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AN APPROACH TO A BACHELOR PROGRAM ON NETWORK TECHNOLOGIES

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The bachelor computer networking education offered by the New Bulgarian University in Sofia prepares students for hardware/software jobs in companies related to network system administration, and Internet-based systems. It includes courses in computer architectures, operating systems, local and global networks, programming languages, Internet applications, and practical projects. In this paper the main emphasis is on the syllabus of the network technologies program and on some problems and results that have been achieved since this bachelor program was started.

1. Introduction. New Bulgarian University has a sixteen-year-history. The bachelor program on Computer Science dates back to its beginning in 1992. There are three bachelor programs now – Computer Science, Multimedia and Network Technologies and two master programs – Multimedia and Software Technologies in Internet. Four years ago an idea to launch a new bachelor program on networking was born in the Computer Science department. The arguments were that the demands of networking specialists will increase. At the same time there is no such a bachelor program in Bulgarin unversities. In the conditions of an open economy, the English language has become obligatory for the people in the information industry. For this reason the English language was chosen as the medium for this program. Another reason was to attract foreign students and to open our education for international university mobility.

The program started in the year 2004 and the first students are now in their last school year of the Bachelor program.

Some educational aspects related to the Network Technologies bachelor program is presented in this paper.

The final educational aims of the network technologies bachelor program are generalized as: design, installation, testing and managing networks; developing software for Internet applications.

The education is organised in auditoria and non-auditoria forms. The auditoria forms are lectures and workshops, as well as training courses supporting any course. Non-auditoria forms are self-organised by students and they include projects, seminars and internships. Auditoria forms give 18 credits per term, and non-auditoria – 12. The educational forms are obligatory and optional ones. 12 of 18 credits from auditoria courses are obligatory during the first two school years – the rest courses are optional.

All courses are optional during the 3-th and 4-th years of education. Every term the students have to do one training course. It is obligatory and gives 0 credits.

During the first two school years part of the auditoria courses include general foundation courses like Bulgarian language literacy and two courses chosen by students according to their interests.

The entry exams for the Bachelor Program of Network Technologies are:

• Test for comprehensive knowledge and skills in ten areas: Mathematics, Bulgarian language, Literature, History, Geography, Chemistry, Physics, Biology, Logic, Semantics.

• English language (level B2).

The education is based on a **credit system**. A new credit system is started in 2004/2005, which completely corresponds to the European Credit Transfer System (ECTS) standards. The credits definition is described bellow:

• Each 10 hours auditoria course is equal to 1 credit. The credits are assigned after the corresponding exam is passed.

• Non-auditoria course credits are defined for each unit. For example, 2 month practice in a IT company gives 6 credits. Usually any project gives 3 credits.

• The training courses don't give credits but they are obligatory as they support all courses.

The program scheme for the bachelor program Network Technologies is described bellow [4]:

First year:

• Comprehensive courses – 15 credits. English language (level B2) is automatically covered because of the entry exam.

• Program auditoria courses – 21 credits.

• Two training courses.

• Projects – 24 credits.

Second year:

• Program auditoria courses – 36 credits.

• Two training courses.

• Projects – 24 credits.

Third year:

• Program auditoria courses from the module chosen – 36 credits.

• Non-auditoria program courses – 24 credits.

• Two training courses.

Four year:

• Program auditoria courses from the module chosen – 36 credits.

• Non-auditoria program courses – 24 credits.

• Two training courses

The education finishes with a Bachelor thesis or State exam – 10 credits.

The total number of hours is 2640. The total number of credits is 250, including the bachelor thesis.

The courses during the first two years are introductory and introduce the bases of the field. After the second year of education, the program is divided into two modules:

• System administration

• Internet programming

The students have to choose one of the modules to continue their education after the second year.

The program documentation includes: characteristics of the program, competence definitions achieved at the end of education; requirements for graduation, list of courses, management body. There is a description for every course which includes: objectives, list of knowledge and skills obtained at the end, educational topics, assessment, organization of the education and tools used, references, CV of the teacher, course passport.

2. The Main Philosophy of the Program. The program of the Carlton University, Canada [3] is used as a prototype of the bachelor program Network Technologies. The main difference is that the Carlton University Program is very pragmatically designed with negligibly small fundamental background. This disadvantage (according to our opinion) is overcome in the NBU version. Some economic, management and organisational aspects are added as well.

The education in the Networking Technologies Program is aimed to guarantee an adequate knowledge, skills and competences on network administration or programming for a long period and flexibility in the conditions of different companies, government and non-government institutions. The main streams are related to data exchange, computer architectures, operation systems, computer networks, Internet and web technologies, distributed systems and information systems.

The expected main knowledge, skills and competences of the graduates at the end of the education are:

• to understand the fundamental network concepts, techniques and technologies.

• to be able to maintain and manage computer and electronic devices, systems and local and global networks;

• to apply programming languages in networking environment and to apply them for a variety of network applications and computer controlled devices like web technologies, multimedia, data bases and information systems, distributed and client-server systems;

• to know the rules of software engineering and to be able to apply them in practice;

• to know the technologies for network security and to be able to apply them practically;

• to have a basic knowledge on company ethics, management, marketing and risks in the IT industry;

• to be able to work in a team;

• to be initiative in obtaining continually new information in the process of the work.

The expected results are provided by sets of lectures, workshops, independent projects and practice in companies.

The graduates will be able to work in a wide range of fields like:

• administration and technical support of electronic devices and networks in companies;

• development of software applications with emphasis on such for networks;

• administration of data bases and information systems;

• system analysis and management in software industry.

Briefly, if we have to give a description of the NBU Bachelor Program "Network Technologies", we have to say that it has all the elements of a Computer Science program with computer networking concentration.

3. Description of the Curriculum. In correspondence with the profile defined, the program courses belong to the one of the following areas:

• Fundamentals of Computer Science: algorithms, data structures, discrete mathematics, programming languages.

• Mathematics and Physics: linear algebra, calculus, theory of probabilities, math statistics, geometry, physics.

• Computer Architectures and Networks Hardware: architectures of computer systems, networking hardware, local and global networks, mobile communications.

• Operating Systems: fundamentals on operating systems, real time systems, distributed systems, Windows/UNIX/LINUX.

• Managing networks: rooting, remote control, network security, cryptography, system Internet programming, enterprise network management;

• Programming in Network Environment: Java, Perl, Rebol, PHP, MySQL, .Net, web programming client-server, software engineering.

• Information Technologies: e-commerce, databases, distributed databases, client-server databases, mobile applications, multimedia Internet applications, web programming, semantic web.

• Economic and Organization aspects: Marketing in IT industry, IT management, IT risk, communications.

The program courses are distributed in the following way:

During the first 2 years, 39 courses are involved and they build the fundamental knowledge and skills of the program. These courses include:

• Algorithms, programming and data structure – 13 courses, 30 hours each (totally 390 hours);

• Mathematics – 8 courses, 30 hours each (total 240 hours);

• Computer architectures and networks – 8 courses, 30 hours each (total 240 hours);

• Operation systems – 3 courses, 30 hours each (total 90 hours);

• Information technologies (data bases, e-commerce) – 3 courses, 30 hours each (total 90 hours).

• Projects – 20 hours

The modules during the 3-th and 4-th years offer the following courses, distributed as it is shown in the table:

Main topics:	**Administration**	**Programming**
Theoretical bases of Computer Science	0	4
Mathematics	0	1
Computer systems and networks	19	2
Operation systems	4	3
Programming	6	21
Applications (information technologies	7	6
Management, marketing and others	3	3
Total:	39	40

How the first term looks like:

NETB 101 Introduction to Programming (C++)

NETB 121 Programming Language WorkshopC++

NETB 131 Programming Project

NETB 141 Programming Language C++ Project

NETB 102 Introduction to Computer Systems
NETB 122 Introduction to Computer Systems Project

NETB 103 Linear Algebra
NETB 133 Linear Algebra Project
NETB 123 Linear Algebra Workshop (training course)

NETB 104 Physics
NETB 124 Physics Project

How the 6-th term looks like for the module Network Administration:
NETB 352 Unix/Linux Operating Systems
NETB 362 Linux Operating Systems Workshop
NETB 392 Linux Operating Systems Project

NETB 356 Network Hardware
NETB 366 Network Hardware Workshop
NETB 376 Network Hardware Project

NETB 357 MobileCommunications

NETB 358 Programming in Java
NETB 368 System and User Applications with Java (training course)
NETB 378 Java Project

NETB 371 Network Multimedia Applications
NETB 381 Network Multimedia Applications Project

NETB 391 IT Risk
NETB 330 Advanced Programming Workshop – 2
NETB 394 Network Technology Project – 2
NETB 399 Practice in IT Company

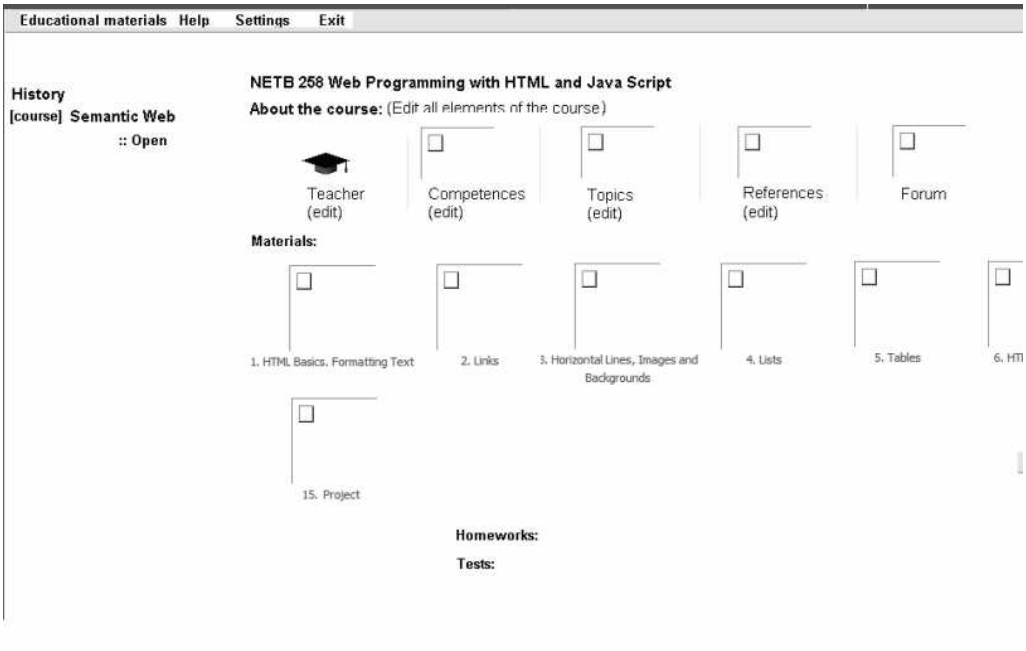
How the 6-th term looks like for the module Internet programming:
NETB 351 Interactive Vector Graphics for the Web
NETB 361 Interactive Vector Graphics for the Web Project

NETB 352 Unix/Linux Operating Systems
NETB 362 Linux Operating Systems Workshop
NETB 392 Linux Operating Systems Project

NETB 353 Cryptography
NETB 373 Applied Cryptography and Data Protection
NETB 383 Cryptography Project

NETB 358 Programming in Java
NETB 368 System and User Applications in Java (training course)
NETB 378 Java Project

NETB 371 Network Multimedia Applications
NETB 381 Network Multimedia Applications Project



NETB201 Data Structures
NETB221 Algorithms for Data Structures

NETB201	Lectures:	**NETB221**	Workshop:
N. Kirov	Wednesday, 8:00-9:30, 217 I	E. Kelevedzhiev	Thursday, 8:00-9:30
		E. Kelevedzhiev	Thursday, 9:40-11:10

- COURSE PASSPORT: DOC, HTML
- Textbook: Michael Goodrich, Roberto Tamassia, David M. Mount, Data Structures and Algorithms in C++, Wiley, 2004.

Some useful textbooks in Bulgarian.

- **Link to NETB 221 Algorithms for Data Structures** NEW!
- Timetable, lecture slides and labs
- VEDA
- **Student's results**

NETB201	Date:	NETB221	From	Due to	NETB221	Date:
The Questions of Test_1	07.11.07	Homework_1	05.11.07	13.11.07	Exam of Practice_1	08.11.07
The Questions of Test_2	12.12.07	Homework_2	05.12.07	13.12.07	Exam of Practice_2	13.12.07
The Questions of Final Test	23.01.08	Homework_3	17.01.08	24.01.08	Final Exam of Practice	24.01.08

- Unix/Linux Operating system:
  - Basic Unix Commands
  - More Advanced Unix Commands
- Cay Horstmann: Compiler and Tool Help

NET 391 IT Risc
NETB 390 Programming Challenges Workshop – 2
NETB 399 Practice in IT Company

4. Resource support of education.

All the courses are supported by educational materials. Several e-learning tools can be used in NBU: Moodle, ISDO and VEDA. The system VEDA is used dominantly for the network program courses. Also some teachers use their own separate sites. The special site is designed by Nikolay Kirov. Some examples of supporting education are shown on the previous page.

The management of the program is effected by the Council body. The managers have access to the university information system, which gives a variety of information about the program like: lists of courses by semesters and years, lists of students taking courses, lists of teachers, timetable of the lessons, list of the lessons which are not taken by the teacher, current control results, students' achievements and others. Having the information about the program, the managers can react, and they are obligated to react to every deviation of the rules.

5. Conclusion. The Bachelor Program Networking Technologies in NBU is a modern and adequate to the real needs of the IT industry. It is composed so that to prepare students for the IT industry with an accent on networking. The interest in the program is high and students are well motivated to learn. The mobility in the frame of European projects and interuniversity agreements gives the possibility to exchange students and teachers, which is a regular practice for this program. The English language, being the medium for this program, makes our students more competitive on the job market.

REFERENCES

[1] Computing and Engineering Technology, Association for Computing Machinery (ACM Press).
[2] Computer Support Services, The Association for Computing Machinery (ACM Press).
[3] Network Technology Syllabus,
http://www2.carleton.ca/shared/shared_academics/pdfs/program/Network_Technology.pdf
[4] Catalog NBU, 2007.

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ЕДИН ПОДХОД ЗА БАКАЛАВЪРСКА ПРОГРАМА ПО МРЕЖОВИ ТЕХНОЛОГИИ

Петя Асенова, Николай Киров

Обучението за бакалавърска степен по компютърни мрежи, предлагано от Нов български университет в София, подготвя студентите за работа във фирми, свързани със системно администриране на мрежи и Интернет базирани системи. То включва курсове по компютърни архитектури, операционни системи, локални и глобални мрежи, езици за програмиране, приложения за Интернет и практически проекти. В тази статия представяме учебната програма на Мрежови технологии, някои проблеми и достигнати резултати от стартирането на програмата до сега.