ELECTRONICS AND TELECOMMUNICATIONS IN NEW CURRICULA

INTRODUCTION

Bearing in mind that our country singed Bologna Declaration last year and accepted all the rules of the declaration and dynamics of making curricula at the Faculty of Electronic Engineering in Nis since its foundation (1968, 1980, 1990, 1998), it seems that "Colloquium on higher education of electronic engineering in Serbia" takes its place at the right time.

Taking into consideration the current situation in the field of higher education in Serbia, it is necessary to take over urgent activities on the reform with the aim to reach unique European principles concerning higher education, established upon Bologna standard (unique European Credit Transfer system, mobile students and teachers at European universities, integrated five-year studies of engineering).

Infrastructure and standard of higher education at our faculties significantly lag behind developed countries (computer education, communications, laboratories, experimental work, etc.). It is necessary to provide appropriate financial means for realization of education upon Bologna model in order to harmonize all activities during the studies (lectures, practical classes, homework, projects, seminar papers, colloquium preparation and examination taking) with prospective European countries. The main aim is the quality, rationality and efficiency of studies.

PRACTICAL ENGINEERING EDUCATION

Improvement and development of technology and computer science brought up the education level growth of engineers. A well-educated engineer represents one of the most important resources today. It is evident that higher education is only a first segment of the process without which a good engineer would not exist. Through his work, an engineer develops that process.

After graduation from faculty, the young electronic engineer entering industry begins a second phase of engineering education: professional training for engineering practice. Since the universities' primary orientation is research, it is with great difficulty that new engineers discover and acquire the practical expertise which will allow them to become full-fledged professionals in industry.

That the engineering faculties are composed mostly of researchers with little representation by professional practitioners is a serious shortcoming. Therefore, the main idea is that the curriculum should be broadened and depended and that there should be an orientation toward professional engineering practice as well as research.

Design-oriented courses, although very difficult, are valuable preparation for work in industry. In such a course, a team of students is given rough requirements for an engineering task, and must write specifications, design, build, and deliver a prototype device to do the job.

As for our faculty, influence of domestic industry and economy (especially Electronic Industry Nis) on education of electrical engineers was of a great importance. It used to lead to important changes in making curricula or it used to cause the opening of some brand new departments. Unfortunately, the situation today is not like that.

ELECTRONICS AND TELECOMMUNICATIONS

As it is known electronics has developed very fast during the past ten years. However, some of the disciplines of engineering have developed even faster, for example telecommunications.

What amount of electronics knowledge is needed for telecommunications and vice versa will be considered in the following set of views.

Modern data communications are based on generation, transmission and processing of signals, which often may be very complex. Achieving these functions requires different electronic components. Their miniaturization is becoming more important every day.

Students in the telecommunication program learn the principles and details of data transmission methods and systems. They work with both digital and analog technologies. Of course, conversion of analog signals to digital domain and vice versa presents a significant aspect in system consideration. The conversion may be relatively simple (in the case of binary signaling), or significantly complex (for example QAM signals or coded modulation). Very often, the errors appearing during the analog-to-digital signal conversion process determine the overall system performance.

During the transmission, a signal may incur different destructive effects, such as distortion, noise accumulation, channel interference and crosstalk, etc. The signal usually passes through different electronic components during the processing, adding to the signal a certain amount of distortion and noise, thus contributing to the overall performance degradation in a communication system. Students are required to understand different types of noises and interferences that might be generated within the electronic components qualitatively and quantitatively, in order to be able to evaluate the performance of a communication system. Moreover, the students should be aware of the techniques that may be undertaken to compensate or minimize such negative effects of electronic signal processing, without significantly affecting its function.

Communication systems are being used in many different application domains, offering an increasing number of sophisticated services to end users. These services are based on the ability of the systems to both transfer multiple types of information at very high speeds and process complex information efficiently. User requirements for electronic products that provide new services with lower cost and higher quality are the driving force for high technology researchers and practitioners.

Modern communication devices can be embedded in a single chip, usually referred to as system-on-chip (SoC). Communication SoCs are designed with several different types of intellectual property cores, including processing elements (embedded processors, digital signal processors, microcontrollers), storage elements (memories of various types and sizes), high-speed, multi-gigahertz interfaces for both wired and wireless applications, and analog and mixed-signal intellectual property cores (phase locked loops, mixers, etc.). The number of components in an SoC is growing rapidly, and the communication infrastructure on a single SoC is major concern. In fact, on-chip interconnect will increasingly be implemented as a network on a chip, complete with network interfaces, routers, and packet or circuit switching. Although the distances over which communication takes place differ by many orders of magnitude, the fields of on-chip networking and computer networking are clearly related.

The commercial wireless industry is begin driven a need for inexpensive radio frequency integrated circuits with low-cost packaging and manufacturing processes.

Therefore, students should be able to understand improvements in microelectronics, and bear in mind the possibilities of implementing required functions in VLSI circuits. Furthermore, the specific procedures for testing and verification of SoC should be known to students pursuing a communication career.

Although the number of Internet hosts has multiplied by a factor of 1000 over the last decade, the rate of installing commercial trunk transmission systems has been some 20 times lower. A vast increase in the transmission capacity is therefore needed to bridge the gap. Much effort is being devoted to achieve trunk transmission systems beyond 1Tb/s by combining time-division multiplexing (TDM) with wavelength-division multiplexing (WDM).

High-speed TDM systems have several merits. Many functions, including multiplexing, demultiplexing, retiming, reshaping, and regeneration, can be integrated in a simple and compact manner using high-speed integrated circuits.

One of the major issues in implementing an ultra-high-speed TDM system is the development of ultra-high-speed electronic integrated circuits. Very mature Si technologies are now being utilized for commercial 10 Gb/s (STM-64) systems. Recently, next-generation 40 Gb/s-class integrated circuits use high electron mobility transistors (HEMTs) and heterojunction transistors (HBTs) based on III-V compound semiconductors like GaAs and InP, and even Si bipolar transistors and SiGe HBTs. Ultra-high-speed integrated circuits are one of the keys to achieving large-capacity optical communication systems.

WDM system introduce several new optical component technologies into field use. The key enabler was erbium-doped fiber amplifier (EDFA), built using many types of optical components. It made possible the amplification of optical signals without conversion back to the electrical level, thus removing the attenuation limitation for the distance span of optical transmission.

Moving from pure WDM transmission to the other WDM network functionalities, optical switching has a key role. Micro-electromechanical systems (MEMS) have emerged as a leading technology for realizing transparent optical switching subsystems. Optical switching technologies are very crucial to future mobile broadband all-optical IP networks.

Accordingly, the new curriculum should encompass all mentioned above components.

CONCLUSION

Should the curriculum in Electronics be improved hastily or should it be done step by step?

On one hand, would engineers who had already attended classes in Electronics before the reform be in the same position as those after the reform? Is it fair to students to make such radical changes of curriculum?

On the other hand, can a step by step reform disable students to learn about the latest trends in science?

A good balance between these questions is needed. One is for sure: the reform of the program should start as soon as possible in order to make it easier for students. The reform must not be something which should be applied and then forgotten. It should be a responsible and continuative process.