real time, the stored-solution mode is used. Through media such as laser video disks, this mode can be made very interactive.

There are three fundamental components of a simulation: i) the numerical model that generates the results; ii) the storage and display hardware used for the results; iii) the user interface to the results.

By using the interactive and multi-media technology in teaching/learning EMC there are at least four main advantages: 1) development of physical pictures and a good intuitive understanding of field and wave phenomena; 2) development of the ability to use the most important analytical tools for solution of problems in electromagnetism; 3) development of an understanding of the role of numerical techniques as these become increasingly important; 4) presentation of practical problems from a variety of situations of EMC discipline.

ROLE OF INTERACTIVE AND MULTIMEDIA EDUCATIONAL TECHNOLOGY IN THE CONTEXT OF THE COMPLEXITY OF INFORMATION ENVIRONMENTS:

Today, it seems that new advance in technology centers around new ways to store, retrieve, and transmit information. The collection of ways that we communicate is called media. Educational institutions use it to teach and simulate. Training professionals and information specialists have long understood the value of media to help gain and maintain attention, as well to deliver content.

Interactive multimedia computer systems (IMMCS) can be defined as the integration of text, audio, graphics, still image and moving pictures into a single, computer-controlled, multi-media product.

The process of learning is permanent (not intermittent), is holistic (not segmented), is problem-centered and context-related and includes all members of the engineering profession (teachers, researchers, students, etc.). The Learning Technology is considered as a flexible, information, communication instrument controlled both by learners and teachers to assist students to increase the levels of competence and knowledge required in their work. The true place of Learning Technology in the 1990's is to be found as an indispensable learning support to the new revolutionary learning organization culture.

IMMCS consider that learning is an activity which take place in the learner. In the future, numerous design issues need resolving: 1) what authoring principles and methods work; 2) how misconceptions can be corrected and feedback provided; 3) how assignments can be created; 4) how the needed self-regulation can be developed in learners; 5) how both the materials and learning can be evaluated; 6) how links can be created and managed; 7) how assistance can be provided; 8) how the learner can be prevented from feeling lost.

The goals of using IMMCS for education should be focused on three primary principles of contemporary cognitive learning theory: 1) learning is a process of knowledge construction as opposed to knowledge absorption; 2) learning is knowledge- dependent, i.e., that people use existing knowledge upon which to build new knowledge; 3) learning is highly tuned to the situation in which it takes place.

The advantages of IMMCS make them into a vastly superior information technique compared with the educational tradition. There are two main players: the sender (teacher, tutor) and the receiver (student, learner). From the viewpoint of the sender, the effects of the latent information content on the receiver depends on: previous knowledge, goals, emotional needs and degree of emotional maturity, intelligence, and educational level. From the viewpoint of the receiver, he/she has to develop a well- defined value hierarchy (with the help of the tutor) sufficiently gradual to continue interaction and thus build up the internal complexity necessary to reduce the complexity of the information environment.

An approach to the delivery of instruction by using IMMCS is based on the following events of instruction (Gagne, 1992): 1) gain attention; 2) describe the goal; 3) stimulate recall of the prior knowledge; 4) present the material to be learned; 5) give learning guidance; 6) elicit performance; 7) provide feedback; 8) assess performance; 9) enhance retention and transfer. These elements determine the quality of the instruction that is designed. In conclusion, by considering different kinds of educational contexts and objectives (informational, practical, cognitive, social and attitudinal), IMMCS will become more effective developing human qualities such as: the ability to take initiatives; engage bin abstract thinking; work in a team; self-learning competency.

DEVELOPING MULTIMEDIA COURSE IN EMC:

Computer-Aided Learning is both a scientific and an engineering disciplines containing five main components: 1) methodology; 2) theory of human-computer interaction; 3) simulation and modelling methods; 4) development of dedicated hardware; 5) application of data-bases and knowledge-bases.

The management activities to develop a multi-media course in EMC must considered: learning styles, learning environments, and instructional activities. There are four management arrays through five project phases (analysis, design, production, implementation, evaluation): 1) planning (arrange conditions and prepare plans for project activities); 2) controlling (deliver communications among team members and outside people); 3) communicating (stimulate, monitor, criticize, and modify project activities); 4) documenting (document materials and products).

CONCLUSIONS:

The development of ODL materials for Continuing Professional Development of Engineers in Romania will have an increasing impact on the national scene of Engineering Education. Certainly, CEE will mainly benefit from the increasing interaction between Academia/University and Industry.

The research and development of ODL materials devoted to the development of human resources and human potential will accelerate the process of transfer of up-to-date technology, if new information and communication technologies are introduced in order to enhance Independent/Autonomous Learning in the context of ODL system for CEE to be introduced in Romania.

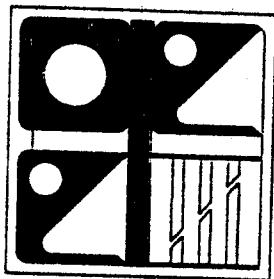
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Quality of Engineering Education ***"An International Perspective"***



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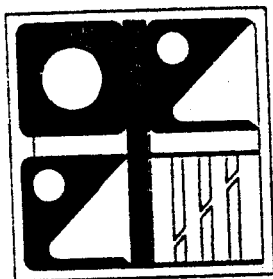
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