

Training in mechanical engineering technology – innovation with traditions in the future

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Abstract: In this topic the model of training in Mechanical Engineering Technology and its similar technological disciplines for the period of the last 30 years in TU-Gabrovo is considered. The shared experience can be discussed and used in education in technical universities and vocational high schools.

KEYWORDS: MECHANICAL ENGINEERING TECHNOLOGY

1. Introduction

The model of training in technology of mechanical engineering (TME) and its similar technological disciplines covers a period of the last 30 years at TU - Gabrovo.

1. Results and discussion

From the very beginning it relies on continuity and continuation of the activity of Assoc. Prof. Dr. Eng. S. Stanchev on the existing curriculum, but begins to work consistently on its own model of education entirely in technological disciplines or one of the most important areas, which shapes the engineer. In 1995, a block diagram of the training in the specialty "Precision technique" (PT) was proposed, in which the technological disciplines occupy 270 hours or 7.4% and part of specialized training (Fig. 1) [1]. The main disciplines in the bachelor's degree are TME and Technology of Mechanical Engineering and Precision Technique (TMEPT), but the technological disciplines include Automated Production Planning and Management (APUP) (1996), Engineering Logistics (IL) (2000), Technology Oriented Design (TOD) and System Design (SD), which developed curricula with abstracts for the specialties Mechanical Engineering and Precision Technique (MEPT), Technique and Technology for Environmental Protection (TTOEP) and Business Administration (BA) - distance learning and characteristics to them in 1995/6 years. The training takes place in 4 stages in classroom employment in the disciplines TME and TMEPT from 150 hours (90 + 60) and project. New topics have been introduced, such as technological processes in microtechnology and training in CAM-systems. The aim is to respond more precisely and thoroughly to the increased demands in a market economy. There is also a laboratory "Automated design and technology of fine mechanical elements and devices". The company of German engineers (VDI) and FEANI has been given descriptions of the training in the specialty "PT" in TU-Gabrovo and developed qualification characteristics for the specialty. The disciplines are provided with textbooks and teaching aids [2, 3, 4, 5, 30]. In 1996 the technologies at the beginning of the XXI century and the training and development activity in the specialty "PT" of TU-Gabrovo were presented and discussed [6]. A study was conducted on which technologies should be developed and which of them should be introduced in the education of students. The training in the technological direction is divided into 8 thematic cycles and measures are proposed to increase the level of training on the path of integration with Europe.

In 1997 the topic of the development of information and communication technologies was reported and the tasks of PT and micro-technique were formulated [7]. The further development of more reliable and with many possibilities intelligent devices and means for different media is forecasted and an opinion is expressed on the ways in which these tasks can be solved. The desire to develop and apply new methods in training is realized with a project of multimedia training in the discipline TMEPT, developed at the EMK Institute at TU - Darmstadt in 3 stages, the results of which are presented in [8].

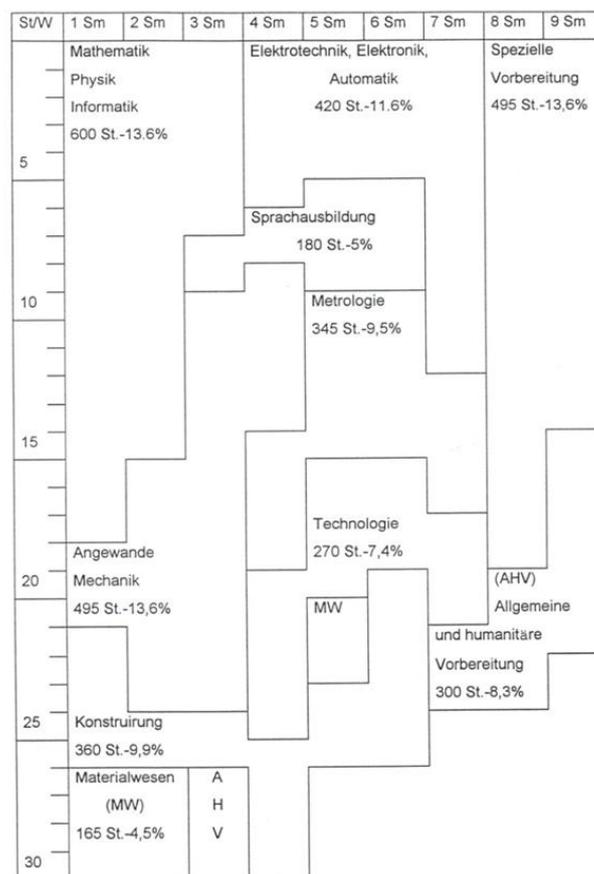


Fig. 1. Block-diagram of the curriculum for the specialty "PT" as of 1995

The goals and target groups of the project and the tasks solved with media-based training on the Internet by high-energy methods in micro-technique are indicated (Fig. 2). The final implementation of multimedia training in TMEPT in two languages (Bulgarian and German) was published in [9], presented abroad and announcing about 4000 entries in the WEB-page of the project [10]. The project has developed a fundamentally new automated approach and system that expands the possibility of training to a modern Hard / Software technology on the Internet by supplementing the place and time of implementation and has developed a methodology for user work. For distance learning 2000 is the IL-program. At the beginning of the XXI century (2001), due to necessity, the discipline Microsystems Technique (MST) was introduced, as well as the specialty "Power Supply and Electrical Equipment" at the Faculty of Electrical Engineering and Electronics (EE) and action was started to develop the specialty "Mechatronics". A curriculum on MST for special EE has been developed. The main goal is the development of MST in our country. To achieve it, the activities are indicated: staff training, modularity and standardization and development. The training is focused on 3 technological areas, profiling the modules of lectures - technologies for microstructuring and modification, materials and structures, system techniques. The problem is also discussed abroad [11]. The beginning of the century is also characterized by projects for technology centers. In order to

meet the requirements, a technological information center was established and implemented at the Technical University of Gabrovo, the activity of which was reported to [12]. The main point in its activity is the realization of technologies (mentioned as examples) and information services as a market application in certain 7 more important areas with expected benefits.

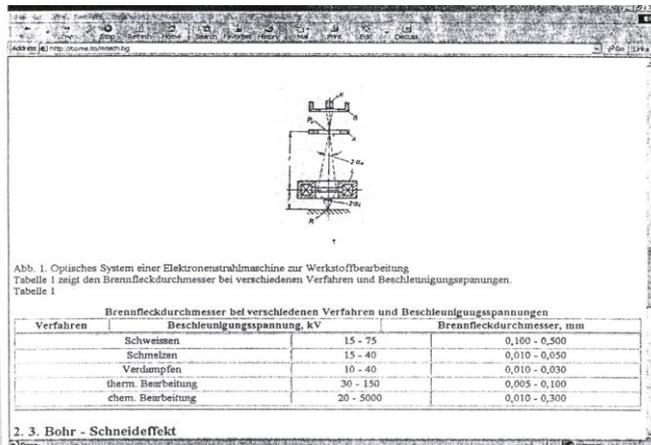


Fig. 2. Part of the lecture 'Electron beam processing' in German on the Internet

During the considered period of 30 years he was regularly involved in the development of new curricula and programs. From the beginning of 2001/2 the discipline TME is divided into two parts with a schedule of 90 hours of lectures and 30 hours of exercises. In 2003 a new program was prepared in TME and TMEPT, as well as in Production Equipment (PE), for 2 specialties in bachelor degree and began training in master degree with a program in the discipline TOD, which continues now. In the same year, a curriculum was developed in the discipline "Micro-technique" for the MEPT-specialty, and the MEPT department celebrates its 35th anniversary. In connection with this, an analysis was made of the state and trends in the development of leading technologies for micro- and nanotechnical products. New ideas for technologies in the field of biology, household and medical equipment, sensors for cars and smart homes, etc. are sought. Throughout the period there were programs for equations from Blagoevgrad, Lovech and other colleges, training in LTP in the specialty IT (2006), Logistics and UMP in distance learning (2005) and training of students in individual plans (for the Erasmus program, etc...). Under the new curriculum 2003/4, the disciplines SD and PE have been introduced with developed curricula from 2003 again for two specialties. From 2003/4, with new curricula, the discipline MST was renamed MT, and TMEPT became one semester with a workload of 45 + 30 hours. The tendency to reduce the load for all disciplines according to the requirements of the state and the university continues in the future and until now, when it is already 30 + 30 hours. In 2004 in connection with the accreditation programs were developed on "Ecological assembly and recycling of products" and "Waste treatment and recycling" for bachelor's degree and "Production of recyclable products" for master's degree who for various reasons have not entered the educational process, but it should be noted the introduction of the modular principle in them in the future. The new curricula from 2005 again require a program in the discipline TOD for masters degree, and for bachelor degree - TMEPT and MT. The pedagogical work is again connected with the research and an analysis of the state, application and trends in the development of the leading technologies in nanotechnology has been published [13]. The analysis is a continuation of the instructions above from 2003 and expresses an opinion on the development and forecast of

the leading nanotechnologies and their impact on the products until 2015. The development of the automated system "MICROSIS" for MT-components and selection of TP for their production as a habilitation work is implemented in the educational process [14, 28, 29] and provokes invitations to give lectures at NPUU KPI Kiev 2006 and SFU Krasnoyarsk, Siberia-Russia 2007. International contacts lead to the development of joint programs and work on projects published in [15, 16, 17]. Lectures were also given on disciplines from curricula at the University of Rēzekne, Latvia - 2 times and the University of Wilhelmshaven, Germany. In 2005 he was trained under the PUMP program in distance learning, and in 2006. A curriculum for LTP has also been developed. The integration between pedagogical and research work for the whole considered period of 30 years is visible. From 2007/8 the discipline Automated Waste Management Systems (ASWM) with a developed curriculum and project was introduced in the Master's Degree Program in Waste Management, and from 2008/9 - Technique and Technologies for Waste Treatment (TWWT) for bachelors majoring in Waste Management. In 2006/7 a curriculum was prepared, and since 2008/9 the subject Metal-cutting machines and automatic machines (MMA) has been taught in Lovech. Curricula and lectures on "Programming of MM with CNC" and "Mechatronics" have been developed for TC-Lovech. Since 2009 a new discipline "Micro- and nanomechanics" has been introduced for the open master's program in "Mechatronics". The same year the discipline "Mechanical and chemical technologies for purification" was developed for professional bachelors in preparatory training for masters, as well as "Technologies for purification of environmental components" for bachelors and masters outside the field of technical sciences. The same applies to the TPE discipline. In 2009/10 a new curriculum was introduced for a bachelor's degree in the specialty of vocational school and the discipline "Micro-technique", and in 2011 - new programs in PE, TMEPT, TTOO and MT for both specialties. The same year a new discipline "Programming and operation of MM with CNC" was developed for the specialty MUPT. The disciplines are provided with textbooks [18, 19]. In 2012/13 the specialty "Mechatronics" was introduced for bachelors, after 2009 there is one for masters, which requires the preparation of the disciplines "Nano-technique and Technology", "Micro-technique and Technology". New curricula have been developed for the basic discipline TMS, as well as a new discipline "Robotic modules and systems in production" (RMSP). The whole process of Mechatronics training was reported [20] at a round table of the UNITECH conference. More than 300 diploma projects have always been practice-oriented. The teaching materials are [21, 22, 23, 24, 25]. In 2015, in connection with the completion of the specialty of PTME, new plans, programs and disciplines were developed for different options for students entering the Master's degree in Mechatronics. In 2017-8, in accordance with the requirements of the business, the existing and introduced new programs and disciplines Advanced Technologies (AT), High Energy Technologies (HET), "Nano-technique and Technology" (NTT), were updated and introduced. An overview of all pedagogical developments by year is given in Table 1. The authenticity of the training can be recognized in the connections between the subjects - technological disciplines in the engineering specialties of TU-Gabrovo and most of all - in the profession of pedagogical engineer. Training that is evolving.

Table 1: Courses, programs and characteristics for the period of 30 years

Year	Bachelor's degree	Master's degree	Distance and electronic education, postgraduate qualification	TC Lovech and equating from colleges
1990-1994	TMEPT, Project			
1995	SD	TOD, course work	IL	
1996	APUP, TPT, TMEPT, Project			
1997	-		course for PC, Gabrovo	
1998	-		course for PC, Sevlievo „Инструмент“ Gabrovo	
1999	-		MT course for PC, Sevlievo	
2000	IL		IL	
2001	MST, TM		L in ВУНПЦ V.Tarnovo	
2002			L in ВУНПЦ V.Tarnovo KP postgraduate qualification	
2003	TMEPT, TME, MST, PE, MT, CD	TOD		
2004	EC, OPO	ПИОП		
2005	TMEPT, MT	TOD	IL, ПУМП	
2006	ЛТП			MMA
2007	-	ASWM Project		MMA
2008	TWWT			
2009	“ТПКОС”, ТРТ	MNM, “ТПКОС”, ТРТ, МТТ, НТТ		МХТП, MMA
2010	MT		course for PC, Фирма „Корона“	
2011	PE, TMEPT, TWWT и MT, Programming and operation of MM with CNC		Professionally training	
2012	МТТ, НТТ, ТМС, RМSP			Programming and operation of MM with CNC and Mechatronics
2013	Double Degree Schmalkalden, Germany			
2014	-		Mechatronics - course for teachers	
2015	-	MNTT, TODM		
2016-2019	TMS, AT, HET	NTT		
2020	Attendance and distance learning			
Total	34	13	15	6

3. Conclusion

A model of training in mechanical engineering technology and derivative technological disciplines or one of the most important areas, which shapes the engineer, is shared. Its development in the last 30 years is given. The technological direction is divided into 8 thematic cycles, measures are proposed to increase the level of education on the path of integration with Europe and reflective teaching is introduced to form a distinctive personality. Multimedia learning is especially relevant now in the context of the Corona virus pandemic. The bibliography and curricula [26, 27] are available to those interested. The established innovative practice and the applied literature can be used in training and practice.

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