MIKLÓS ZRÍNYI NATIONAL DEFENSE UNIVERSITY
JÁNOS BOLYAI MILITARY TECHNICAL FACULTY
PhD INSTITUTE IN MILITARY TECHNOLOGY

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Some specialities of educating the required electrical knowledge for the operation of complex electric systems of military use, in particular aspect of the Digital electronics subject

titled PhD dissertation
author's review

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1. Drafting the scientific problem

In the HD, the preparation for tools belonging to the category of complex electric system operation is fulfilled by the education in MZNDU János Bolyai Military Technician Faculty. Currently, students graduating as an electrical engineer (but this will have been changed to military engineer by 2008) get close to the assignment mentioned above. In both forms of study the preparation is done with the same tools in short-term, yet the training structure and the curriculum content are different.

In the HD, troops use different generations (and technical advanced states) of complex electric devices for solving their tasks. These devices contain both analog and digital circuits in various ratios. There are some devices having analog computers and non-integrated transistor circuits, and others that have the latest technology of analog and digital integrated circuits. So the Analog and Digital electronics subjects have a strong impact on the preparement for the assignment.

MZNDU is the part of the elemental Hungarian higher-education system, so the training being held here is to match the requirements of social and military professional. The education has a speciality which greatly differs from the similar profiled civilian higher-educational institutions. While the civilian higher-educational institutions do a very deep preparation job and outputs well trained engineers within a certain profession, the civilian young technician get a grace period by their first employers to get learnt for their scope of activities, whereas they don't need to make any decisions at this time. The engineer officers being trained by MZNDU are to be able to perform their jobs by applying military devices that have been entrusted to them similar to war situations, making liable decisions and leading people while being liable for people's lives at their first real assignment. An engineer officer controls and leads complex organizations, uses high-complicated technical equipment, trains and prepares people for a battle while practicing their career. The practice-oriented preparation for this makes the participants of the education an increased responsibility.

The educational task of Electric and Scientific Grounding Department also conduces to this practical preparation. This kind of activity is brought to reality by homework and lab measurements.

2. Research objectives

1. I will analyze the 50-year preparation for complex military electric systems operation in curriculum level, and will define the preparation for the latest knowledge structure.
2. I will define the optimal order for the subjects being taught by Miklós Zrínyi National Defense University János Bolyai Miliatry Electric and Scientific Grounding Department by using macro-coordination analysis.
3. I will perform the selection and optimal arrangement of Digital electronics subject by using micro-coordination analysis.
4. I will present the usage of simulation programs in educating Digital electronics subject.
5. I will analyze the lab exercises being held by our Department in a professional-didactical way in order to be more efficient and successful, and will work out the improved methods of planning and transaction of the lab measurement exercises.

3. Research methods

To complete the research objectives, I used the following research methods:

- studied the literature connected to the topic,
- for accomplishing this, I resorted the libraries MZNDU, Budapest University of Technology and Economics (BUTE), National Educational Library and Museum (NELM), and the chances given by the Internet,
- oral professional conversations was made to teachers educating in military or civilian higher-educational institutions,
- analyzed the experiences of civilian higher-educational institutions which are related to my research,
- studied the lab measurement exercises in their content and methodical way at the same civilian higher-educational institutions.

4. Short description of the performed analysis

1. The tasks of electrical engineers capable of operating complex electric systems of military use

As a result of the accelerated scientific and technical development and our NATO integration new tasks have appeared and the high standard completion of these tasks greatly depends and is going to depend on the electrical engineer officers of the Hungarian Defence Forces and later in the future on the military engineer and security engineer officers. These officers are mainly involved in the optimal operation of the electronic and electrotechnical systems of the defence forces. The majority of engineer officers receive their degrees at the János Bolyai Military Technical Faculty of the Miklós Zrínyi National Defence University (MZNDU).

The objective of the military professional training of engineer officers is to produce engineer officers who possess a well-grounded knowledge of science, technology, security engineering, quality assurance, environmental protection as well as general and special military leadership skills and who are also familiar with the concrete practical methods and reproductive applications of the knowledge. After adequate practice these officers will be capable of independently completing the operational, maintenance and controlling tasks regarding the electronic and electrotechnical systems in service in the Hungarian Defence Forces and they will also be able to perform tasks in the field of military technical development and their first assignment in their respective specializations.

At the Military Technical faculty the engineering knowledge of our cadets is provided by the teaching of subjects belonging to the professional core material and also by the teaching of differential (military) professional subjects. The engineering knowledge attainable is at least equivalent to that of electrical engineers graduating from civilian higher educational institutions. There is, however, one basic difference: the electrical engineers produced by the Bolyai faculty receive a wider spectrum of training compared to those studying at civilian colleges of a similar profile. In the majority of colleges the training is more specialized i.e. of a narrow spectrum, which is due to their traditions and recently to the market demands. Both training structures have their advanteges. Considering the functions and objectives of the János Bolyai Military Technical Faculty of the MZNDU and the interests of the cadets, it is more expedient to provide a training of a wider spectrum, which encompasses the

requirements of the different engineering specializations. The electrical engineering graduates possess a well-grounded professional outlook and a wide-ranging, BSc level knowledge which is required for the solution of the practical problems that will arise in the future.

This teaching of a wide spectrum of knowledge has its difficulties from the point of view of the cadets, the teachers and the whole of the training system. In civilian higher education it is unimaginable to teach and satifactorily acquire simultaneously the knowlwedge of electrical engineering fields that are remote from each other. It is the task of the Electrical and Scientific Grounding Department to provide the required professional knowledge through the teaching of the professional core material.

2. Differential (military) professional knowledge

During the specialized training of engineer officers the acquisition of specialized electrical engineering knowledge is ensured by the teaching of those subjects which belong to the area of differential (military) professional knowledge. Hungary's NATO integration afffected officer training and education as well and its challenge is the most manifest in the above mentioned area. I would like to draw the attention to two problems in this area, which endanger academic standards:

- one of the problems is the **professionally unambitious** approach to teaching these subjects, according to which it suffices „to know how to turn on" a device. While teaching the new principles and devices that are already in service or are expected to be put in service in the Hungarian Defence Forces, the significant role the subjects belonging to differential (military) professional knowledge play in the acquisition of high standard engineering knowledge must not be forgotten.
- The availability of the necessary **computer technology** has to be provided and improved in order to assure high academic standards. The high standard teaching of the devices expected to be put in service and the theoretical knowledge connected to them, most importantly the teaching of Analogous Electronics and Digital Electronics , is unimaginable without an adequate background of computer technology.

3. Professional core material

The main goal of teaching the subjects belonging to this area is to provide a professional grounding for each of the specializations as well as teaching general electrical engineering knowledge and developing a modern engineering approach. The standard of the Bolyai Faculty's electrical engineering training is greatly determined by the curricculum and the standard of the instruction of the subjects belonging to professional core material. While teaching these subjects the acquisition of an electrical engineering basic knowledge that meets the requirements of the profession must be ensured (here there is an opportunity for comparison with the electrical engineering curricculum and knowledge taught in civilian colleges). Also it is this area where engineering students first learn the basics of thinking in engineering terms. This is why it is very important to establish a professionally and pedagogically well-grounded structure for the material of these subjects and the correlation between these subjects, as well as to apply the up-to-date principles of choosing the curriculum and **to design the structure of the curricculum and the correlation between the subjects on an exact mathematical basis.**

4. Some of the characteristic features of complex electric systems of military use

A basic electric standard (MSZ 1600) that was in effect until recently defined a complex electric device as follows: „an electric device is complex if it can neither be classified as a weak-current device nor as a heavy-current device". The majority of electrical engineers, and our graduates as well, are involved in operating and designing **complex appliances (systems).** When making decisions about whether the specifications regarding weak-current systems, heavy-current systems or both have to be complied with, in the case of complex systems there is a wide range of considerations in addition to finding a technologically and economically optimal solution. Each system requires the individual consideration of the possible faults, their destructive effect and the changes in the different electric, electronic, control technology and telecommunications parameters. The specifications regarding heavy-current appliances are usually stricter owing to the higher fault-power, the energy connected with failures and the more direct danger to life. The specifications regarding weak-current appliances are mainly aimed at the elimination of the various signal-distorting effects but the

specific requirements regarding electric shock protection have to be met in case of these appliances as well.[1]

Due to the development of **electronic subsystems** (analogous and digital circuits) more and more modern appliances are put in service in the Hungarian Defence Forces and thus the teaching of the theoretical and practical issues with regard to these appliances plays an increasingly important role in the electrical engineer training at the Bolyai Faculty. The clarification of the theory of digital systems and the evaluation of the operating parameters that are significant in practical applications require a very different approach as opposed to the approach common in the case of analogous systems which are still widely used. One of the consequences of the above is that some important changes will have to be made in the curricculum.

A typical example of the standard of the technical appliances that are in service in the Hungarian Defence Forces is that in the early 1990s 95 % of the then in service morally and technically obsolete locators were analogous thermionic valve appliances (40-42% originating from the 1950s and a further 42% from the 1960s), the average fault-free operating time of which is between 10-20 hours. Enormous development has since taken place in radar technology and in our days its most important characteristics are digital signal processing and the use of microwave semi conductors [2].

Computers play a significant role in the accelerated flow of information and in the processing of information and through this a new chapter is opened in human development. Information science has facilitated the qualitative leap in the cognition of the laws of nature and society. As a result of this the civilization based on classic mechanized industry is being replaced by a more highly developed technical civilization which is based on the intensive and extensive application of highly developed science. The age of a new type of society and production is emerging, which in technical literature is often referred to as the information age or the information society [3].

In the sphere of defence new and complex concepts have appeared as a result of the dechnical development, dramatically changing the military way of thinking. The most important of these concepts is C2W (Command Control Warfare), which has been in use since 1995. C2W means the integrated use of all military capabilities, supported by all forms of reconnaissance as well as signal and information systems.

In order to achieve information supremacy new concepts have appeared such as **Network Centric Warfare** (NCW), the essence of which is the effective connecting and networking of

geographically separated battlefield entities. The bandwidth available to the commanders of operations has gradually increased and is going to increase even further.

The infocommunication system of the Hungarian Defence Forces is developing more and more dynamically and it is working in close cooperation with the signal and informatics system of NATO. In order to ensure the effective operation of this system it is indispensible to provide high-level training for the personnel so that they become capable of using the state-of the-art infocommunication equipment. The army of the 21st century will be a digital army well-equipped with the most up-to-date electronic equipment and if need be, it will be able to operate in the digital battlefield applying Network Centric Warfare [4].

In the area of army unit signals the army will be prepared for mobile computer based Net Control Warfare and Net Command and Control (NCV/NC2) and for bringing into service software guided frequency jumping VHF radios. In the Hungarian Defence Forces the following multi-role tactical radio equipment, developed by the Norwegian Kongsberg Defence Communication, has been introduced and is now in service: the hand-held MH300, the portable MP300 and the vehicular MV300 radios.

The army of the 21st century will be characterized by the prevelance of electronic equipment and the application of the latest developments in electronics. All the branches of every one of the services use technical equipment based on the application of electricity and magnetism. The operation of some of this equipment (e.g. radars, signal equipments, radio-electronic reconnaissance and jamming devices etc.) is solely based on electromagnetism. The research, development manufacturing and operation of such equipment requires well-prepared experts with a high level of professional intelligence.

8. A list of my publications about the topics

Lectured journal articles:

1. Digital technology and experiences of the measuring workshop and the questions of its update development (Bolyai Szemle, 2002/4)
2. The selection of the curriculum, the description of professional-pedagogical methods of the subject development throughout the selection and the improvement of the material for teaching Digital technology (Bolyai Szemle, 2004/1)
3. The role of the geographical information system in the modern warfare (Bolyai Szemle, 2005/4)

4. The outline of the development of the electronics in science-measurement approximation (Bolyai Szemle, accepted for publication)
5. Simulation in teaching of Digital electronics (Bolyai Szemle, 2006/2)
6. The education questions concerning the operation of complex electric systems of military use (Bolyai Szemle, 2006/2)

College books

1. Technological drawing I.-II., III., IV. (MZMTC, 1973)
2. Elements of precision mechanics (MZMTC, 1975)
3. Radio technics V. (MZMTC, 1982)
4. Exercise book of figures (MZMTC, 1991)
5. Measurement instructions and minute-books for the measure lessons of Digital technics (JBMTC, 1988)
6. Study guide for the Digital technics for the students of security-technics engineer (JBMTC, 1999)
7. Study guide for the Digital technics for the students of correspondence electrical engineer, 4^{th} semester (JBMTC, 2000)
8. Study guide for the Digital technics for the students of correspondence electrical engineer, 5^{th} semester (JBMTC, 2000)
9. Digital technics I. for (correspondence) students of security-technics engineer (MZNDU JBMTC, 2000)
10. Digital technics III. (Microcomputers) (MZNDU JBMTC, 2000)
11. Digital technics II. for (correspondence) students of security-technics engineer (MZNDU JBMTC, 2001)
12. Digital technics III. for (correspondence) students of security-technics engineer (MZNDU JBMTC, 2001)
13. Digital technics I. for students of electrical and informatics engineer (MZNDU JBMTC, 2001)
14. Digital technics IV. for (correspondence) students of security-technics engineer (MZNDU JBMTC, 2001)
15. Digital technics II. for students of electrical and informatics engineer (MZNDU JBMTC, 2003)
16. Digital technics V. for (correspondence) students of security-technics engineer (MZNDU JBMTC, 2003)

9. Scientific professional biography

I started working in my current workplace (MZNDU JBMTF) on 8th October 1970, its previous name was Mate Zalka Military Technical Faculty.

I have two degrees which are:

1. Technical teacher of wireless communication of information, and
2. Electrical engineer of instrument and regulation-technics

From 1975 to 1990, I taught analog electronic circuits (and sometimes now as well) in different names of subjects.

In 1991, I got a task which was the integration of a subject called Digital circuits into the college education. I have been teaching this subject since then in many of the college departments in both correspondence and full-time courses, although it was only taught for the electrical engineer students earlier.

Beside my educational work, I have written 22 publications close to this topic.

I have helped students in Scientific Student Scope, and students who were doing their thesis for several times. I have been asked by Budapest Chamber of Commerce and Industry to participate in GCSE and technician-qualification as an inspector.

In the School of PhD, I have completely fulfilled my study.

In 2003, I passed a type C (complex) English military language exam.

In 2003, I passed a type C (complex) Russian military language exam.

6th October 2006, Budapest

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György Veres

college assistant professor