

Teaching Process Enhancement in the Field of Telecommunications at the Faculty of Electronic Engineering of the University of Niš

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Abstract - In this paper, new teaching and assessment techniques, introduced on a pilot master study programme in the field of telecommunications at the Faculty of Electronic Engineering of the University of Niš, are reported. Such teaching process enhancement has been done within TEMPUS project JEP-41112-2006. Short description of new forms of presenting teaching materials and monitoring/evaluating students achievements for courses carried out at the first year of pilot master study programme, along with other activities aiming to enhance educational process, is given. Some experience regarding the implementation of these teaching and assessment techniques is also reported.

Keywords - TEMPUS project, pilot master study programme, telecommunication engineering, teaching process enhancement.

I. INTRODUCTION

Serbia signed the Bologna Declaration in 2003, and has thereby taken upon itself a binding commitment to this action programme, recognizing that higher education sector is the one that plays a key role of its economy and social transformation. The new law on Higher Education, adopted by the Serbian parliament in September 2005 [1] was an important step, making the framework to significant changes that later started to happen within local higher education structures according to EU standards.

Faculty of Electronic Engineering (FEE) at University of Nis is among the strongest educational and research centers of southeast Serbia and it has seen substantial interest in being a leader of higher educations reforms in this part of Serbia. The strategic aim of the FEE is to constantly improve the quality of study programmes, carried out at the faculty, and give them European dimensions with special regards to curricular development. In developing new and internationally recognized study programmes in various fields of electrical and electronic engineering at various educational cycles, the FEE has been involved, in the past, in several TEMPUS projects financed by European Commission. They aimed primarily at reforming study programmes in the field of computer science and software engineering.

Currently, at the FEE, three TEMPUS projects are carried out, among them, project JEP-41112-2006 [2] is focused to the development of new master study programmes in two fields: telecommunications and automatic control. Close cooperation of FEE with several technical universities in Europe (National Technical University of Athens, Greece;

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Technical University of Munich, Germany; University of Messina, Italy; University of Maribor, Slovenia), highly representative in the fields covered by the project, and telecommunication company Ericsson d.o.o., located in Belgrade, Serbia has been established within this TEMPUS project.

Following suggestions from EU university partners, consortium enterprise member and taking into account local and regional market needs, the structure and curricula of new master study programme *Telecommunication Engineering* (TE) in the field of telecommunications and *Computer Control Systems* (CCS) in the field of automatic control have been defined during the first year of the project [3]. The master study programmes have been based on the Bologna process requirements, and introduce, besides theoretical content, practical and research orientations and interdisciplinary character of the studies. They consists of innovated existing and new one-semester long courses, compulsory and elective, that comply with European core curricula standards and standards and procedures established by Serbian quality assurance system. In addition, student-oriented European Credit Transfer System (ECTS), is put in place aiming to include all educational activities and estimate time necessary for an average student to achieve specified learning outcomes.

Realization of defined pilot master study programmes at the FEE has begun in winter semester of academic year 2008/2009. During the first two semesters, some of the new teaching and assesment techniques have been introduced by teaching staff in order to generate new patterns of teaching and learning at the FEE. Such teaching process enhancement has been implemented aiming to provide more interactive education, attract students' attention and increase their involvement on lectures and exercises. It allows for continuous evaluation of students' success in accepting the learning outcomes, defined for each course, during the semester. In addition, activities of creating new or adapting the existing teaching materials, allowing students to access these materials through project web site and making laboratory environment that will give practical and research dimensions to the new curricula, have been running in parallel with the main teaching process.

This paper is representing a summary of all activities carried out during the winter and summer semester of the first academic year of pilot TE master study programme. It will comprise compulsory courses and courses that have been elected by the students and it will describe new forms of presenting teaching materials and monitoring/evaluating

students achievements, used for these courses. Some experience regarding the implementation of new teaching and assessment techniques and students' feedback on enhanced teaching process will be also reported.

II. TELECOMMUNICATION ENGINEERING (TE) MASTER STUDY PROGRAMME

The 2-year TE master study programme is created to provide students with a more specialized theoretical and practical knowledge in the different fields of modern telecommunication system engineering. It is intended for the students that have finished bachelor study programme not only in the field of telecommunications but also in other similar electrical and computer engineering fields. Students are provided with the knowledge to find optimal technical solutions, to operate, maintain and design different telecommunication systems and networks, to measure performances of numerous telecommunication devices, to apply different technical standards in modern fixed and mobile RF and microwave systems, etc. Having in mind that today modern systems represents convergence of different information and communication technologies, students are also provided with the theoretical and practical skills in some of ICT fields such as multimedia systems, video communications, computer communications, etc.

TE master study programme consists of:

- 8 compulsory courses,
- 9 elective courses that students can chose from the 9 different groups consisting of 2 or 3 course (giving in total 20 courses),
- Team project (carried out in collaboration with numerous ICT Serbian companies) and
- Diploma thesis.

All courses are one-semester long and weight dominantly 5-6 ECTS credits. ECTS is rated on estimated student overload that count for all educational activities and student preparation time (not only number of lectures and exercises hours). Typically, one ECTS credit requires a total student workload of 25 hours. Total of 120 ECTS credits are required to complete this master study programme and earn master of science degree.

Elective courses contribute with 43.3 % to the total number of ECTS credits. Some of elective courses can be chosen from the list of interdisciplinary courses such as Multimedia communication systems, E-business or Project management. In addition, there is a link between TE and CCS master study programmes as students on TE study programme can chose one or two courses from CCS study programme and vice versa.

For each course, the following subjects have been defined:

- Course objectives
- Learning outcomes
- Course content
- Lecture topics
- Laboratory topics
- List of references

- Contribution of each assessment method to final mark.

Each teacher has defined the key objectives for his/her course and identified the learning outcomes clearly expressed in terms of generic and course-related competences relevant to this level of studies and estimated labour market needs. Course content is shaped according to defined learning outcomes and then it is expresses in detail through specific lecture and laboratory topics. Numerical evaluation of students (from 6 to 10) at the exams is kept but results on the written and/or oral exam are not contributing 100% to the final mark. Each teacher has to specify the exact percentage of how much each of the pre-exam assessment methods (tests, colloquiums, seminar papers, etc) contributes to the final mark.

All course-related subjects, together with the name of professor/assistant conducting the course and their email addresses are available on TEMPUS project web site (available in Serbian and English language) (Fig.1):

<http://tempus41112.elfak.ni.ac.rs/>

In addition, on the web page dedicated to each individual course, there is a section containing online materials (at the moment in Serbian language) such as lectures in power point format and/or text-scripts in pdf or word format (Fig.2).

The screenshot shows a web browser window displaying the TEMPUS project website. The page title is "Development of Master Study Programmes in Telecommunications and Control" and the course is "TEMPUS JEP - 41112 - 2006". The course title is "Measurements in telecommunications". The course schedule is "2 hours of lecture per week" and "2 hours of problem of solving per week" and "1 hour of lab work per week". The number of ECTS credits is 6. The prerequisites are "Non". The teacher is "Prof. Dr. Nebojsa Dončov" (email: nebojsa.doncov@elfak.ni.ac.rs) and the teaching assistant is "Mr. Aleksandar Atanasković" (email: aleksandar.atanaskovic@elfak.ni.ac.rs). The course content includes "Specific aspects of measurements in telecommunications. Measurements in spectral domain. Microwave scalar and vector measurements. Measurement of frequency and power of RF and microwave signal. Noise characteristics measurement. Reflectometry. Measurement of signal parameters in broadcasting systems. Measurement in cable systems. Measurements in optical communications systems. Measurements in digital communications systems. Computer networks performances measurements. Automatization of measurements". The course objectives are "To introduce students to fundamental working principles and architecture of basic instruments used for measurement in telecommunications. Acquiring fundamental knowledge about measurement methods, their applications and limitations. Train students to efficiently use measurement equipment and software tools for automatization of measurement procedure." The learning outcomes are "Ability to select the right method and instrument for appropriate measurement application. Capacity to perform measurement and process/use measurement results in order to estimate telecommunication systems performances".

Fig.1. TEMPUS web site – page dedicated to the course
Measurements in telecommunications

III. TEACHING PROCESS ENHANCEMENT ACTIVITIES

Two semesters of TE pilot master study programme (winter semester running from October 2008 to January 2009 and summer semester running from March 2009 to June 2009) have been completed so far. Total number of enrolled students in both semesters is 14. Main focus on teaching process

enhancement activities that have conducted in both semesters has been on compulsory courses at the first master year and courses that students chose from the lists of elective courses defined at the same year. These courses are listed in Table 1.

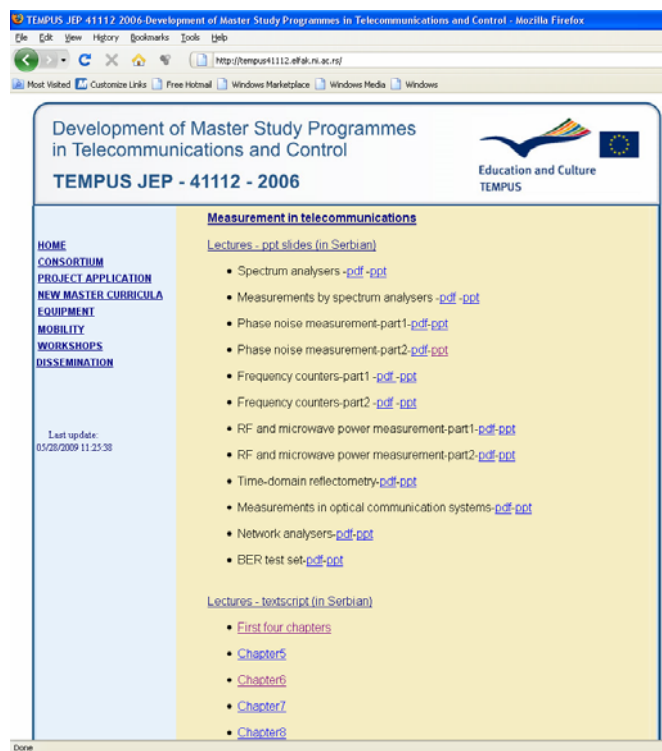


Fig.2. TEMPUS web site – section containing online materials relevant to the course *Measurements in telecommunications*

Table 1: List of courses conducted at the first year of TE master study programme

Winter semester of academic 2008/2009 year		ECTS
1.	<i>English language II</i>	2
2.	<i>Microwave systems</i>	6
3.	<i>Microwave electronics</i>	6
4.	<i>Computer communications</i>	6
5.	<i>Video communications</i>	5
6.	<i>Commutation and routing</i>	5
Summer semester of academic 2008/2009 year		ECTS
7.	<i>Mobile communication systems</i>	6
8.	<i>Optoelectronic communication systems</i>	6
9.	<i>Measurements in telecommunications</i>	6
10.	<i>Broadcasting systems and technologies</i>	6
11.	<i>Modelling and simulations of the systems</i>	6

Permanent activity, carried out dominantly by the teachers during the both semesters has been to reshape and adjust previously defined course content in order to better translate them to the learning outcomes - skills and competences that students should acquire. This activity is likely to be continued not only for the courses at the second master year but also for new generation of students as the TE master study programme

contains a significant number of newly introduced courses, (e.g. *Computer communications*, *Video communications*, *Optoelectronic communication systems* and *Broadcasting systems and technologies* at the first year) which will require 2-3 years time to be fully established.

Second activity, introduced to provide more interactive education, attract students' attention and increase their involvement on lectures and exercises, has been to change the way of how professors/assistants conduct their lectures and exercises. In the past, teaching was conducted in a traditional manner, ex cathedra, in front of large groups of students, using chalkboard. However, for majority of the courses at the first year of new TE master study programme, lectures have been organized in a computer classroom, equipped with ViewSonic PJ551D video beam and 10 PCs bought from the TEMPUS project fund (Fig.3).



Fig.3. Computer classroom used for teaching process carried out at the first year of TE master study programme

Power point slide presentations have been dominantly used by the professors to present teaching materials to the students. This presentation form has allowed them to enrich lectures with multimedia contents (e.g. animations) in order to better explain and illustrate teaching subjects. Rather than spending time in drawing figures and writing equations on chalkboard, professors have started to more efficiently use class hours, include students into discussion related to the lecture subject, answer to students' questions, solve one or two examples that illustrate presented theory, etc. Common practice has been to distribute all teaching materials (electronic or hard-copy) to the students one-week in advance of each teaching unit class so that students have enough time to be prepared for the class lecture. In addition, project web site has been periodically updated with new presentation materials and text-scripts for currently running courses in order to allow students to follow lectures in cases when they are not able to attend the class.

Numerical exercises have been done by the assistants in a classical way when numerical solving of some practical problems related to the course content was their subject. However, where appropriate, some of the exercises have been done on PCs in the computer classroom using appropriate software packages such as HP VEE, LabView, MatLab, etc.

Except for lectures and numerical exercises, the computer classroom has been used for other educational activities as well, such as preparation and defense of project or/and seminar works required in some of the courses.

Regarding the practical work, several new laboratory exercises have been implemented on a few courses at the first year using equipment bought not only from the project fund but also using other available funds. They have been realized either as simulations performed by using appropriate software packages installed on PCs or as measurements lines setup at the laboratories within the Department of Telecommunications at the FEE (Fig.4). In addition, existing laboratory exercises have been reshaped to be in line with up-to-date lectures and to include a clearly indicated learning goal with a detailed description of task steps students should perform. As previously said, TE master study programme is quite different from the old curricula in the field of telecommunications at the FEE, so that activity of creating a laboratory environment, that will give practical and research dimensions to the new curricula will continue even after the end of the project life.

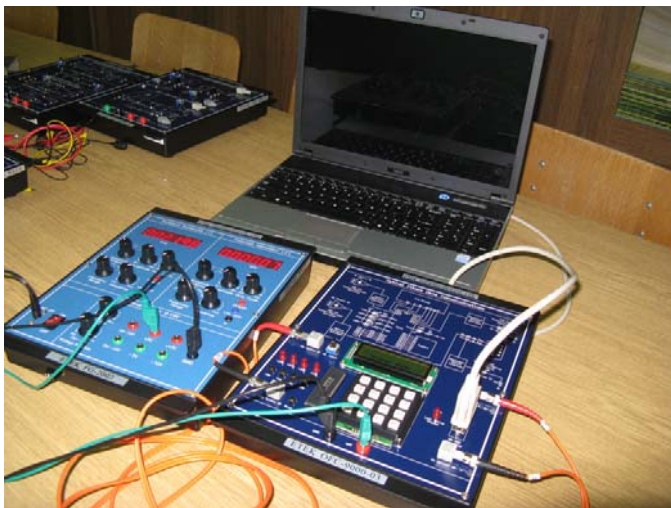


Fig.4. Laboratory exercise setup for the course *Optoelectronic communication systems*

In order to closely monitor and evaluate learning achievement of each student for their courses during the semester, teachers have introduced several assessment methods prior to the final written and/or oral exam. Therefore, a final mark grade student can achieve on each course has been based on successful accomplishment of all pre-exam and final-exam tasks. The following pre-exam assessment activities have been introduced:

- Class attending/participation and homework
- Colloquiums (usually two per semester, combining numerical problems and theoretical questions)
- Test related to laboratory exercises and laboratory report
- Project/seminar work.

Not all activities have been introduced to each course. Evaluation of assessment activity accomplishment, varies from course to course, but it is adopted that all pre-exam tasks can contribute from 30% to 70% of the final mark. Partly

because of these assessment methods and partly because of new more attractive ways of conducting lectures and exercise, average number of students attending classes has raised to 90% of the total number of enrolled students. However, as TE is still a pilot programme, it is decided to allow students, if they wish, to pass courses taking only written/oral exams in regular exam periods.

At the end of each semester, short review of conducted activities has been done in order to identify the advantages and possible weaknesses of implemented teaching and assessment techniques. Students' view on enhanced teaching process, expressed either through their discussions with the teachers or by official polls organized by the Student parliament of the FEE has been also included in the review. Students have positively reacted to the changes in presenting teaching materials at the lectures and numerical exercises and availability of these materials through project web site. Also, students have supported an improved laboratory environment and possibility to build their final mark grade permanently working during the semester and taking pre-exam tasks. Common concern has been a lack of time to be better prepared for the exams due to a lot of courses from the previous academic years that students have not been passed yet.

IV. CONCLUSION

General frame in which enhancement of teaching process at the first year of TE pilot master study programme has been done, is presented in the paper. During the second year of the TEMPUS project JEP-41112-2006, several modern student-focused teaching and assessment techniques have been introduced in order to increase quality of teaching and studying in the field of telecommunications at the FEE. As the process of buying the necessary laboratory equipment is still in progress, the remaining period of the project life will be used, among other things, to strength practical component of new TE curricula introducing, in all courses, modern laboratory exercises covered by appropriate manuals.

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