BIOMEDICAL ENGINEERING EDUCATION IN A NEW BRANCH OF BACHELOR STUDY "BIOMEDICAL TECHNOLOGY"

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Abstract: The new bachelor branch Biomedical technologies combines technical and socio-healthcare study branches into a new study branch accredited in year 2003 and now proceeding at the Faculty of Electrical Engineering and Computer Science of the VSB - Technical University of Ostrava. The humanity lessons are taught and guaranteed by the Medico–Social faculty of the University of Ostrava and the technical lessons by the VSB- Technical University of Ostrava. This paper presents several aspects concerning both the creation of the biomedical technologies study program as the combination of the technical and health courses and also the legislative views that introduce new requirements in this process that have to be respected in the students interests.

Introduction

Biomedical engineering, clinical engineering and medical informatics represent interdisciplinary branches which are very progressive and acknowledged and which intervene into many spheres. The mentioned branches apply various technical principles and skills in biology and medicine: from proposals, construction and implementation, to the servicing of medical technology. Up until now, biomedical engineering has been taught at the Department of Measurement and Control within the master program as one of its majors called, "Measurement and Control in Biomedicine". Changes both concerning the overall higher education system in Czech Republic and resulting from the entry of Czech republic into the EU influenced the formation of a new type of biomedical study field.

The new bachelor study branch "Biomedical technologies" has been proposed and accredited at the Faculty of Electrical Engineering and Computer Science. From a technical point of view, the branch is very close to the field of "Measurement and Control" and that is why the department of measurement and control guarantee this study branch. The previous experience gained by the training of the mentioned master program made a very good groundwork for administration of the bachelor program. However, the cooperation of lecturers from other faculty departments, which are specialists in particular topics is expected and required.

Conception of study

The bachelor program "Biomedical technologies" combines both technical courses and socio-health and medical courses. The classes are taught at the Faculty of Electrical Engineering and Computer Science and at the Medico–Social Faculty of the University of Ostrava respectively. Thus, the branch has an inter-disciplinary character and qualified teachers from both universities have become involved in its realization.

The graduates will be specialists in installing, operating, monitoring and innovating medical technique and advancements in medical institutions and may work in a direct contact with patients. They will be sufficiently educated in anatomy, physiology, pathology and other health and social disciplines. However, they must not work as a nurse. They also will be able to assist in selected areas of medical research and to use related information technology to this purpose.

Conception of interdisciplinary study

The preparation of the bachelor interdisciplinary program Biomedical Technologies (BMT) began already in year 2002 along with the transformational and developmental project of the Ministry of Education for youth and physical education of the Czech Rep (CZ). Groundwork for accreditation was prepared for this project and in year 2003 this branch was accredited by an accreditation committee of the Ministry of Education CZ as another study branch of the educational program Electrical Engineering, Telecommunications and Computers. At that time a law had not yet been passed that had to do with the existence and influence of non-medical staff in the public health work force because the government was waiting for further changes in legislation resulting from the Czech Republic's entrance into the EU. This law was therefore passed a year later as number 96/2004 of the Statute Book on non-medical staff in healthcare.

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This law defines, for the first time, the term lifelong learning in healthcare and exchanged activities, which are perceived as lifelong education. This law also modified the process of obtaining certification to work without a supervisor, which until then supervision was a requirement for this field of work. Detailed conditions are specified in the edict 423,424/2004 of the Statue-Book under the government number of 463/2004 of the Statue-Book, which applies to the sector of specialized education and selected employees with specialized professions. These edicts are part of the administered law regulation, which defines an altogether new standing of technical staff in the healthcare system. It has been shown that because of an increasing amount of sophisticated health diagnostic, laboratory and therapeutic machines, there is an increasing need for qualified technical staff without skilled supervision. These edicts have a strong impact on branches such as Biomedical Technologies and Biomedical Engineering, which are explicitly discussed and cited in relation with standard professions like "Biomedical Technician" or "Biomedical Engineer" in which the graduates will find employment.

Another edict, number 39/2005 of the Statue-Book, follows and extends the edict in accordance with EU edicts and makes minimal alterations to both theoretical and practical classes which gives the program professional qualification with which to operate and create non-medical healthcare professionals.

The edicts require the following criteria in order to acquire qualifications as a Biomedical Technician:

- The obtainment of the Biomedical Technician title is possible after studying in the accredited (by Ministry of Healthcare!) bachelor program in the standard time of a minimum of three years.
- From this, practical classes must make up at least 600 semester hours in the case that they are taken as part of daily study program as opposed to long distance studies.
- The program must provide knowledge and skills according to the edict number 424/2004 of the Statue-Book that gives the requirements for healthcare workers and other specialized workers.

The program must include basic general theoretical and practical classes:

a) The theoretical education must provide the following knowledge:

- Basic knowledge in anatomy, physiology and pathology for programs that supply basic services for the performance of technical health care.
- In technical programs; knowledge in signal and image processing (introduction to the theory of signal processing, analysis and interpretation of biosignals and biomedical sensors), in equipment health care instruments (knowledge in basic electrical circuits, diagnostic, therapeutic, laboratory and complex healthcare equipment and visual systems in clinics), in informatics and cybernetics (basic knowledge in statistics, support of computer diagnostics, telemedicine, information systems in health care, introduction to the theory of simulation and modeling), in electro technical subjects (knowledge in math, physics, theoretical electrotechnics, electronics, electrical measurements and programming).

Technical law and norms that apply to healthcare, in management of health care technology and the basics of scientific methodology in scientific research.

b) The practical classes must provide the following skills and knowledge:

- In classes that take place in school laboratories and in healthcare centers.
- A minimum of 50 hours of practical classes must take place in healthcare workplaces that use diagnostic healthcare equipment.
- A minimum of 30 hours of practical classes must take place in healthcare workplaces that use therapeutic healthcare equipment.
- A minimum of 20 hours of practical classes must take place in healthcare workplaces that use laboratory healthcare equipment.

To show how in year 2003 accreditation for the BMT program corresponds with the required edict number 39/2005 of the Statue-Book, we will show some statistic information from this program.

Statistical data about BMT

Classes, both theoretical and practical, are taught by two universities; by the Faculty of Electrical Engineering and Computer Science at VŠB-TU Ostrava and by the Medico-Socio Faculty at the University of Ostrava. The faculty of Electrical Engineering and Computer Science, makes up 54,3% of total hours and provides technical and language classes with the exception of Latin. Among the required classes are Math I and II, Physics, Optical Electronics, Biophysics, Electrical Circuits, Signal Analysis, Basic Computer Skills, Measurement and Processing of Data, Information Systems in Healthcare, Sensors in Biomedicine, Electronic Instruments technique, Electronic Instruments Measurement and Monitoring and Control Systems. Another class that is required that belongs to two semester practical classes is the Healthcare Electronic Equipment class that consists of basic and specialized healthcare technique, including its clinical application according to individual medical fields. The Electrical Engineering and Computer Science department offers optional courses in Biocybernetics and Biotelemetry.

The Medico-Socio faculty provides required classes in healthcare such as First Aid, Basics of Anatomy, Physiology, Pathology, Psychology, Chemistry and Biology, Work Hygiene and Epidemiology, Microbiology and Immunology. Also included in the required courses are Ethics in Healthcare, Management and Operations in Healthcare, Healthcare Law, Marketing in Healthcare, Public Healthcare, Security, and Latin and Specialized Terminology. Other required classes are courses focused on practical therapeutic and

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diagnostic technique. In this area are included classes such as Clinical Propedeutics, Technique in Diagnostic Sickness in Internal and Surgery Sectors, Healing Technique in Radiotherapy and Nuclear Medicine in Healthcare Equipment. Furthermore, the Medico-Socio faculty offers optional courses such as Audiometry, Rehabilitation Methods and Technique, Equipment Technique and Compensation Aids for the Handicapped, Examining Methods and Equipment Technique in Optometry, Civilization Diseases and Physical Body Workload Risks.

A very important part of the program is the related specialized workplace classes taken place at healthcare clinics that make up 120 hours, which over qualifies the norms according to the edict number 39/2005 of the Statue-Book. In their first year, students complete 14 daily practical classes in the area of Technique in Diagnostics of Disease and in the second year, they complete similar practical courses in Technique in Theraphy of Disease. Thus the Socio-Medico department classes of the University of Ostrava make up 45,7% of the total program.

Statistics that are more detailed (number of credits and hours taught) in relation to the healthcare and technical courses of the BMT program are shown in the following table, Table 1.

Table 1: Table of skills in subject representation according year, Hours also in percent

	Electrical (Technical)		**Health (Humanity)**		**Others specialized subjects**	
Yr.	Hrs.	Lect./ exerc.	Hrs.	Lect./ exerc.	Hrs.	Lect./ exerc.
1	476	252/224	294	168/126	70	42/28
2	448	252/196	196	140/56	56	42/14
3	209	77/132	242	110/132	44	44/0
∑	1133	581/552	732	418/314	170	128/42
%	48,8	24/23,8	31,5	18/13,5	7,2	5,4/1,8

Here are 22 (35,5%) electro-technical classes and 26 (42%) healthcare classes, language classes are 3 (5%) and the rest of the classes from both departments are 11 (17,5%). From the semester hour point of view, technical classes make up 1133 hours (48,8%) and healthcare classes make up 732 hours (31,5%). Language classes make up 126 hours (5,5%) and other classes make up 170 hours (7,2%). The remaining classes, professional practice at the clinical workplace, make up 120 hours (7%). This statistic is calculated from all the classes offered, in practice the overall number of credits is smaller because students choose a limited number of optional credits so that they will complete the requirement of 180 optional credits during the program.

The Biomedical Technologies inter-disciplinary program was commenced in the school year of 2004/2005. Entrance exams were successfully accomplished by 48 students, 39 students registered and 36 students began studying. After the first semester 32 students continued study; of that, 23 men and 9 women. Only after the 31st of September will we know how many students will continue studying the program. Around 59 students are applying into the first year of the next school year and there are 45 places open according to the present capacity of the school including consideration of realistic capacities of practical classes. In this area the Faculty Hospital of Ostrava-Poruba is providing excellent groundwork and support for the program.

Profile and enforce of graduate

The graduates will be specialists in installing, operating, monitoring and innovating medical technique and advancements in medical institutions and may work with in direct contact with patients. They will be sufficiently educated in anatomy, physiology, pathology and other health and social disciplines. However, they must not work as a nurse. They also will be able to assist in selected areas of medical research and to use related information technology to this purpose.

Currently, graduates can find employment most often as assistances in clinical healthcare, in equipment security and in operating healthcare equipment. They can also find employment in firms that work with healthcare equipment and technique, in healthcare management and administrative functions such as technical operations, in the instalment and operation of modern healthcare documentation and also currently, in developmental research in healthcare equipment.

In order to obtain a certificate to practice in the profession without skilled supervision, the Ministry of Health needs to accredit the program. The structure and contents of the new bachelor study field Biomedical Technologies conforms to legislative requirements and all graduates of these biomedical professions are ready to practice in the profession in accordance with newly accepted legislative requirements.

Figure 1: Logo of the new bachelor study branch "Biomedicine technology".

Quality management system on FEEC

The Biomedicine Technical program was established in agreement with the goals of the Faculty of Electrical Engineering and Computer Science in terms of quality in operations. The faculty is a holder of the ISO 9001

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certificate, as the 1st academic institute in Czech Republic. The administrative system of the faculty is first and foremost oriented toward the needs of the customer. Our main customer in this context is not only the student but also the state and present and future employers. In the case that programs are of a similar nature to Biomedical Technologies or Biomedical Engineering, the legislative activities of the state clearly declare the interest of the state and also the interest of a large portion of employers. Here therefore are also created conditions in the interest of the student, conditions that will enable the graduate to find work and lifelong employment and also further opportunity for education and specialization in the given field. This program appeals to new group of students, students that are interested in both specialized technical fields and healthcare, which represents a strong motivation challenge on the side of the student. In the same area, the challenge is on the side of both faculties: to prepare and realize a new prospective branch of study through cooperation so that this new branch will be realized and become more and more prospective while using technology in healthcare.

Figure 2. Logos of Management system used on FEECS

Conclusions Summary and perspective

This new bachelor branch was successfully accredited in year 2003. The education in this branch started in the winter semester of the academic year 2004/2005. In the year 2004 the Czech Republic passed a law, number 96/2004 of the Statute Book, about non-medical sanitary professions. Detailed conditions and requirements for obtaining the certificate for practice of profession without skilled supervision was subsequently modified in the regulation number 423/2004 and 39/2005 of the Statute Book and in the decree number 463/2004 of the Statute Book. These legislative changes have a strong impact on branches like biomedical technology, respectively, biomedical engineering.

Although the instruction of this interdisciplinary program is new and there do not exist curriculums and past experiences with graduates in such a branch, the cooperation between universities is very close and all evaluations, both from the students and from the teachers of the first year will lead to changes and alterations in the curriculum so that the quality of the branch will continue to grow.

After the completion of the bachelor program, the graduates have an opportunity to continue their studies in the master program that is taught at VSB -Technical University of Ostrava at the Faculty of Electrical Engineering and Computer Science in the area of "Measurement and Control of Technology in Biomedicine". After the completion of the master program, a doctoral program is offered in Technical Cybernetics.

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References

(Journals)

[1] Žídek, J., SVATOŠ Z., KUNČICKÝ, P. (2005): 'Faculty of Electrical Engineering and Computer Science VŠB – TU Ostrava, as the first academic institution in the Czech Republic to have a certified management system Academician', *Akademik* Vol, No **1**/2005., pp. 9-10.

(Electronical Publications)

[2] VŠB – TU, Internet site address: http://www.fei.vsb.cz/

[3] Biomedical laboratory internet site address: http://bmeng.vsb.cz/default.aspx

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