

## 50 YEAR DEPARTMENT OF PRECISION ENGINEERING AND MEASUREMENT INSTRUMENTS

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*Abstract:* The following report showcases the history and development of the fifty year old department of “Precision Engineering and Measurement Instruments” of the Technical University-Sofia. The report provides insight on the main objectives and experimental work done in the department. Quantitative research based on the results of the work of professors, associate professors and post-graduate students is presented. The report takes into consideration the possible future development of the department.

*Keywords:* Precision Engineering, Measurement Instruments, Education, Scientific Research

Fifty years ago, the department of “Precision Engineering and Measurement Instruments” was founded in the Technical University-Sofia. Department members and alumni have been the driving force of progress in the fields of metrology and measurement devices, fine mechanics and optics, mechatronics and office technology, control and quality management in Bulgaria.

The department of “Precision Engineering and Measurement Instruments” was founded in March of 1968 as the department of “Mechanical Instrumentation”. It was done by the Order № 1842 of the Minister of National Education.

The first Head of this department was Assoc. Prof. Doycho Dimitrov, who served the position until 1993. The initial department staff consisted of two associated professors, seven assistants and several technical assistants. Four of the lecturers, incl. the Head of the Department had been transferred from the Department of “Manufacturing Technologies and Industrial Machinery” and the remaining five - from the Department of “Machine Elements and TMM”.

Since the department of “Precision Engineering and Measurement Instruments” has been founded, its team of distinguished professionals and research-assistants has been dedicated to entrenching a successful and noble department. Main priorities throughout the working process were to manage the education process effectively and to encourage the department members to improve academically.

Back in the beginning, the department started off having only an 80 sq. m laboratory at its disposal, as well as a limited amount of laboratory equipment to use, which had been provided by the founding departments. As a result of many years of efforts, the department now has 10 spacious, fully equipped labs, and a total laboratory area of 800 sq. m. These facilities are used for educational and research

purposes and include laser measurement systems (interferometers, centering systems, diffractometers), coordinate measurement systems (three-coordinate measurement machines, instrumental microscopes, profile meters), electronic, optical, pneumatic and mechanical devices for measuring linear and angular dimensions, roughness measurement systems, temperature, pressure, mass, force, speed, vibration, measurement devices etc. A significant part of the present department equipment has been conceived and constructed within the department itself by university lecturers, associate professors, post-graduate students etc. These are mainly medical devices, test equipment for measurement of reliability and wearing out of materials, flow rate measurement of fluids and others. The department also has a well-equipped workshop for mechanical operations.

Presently, the department team consists of 15 members: twelve university lecturers and three technical support officers.

One professor, four associated professors, six assistants - PhD, and one assistant are involved in the educational process and interact with university students. Unfortunately Prof. Doycho Dimitrov PhD, Prof. E. Vuleva PhD, Assoss. Prof. Atanas Sermedzchiev PhD, Assoss. Prof. Nasko Ignatov PhD, Assoss. Prof. Petar Jivkov PhD, Assoss. Prof. Georgi Stavrev PhD and Assoss. Prof. Nikola Tsonev PhD, left us in the heyday of their forces.

Prof. Tsanko Nedev, Assoc. Prof. Alexander Lilov PhD, Assoc. Prof. Bojan Trojanov PhD, Assoc. Prof. Iliya Lazarov PhD, Assoc. Prof. Rumen Yordanov PhD, Assist. Hristo Gurnev and Assist. Kiril Yarmov are already retired, however, some of them haven't ceased their devoted work for the department in terms of lecturing and scientific research.

Over the years, thirty-five university lecturers, ten researchers and twenty scientific- and technical

## PLENARY SESSION

support officers have served the department “Precision Engineering and Measurement Instruments” of the Technical University-Sofia.

Results of their intense work is the establishment and management of fifty-two disciplines in the context of the faculty of Mechanical Engineering and to other faculties - Faculty of Industrial Technology (FIT), Faculty of Management (FM), Faculty of Power Engineering and Power Machines (FPEPM), Faculty of Transport (FT), Faculty of Telecommunications (FTC), Faculty of German Engineering Education and Industrial Management (FGEEIM), English Language Faculty of Engineering (ELFE).

Within the framework of the unified course “Mechanical Engineering” the department of “Precision Engineering and Measurement Instruments” is responsible for specialization “Precision Engineering”. We offer our students lectures in the following subjects:

- Metrology and measurement equipment;
- Precision mechanical equipment;
- Optical and laser technology;
- Medical equipment;
- Office and security equipment;
- Transducers, instruments and systems for measurement and control of physical, mechanical and geometrical parameters;
- Micromechanics;
- Control and quality management.

For the purposes of the course in “Control and quality management”, a training center has been established within the department in the context of two EU Tempus Program projects. These facilities included a seminar hall and a computer room.

Main objectives of the scientific research activities held at TU-Sofia department of “Precision Engineering and Measurement Instruments” are:

- Modular Coordinate Measurement Systems;
- Measurement instruments for shape and position control of surfaces and axes;
- Optical, optoelectronic and laser systems for quality control of geometric parameters;
- Sensors, devices and automatic control systems;
- Control and sorting devices for machine-building and electronics;
- Mechatronic systems and office equipment;
- Medical engineering - microsurgery devices, infusion pumps, equipment for rheology examinations, cryo electrophoresis apparatus;
- Testing methods of product reliability
- Physical and mechanical measurements (mass, pressure, consumption, etc.);
- Development of scientific approaches and

software products for unification and quality assurance.

Having existed for fifty years now, the department of “Precision Engineering and Measurement Instruments” reports its main achievements as it follows:

- More than 2000 graduate students;
- More than 1200 released publications written by department staff members;
- More than 150 patents registered by department staff members;
- Over 400 scientific researches being conducted and reported;
- Over 40 course books being released by department staff members;
- Number of PhD students in the department – 32.

The department of “Precision Engineering and Measurement Instruments” at the Technical University-Sofia has been administrating training courses in post-graduate qualification in the following fields:

- Metrology and metrological assurance, over 500 students have completed the training so far;
- Technical legislation and quality management, over 1300 students have completed the training so far.

The courses named above are carried out in post-graduate training schools in collaboration with the Union of Metrologics in Bulgaria and the German company “TÜV Rheinland”. Having completed the course, students are certified as being for qualified to excel jobs as professional experts, auditors and quality managers with international recognition.

In the course of fifty years, the department of “Precision Engineering and Measurement Instruments” has been educating young professionals, who now have leading positions and distinguished jobs. Our alumni are exercising the jobs of constructors and technologists, heads of enterprises and companies, bank directors, scientific researchers, lecturers at secondary and higher education institutions, deputy ministers, members of The National Assembly, etc. It is safe to say that the department of “Precision Engineering and Measurement Instruments” of the Technical University-Sofia has contributed to their personal success, which is our honor and a proof that our constant effort towards increasing the quality of education is worth it.

In the last few years, the department of “Precision Engineering and Measurement Instruments” has obtained a strategy to modernize the education process. Our main targets are outlined as it follows:

- To broaden the spectrum of knowledge and training we provide to our students through the application of modern technologies, devices and

better materials. Micro- and nanotechnology are entering our learning process and our laboratories;

- To implement in our courses and develop control instruments of Industry 4.0.

- To adjust our course in quality control and management, introducing European safety and quality requirements for the purpose of optimizing the working process and increasing the end product quality.

The features mentioned above have been our main targets for education quality improvement over the last few years. Our collective efforts show positive results, some of which are outlined in the following:

- In 2005, both a Bachelor's Degree Course and a Master's Degree Course in "Mechatronics" were established within the department of "Precision Engineering and Measurement Instruments". The specialty represents an up-to-date version of the old "Mechanical Instrumentation". It combines three fundamentals areas – mechanical engineering, electronics and informatics. Students are offered optional subjects from the following directions - Robotic Devices and Precision and Micromechanical Equipment.

As the mechatronics is an interdisciplinary engineering field the training of this course is held together with the department of "Automation of Discrete Production Engineering" (ADP) and faculties of "Electronic Engineering and technologies" (FEET) and "Computer Systems and technologies" (FCST).

- A new course with a master's degree was established in 2007, "Technical Legislation and Quality Management" (TLQM). The course is available for all students who have already earned a bachelor's degree from TU-Sofia as well as from other institutions of higher education. The course concentrates on management – students are trained to develop and find application of quality managing systems according to the European and Bulgarian legal restrictions and standards. Students' projects throughout the course generally concern the environment, health and safety on the working place, information security, etc.

Between 2013 and 2015, within the frame of Operational Program "Human Resource Development", a project between the TU-Sofia and the industry was realized. It was focused on the measurement systems and quality management. During the project the department of "Precision Engineering and Measurement Instruments" had been running in collaboration with the departments of "Electrical Measurement Systems" (EMS) and "Fundamentals and Technical Means of

Design" (FTMD) as well as the Association of Industrial Capital in Bulgaria (AICB). The project showed positive results: the curriculums of the master's degree courses in "Technical Legislation and Quality Management" and "Metrology and Measurement Equipment" were modernized. The project participants discussed and conceived the starting of a bachelor's degree program in "Metrology and Measurement Equipment".

In 2015, the department of "Precision Engineering and Measurement Instruments" started a new master's degree program, "Medical Equipment", involving lecturers from six faculties at TU-Sofia.

Over the course of the past few years, an international team of authors, with the participation of professors from the department "Precision Engineering and Measurement Instruments", headed by Professor Hristo Radev, released the scientific work "Metrology and Measuring Equipment" – a group of three related scientific books in Bulgarian and Russian language.

At the department of "Precision Engineering and Measurement Instruments", we have focused our work on the development, research and implementation of intelligent measurement systems, based on virtual technical standards. As a result of scientific work, several large-scale intermodal acceleration projects were conducted in France and Germany.

One of the project objectives was the XFEL (European X-ray Free Electron Laser) ultra-high frequency linear accelerator. A similar collaborative enterprise currently takes place in Dubna (Russia). Several PhD dissertations at the department also explored the themes of the above-mentioned projects.

The information given in this report sufficiently proves that our department provides the qualification and skills which are particularly well evaluated by employers in the field of engineering in the world of modern work.

The staff members of the department "Precision Engineering and Measurement Instruments" maintain an expert level. Their expertise is highly requested in the overall engineering community.

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