

## РОЗДІЛ 8. ТЕОРЕТИЧНА ЕЛЕКТРОТЕХНІКА

*To the 120th anniversary of the Department of Theoretical Electrical Engineering of  
Igor Sikorsky Kyiv Polytechnic Institute*

### DEPARTMENT OF THEORETICAL ELECTRICAL ENGINEERING OF IGOR SIKORSKY KYIV POLYTECHNIC INSTITUTE – STAGES OF FORMATION AND DEVELOPMENT

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One of the oldest departments of Kyiv Polytechnic - the Department of Theoretical Electrical Engineering celebrates the 120th anniversary this year. Its history and formation are inextricably linked to the history and formation of the KPI.

According to the "Regulations on the Emperor Alexander II Kyiv Polytechnic Institute" [1], 35 departments were created to ensure the teaching of disciplines, among which appeared the Department of Electrical Engineering in 1901.

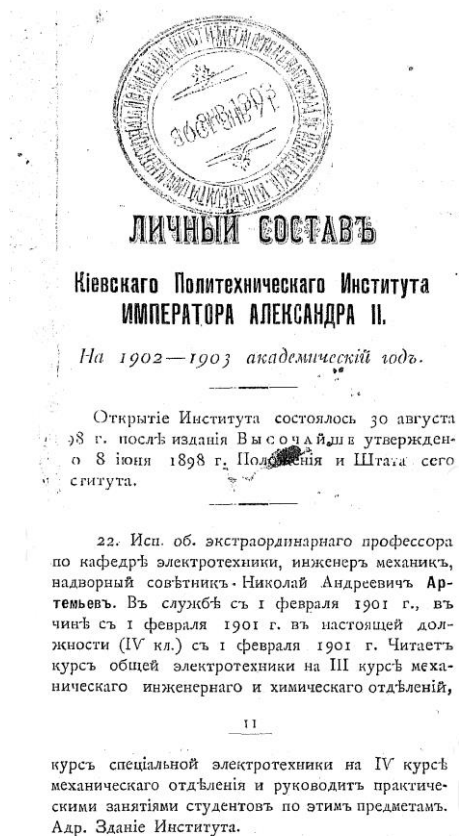


Figure 1

Many famous scientists were invited to work at the institute, among whom was Mykola Andriyovych Artemyev. He was also invited to KPI, on the recommendation of the famous Russian scientist M.Zhukovsky. In 1901 he became the head of the Department of Electrical Engineering, and in 1902 he created and headed the electrical laboratory.

Mykola Andriyovych Artemyev was born in Moscow on December 10, 1870. He was educated at the St.Petersburg Imperial Technical School, the Moscow Higher Technical School, and the Charlettenburg Polytechnic (Berlin).

On returning from abroad M.A.Artemyev worked as the technical director of the Russian branch of the "Siemens and Galske" electrotechnical enterprise. According to his calculations, a new series of three-phase asynchronous motors with a capacity of 1.5 and 3.5 horsepower was manufactured. These engines were 35% lighter than the previous ones.



Figure 2 –  
Mykola Andriyovych  
Artemyev

In 1900 M.A.Artemyev was elected as professor at the Kiev Polytechnic Institute, where for the next 11 years he continued his scientific and pedagogical activities.

In 1902, a 100 kV high-voltage electrical laboratory was organised at KPI [7]. On the installation of high voltage with a transformer of the newest, at that time design, with a capacity of 20 kW and a voltage on the secondary winding of 200 kV, M.A.Artemyev tested a self-developed protective suit for work under high voltages. The main idea of the invention was to use conductors for protection against electric current, which create a closed conductive surface, that is such suit, and do not allow the power lines of the electric field to penetrate through it.

With this design, the high voltage of the machines or devices that the person worked with was grounded and it was possible to work with the equipment without disconnecting it. The underlying principle has been applied to this day. The demonstration of the protective suit took place for the first time at a meeting of the German Electrotechnical Society in Berlin.

According to the projects of M.A.Artemyev a central power plant was built in Kyiv and a city power grid was laid [4, 5].

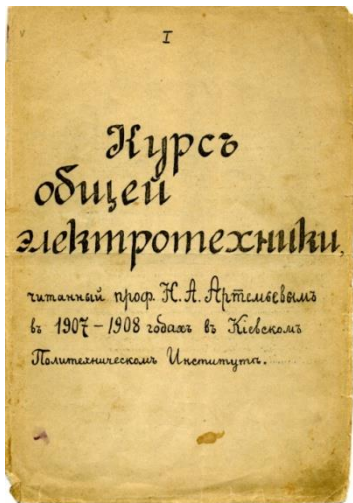


Figure 3 –  
Title page of the textbook  
on electrical engineering,  
M.A.Artemyev

While working at KPI M.A.Artemyev defended his doctoral dissertation on "Determining the size of dynamos and the effect of voltage on the size of the machine." After his defence, he was approved as an ordinary professor of electrical engineering. M.A.Artemyev held a general course in electrical engineering for students of the 3rd year of three departments of the Kiev Polytechnic Institute, a special course for students of the 4th year of the mechanical department, as well as lectures on central power plants and networks [6]. In 1909, a textbook on electrical engineering, based on his lectures, was published.

M.A.Artemyev was the initiator of the creation of an aeronautical department in KPI. In 1907 the South Russian community of electricians was founded by M.A.Artemyev. Under his leadership, a new power plant was designed and built, the city power grid in Kharkiv was expanded and several power plants were merged into one common system in Petrograd.

For a long time M.A.Artemyev worked as a professor at the Department of Electrical Engineering of the Timiryazev Agricultural Academy of Moscow. He took an active part in the development of the GOELRO electrification plan, as practically the only highly professional electrician in the agricultural sector at that time [7].

The future first dean of the Faculty of Electrical Engineering, Anatoly Vladimirovich Krukovsky, became an extraordinary professor of the Department of Electrical Engineering on the heels of M.A.Artemyev. In 1906–1911 he headed the Department of Electrical Engineering and the Electrical Engineering Laboratory of the Ekaterinoslav Higher Mining School (henceforth the National Technical University "Dnipro Polytechnic", Dnipro). From 1911 - Extraordinary Professor and Head of the Department of Electrical Engineering, from September 1918. - First Dean of the Faculty of Electrical Engineering of Kyiv Polytechnic Institute.

From 1914, Alexander Alexandrovich Skomorokhov started working as a full-time lecturer at the department. Later he became a famous electrician, the first head of the department of electric machines (1920) and dean of the Faculty of Electrical Engineering (1922-1925).



Figure 4 –  
I. Gorbachevsky

Since 1921, KPI students have been taught courses: "Introduction to Electrical Engineering", "Encyclopaedia of Electrical Engineering", "Theoretical Foundations of Electrical Engineering" and "Fundamentals of Alternative Theory", "Vector and Harmonic Analysis". Lectures were given by prof.O.O.Skomorokhov, prof. I.D.Gorbachevsky, prof.L.J.Kordish. Laboratories of general electrical engineering and alternating currents worked, both of them were headed by I.Gorbachevsky.

The laboratories were supplied with direct voltage from the faculty battery and three-phase voltage from the institute power plant. The Laboratory of General Electrical Engineering served all five faculties of KPI, the laboratory of alternating currents - only the Faculty of Electrical Engineering. Laboratory classes were conducted by teachers D.N.Rashev, S.I.Inozemtsev. In 1926 O.O.Skomorokhov's textbook "General Electrical Engineering" was published in Ukrainian.

In 1920 the department of electrical engineering was headed by prof. I.D.Gorbachevsky. In 1930 the department was named Theoretical Foundations of Electrical Engineering, at the same time the Department of General Electrical Engineering was established, headed by D.N.Rashev, .

After the outbreak of World War II in 1941, KPI and the Leningrad Polytechnic Institute were evacuated to Tashkent, where they merged with the Central Asian Industrial Institute. In 1944 they returned from evacuation to Kyiv and the department of general electrical engineering was headed by Assoc.Prof. V.L.Ulasik.

In 1944-1950 the theoretical foundations of electrical engineering were taught by Prof. A.D.Nesterenko, who headed the Department of Instrumentation. Many famous scientists such as Assoc.Prof. V.G.Matsevyt, Assoc.Prof. P.G.Gorodetsky, assistants G.V.Devidze and G.M.Mykolyuk, as well as Assoc.Prof. K.V.Czartoryski, who worked at the Department of Electrical Equipment of Industrial Enterprises, gave lectures on theoretical electrical engineering.



Figure 5 –  
Ivan Myronovych  
Chyzhenko

In 1950, the Department of Theoretical Foundations of Electrical Engineering was headed by Ivan Myronovych Chyzhenko.

Ivan Myronovych was born on March 27, 1916 in the village of Kozyn, near Kyiv. In 1922-1931. studied at the school in Obukhov, in 1931-1933 in FZU of communal services at the Kiev tram plant.

He received his higher education at the Faculty of Electrical Engineering of the Kyiv Industrial Institute (now KPI). After the end of the Second World War in 1946, I.M.Chizhenko returned to KPI and in 1949 defended his dissertation on "Compensation of reactive power in circuits with ionic converters."

Under his leadership, the first compensation converter was developed. A total of 46 such converters with a total capacity of 365 MVA were developed and put into operation in industry and electrified transport, which provided annual electricity savings of more than 145 million kWh.

For the development, research and implementation of compensation converters, a team of scientists led by Ivan Mironovich in 1962 was awarded the Lenin Prize of the USSR in the field of electrical engineering.

In 1963 I.M.Chizhenko defended his Ph.D. dissertation, in 1965 he became a professor, and in 1972 - a corresponding member of the Academy of Sciences of Ukraine.

For ten years I.M.Chizhenko was the vice-rector for scientific work of KPI.

In the late 1980's, I.M.Chizhenko and his students began to develop thyristor devices capable of regulating the phase shift between voltage and current at their poles in the widest range.

In 1988, I.M.Chizhenko was elected Academician of the National Academy of Sciences of Ukraine.

I.M.Chizhenko made 33 inventions, which were awarded medals and diplomas of the ENEA(Exhibition of National Economy Achievements) and implemented in industry. There were patents in Germany, Japan, France, Italy. He is the author of more than 300 scientific works, 14 of which are textbooks and monographs.

For almost 40 years he headed the Department of Theoretical Foundations of Electrical Engineering of Kyiv Polytechnic Institute.

In honor of I.M.Chizhenko one of the laboratories of the Department of Theoretical Electrical Engineering was named, memorial plaques were installed on the houses in Kyiv and in the village of Kozyn, where he lived.

In 1950, the Department of Theoretical Foundations of Electrical Engineering consisted of four teachers: Head. Department of I.M.Chizhenko, Assoc. V.G.Matsevyty, assistants G.V.Devidze and G.M.Mykolyuk. In subsequent years, due to a significant increase in the number of students and increased the number of departments of TOE. In 1962, associate professors D.Y.Glukhov and V.S.Rudenko were elected heads of departments of General Electrical Engineering and Industrial Electronics, respectively.

In 1962–84, the Department of General Electrical Engineering was headed by Prof. Dmitry Yakovlevich Glukhov. The department researched electric power processes in valve converters, in particular for electric arc equipment. The works were implemented at the Saratov Chemical Plant.



Figure 6 –  
Anton Mykolayovych  
Silvestrov

From 1984 to 1999 the Department of General Electrical Engineering was headed by Prof., Ph.D. Anton Mykolayovych Silvestrov. Research interests are theoretical and applied aspects of the theory of identification of objects of different nature; adaptive systems of dynamic objects automatic control in the conditions of non-stationarity and a priori uncertainty of their characteristics; improving the theory and practical aspects of electrical engineering from the standpoint of a systems approach; research and explanation of complex electrodynamic processes in Huber's, Milroy's devices, etc.

Under the leadership of A.M.Silvestrov research laboratories were established, where contract-based research were performed. The proceeds allowed to create four training laboratories and equip them with modern electrical equipment: laboratory stands UILS-1, universal laboratory stand EV-4 and measuring instruments.

In 1987, a group of teachers of the Department of Industrial Electronics, headed by Doctor of Technical Sciences, Prof.V.I.Senko joined the staff of the Department of TOE. At that period the educational and scientific laboratory of electronic devices was also established.

The Department of TOE begins to provide training courses: "Theoretical foundations of electrical engineering", "Electrical and magnetic circuits", "Electrical engineering and electronics", "Industrial electronics", "Electronic, microprocessor and converter devices", "Fundamentals of converter technology", "Electronics and microcircuits" ", " Microprocessor technology ", " Electronics ", " Special issues of power transmission ".

In 1989 the head of the department of theoretical bases of electrical engineering became doctor of technical sciences, prof. Vitaly Ivanovich Senko.

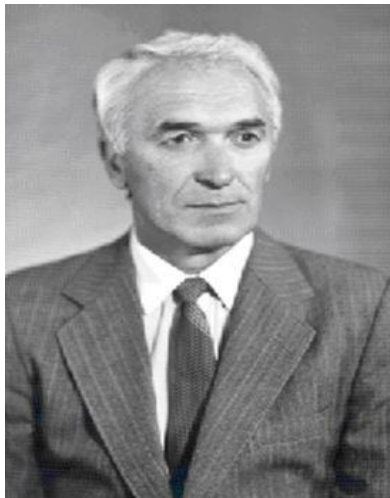


Figure 7 –  
Vitaly Ivanovich  
Senko

Research interests - power electronics, semiconductor frequency converters, power electronic devices, power supply of electronic equipment. Laureate of the State Prize of Ukraine (1982), KPI Prizes (1974 and 1981) and the NASU Prize. G.F. Proskura (1998) for outstanding achievements in the field of energy. Academician of the International Academy of Electrical Sciences, member of the Institute of Electrical and Electronics Engineers (New York).

For more than 30 years, the Department of TOE was the basis for the Scientific and Methodological Commission for Theoretical Electrical Engineering of the Ministry of Higher Education (later the Ministry of Education) of Ukraine. Until 1990, the commission was headed by I.Chizhenko, then - V.I.Senko.

For many years, L.R.Slobodyan was the deputy chairman of the commission, and I.E.Rakhniy was the secretary. O.B.Tolpigo, V.S.Boyko, V.A.Fedorenko, A.O.Baran and others took an active part in the work of the commission.

From 1977 to 1991 there was a faculty department of advanced training of teachers from TOE department. Every year 10-15 or more teachers (not only from Ukraine but also from all over the USSR) came here to study.

Olympiads on the theoretical foundations of electrical engineering are regularly held, in which students of KPI and other universities of Kyiv and all over Ukraine take part.

The department places special emphasis on the initial methodical work. In addition to the traditional courses for the department such as "Theoretical foundations of electrical engineering", "Electrical Engineering", "Theory of electric and magnetic circuits" the courses "Mathematical problems of energy" and "Transmission of high voltage direct current" were developed and methodically provided

In 1982, I.M.Chizhenko, V.I.Senko, and V.S.Rudenko were awarded the State Prize of Ukraine in the field of science and technology for the textbook "Fundamentals of Transforming Technology."

The end of the XX - the beginning of the XXI century are marked by the recognition of pedagogical skill of the leading teachers of the department. Four of them were approved in the academic title of professor - V.I.Shekhovtsov (1992), I.A.Kurilo (1993), V.S.Boyko (1995), L.R.Slobodyan (2002). ). In 1992 I.A.Kurylo was awarded a diploma of the Ministry of Education of Ukraine for achievements in educational and methodical work.

In 1999, the Department of Theoretical Foundations of Electrical Engineering and General Electrical Engineering was merged into the Department of Theoretical Electrical Engineering (TE), which in 1999-2002 was headed by Professor V.I.Senko.



Figure 8 –  
Anatoliy Andriyovych  
Shcherba

In 2003, Anatoliy Andriyovych Shcherba, Corresponding Member of the National Academy of Sciences of Ukraine, Doctor of Technical Sciences, Professor, Laureate of the State Prize of Ukraine in Science and Technology, was elected Head of the Department of Theoretical Electrical Engineering.

Scientific research of A.A.Shcherba aimed at developing the theory of non-stationary electrophysical processes and the development of electrical equipment for the implementation of new electrical technologies in energy and industry. He substantiated new regularities of perturbation of low-frequency electric fields in nanomodified solid polymer insulation and the emergence of threshold electrophysical processes in it, on the basis of which he developed a kinetic activation theory of threshold mechanisms of its degradation.

A.A.Scherba developed the basics of the theory of formation of multichannel electric discharge currents in a layer of metal granules between electrodes with rapid migration of short-term electrosparks - microplasma formations. He identified the relationships between the electrical parameters of discharge pulses and the characteristics of spark erosion powders as the basis for the principles of construction of semiconductor systems for the production of micro- and nanopowders with unique properties.

Under the chairmanship of A.A.Shcherba the department received a new impetus in the development of scientific work, improved methodological and publishing activities, significantly increased the participation of young professionals in teaching and research processes, there young candidates of science came to.

At the initiative of A.A.Shcherba, a scientific council was created and it has been working to defend PhD theses in the specialty 05.09.05 "Theoretical Electrical Engineering". Scientific research for high-tech enterprises has been successfully conducted on the following topics: "Improving the reliability, electrical capacity and environmental friendliness of power cables for voltages up to 110 kV and the development of new technology for their industrial manufacture and diagnostics", "Optimisation of new technology for industrial production of cables with rigid polymer insulation to improve energy networks of ultrahigh voltages", technical means of non-destructive diagnostics of domestic over high-voltage cables of world level for increase of their operational reliability and resource “.

The All-Ukrainian Olympiads in theoretical electrical engineering were held at the department from 2012 to 2017.

A.A.Shcherba awarded Diplomas of the Ministry of Education and Science of Ukraine (2008) and the Verkhovna Rada of Ukraine (2009), winner of the prize of the National Academy of Sciences of Ukraine. V.M. Khrushchev (2010).

In 2004, the first volume of the textbook "Theoretical Foundations of Electrical Engineering" was published. The second and third volumes were published in 2008 and 2013, respectively. June 30, 2016 at a meeting of the Academic Council of NTUU "KPI" on the results of the competition for the best textbook, manual, monograph author's team of the textbook "Theoretical Foundations of Electrical Engineering" in 3 volumes - V.S.Boyko, V.V.Boyko, Y.F.Vidolob, I.A.Kurylo, V.I.Shekhovtsov, V.A.Shydlovska became the winner of the NTUU "KPI" award.

A.A.Shcherba has more than 420 scientific publications, including 9 monographs, 27 publications in SCOPUS, 32 patents for inventions, 5 scientific and methodological publications, 7 textbooks for universities with the stamp of the Ministry of Education and Science of Ukraine, 18 educational publications with the stamp NTUU "KPI", 13 electronic educational publications with the stamp of NTUU "KPI".

In January 2015, the Department of Theoretical Electrical Engineering was headed by Professor, Doctor of Technical Sciences Ostroverkhov Mykola Yakovych.



Figure 9 –  
Mykola Yakovych  
Ostroverkhov

The main directions of scientific research: electromechanical automatic control systems with contactless actuators; methods of control of interconnected electromechanical systems in the conditions of uncertainty of mathematical model of object.

M.Y.Ostroverkhov graduated from the Faculty of Electrical Engineering of Kyiv Polytechnic Institute with a degree in "Electric drive and automation of industrial plants" in 1985.

He defended his dissertation on June 17, 1991 at the Kiev Polytechnic Institute, specialty 05.13.07- "Automation of technological processes and industries" on "System of automatic control of the telescopicity of the rolls when rolling."

M.Y.Ostroverkhov defended the doctoral dissertation on January 17, 2013 at NTU "Kharkiv Polytechnic Institute" in the specialty 05.09.03- "Electrotechnical complexes and systems" on "Electromechanical systems based on contactless actuators for automatic control of the parameters of the staff during continuous rolling.

At the Department of Automation of Electromechanical Systems and Electric Drive, he went from a research trainee to a professor. He taught the disciplines "Theory of electric drive", "Automated process control systems", "Computing and programming". He was responsible for scientific, educational and methodical work of the department.





Figure 10 –  
Volodymyr Oleksandrovych  
Brzezycki

In the summer of 2018, a group of teachers from the Department of Electrophysics of High Voltages, headed by Dr., Prof. V.O.Brzezycki joined the Department of Engineering. In 1954–2018 at the Department of Engineering and Electrophysics of high voltages studied the electric and magnetic fields of energy objects and their impact on the environment; insulation of overhead and cable power lines; insulation of station and substation equipment and issues of protection of energy facilities from surges and lightning.

From 1993 to 2018 The Department of Engineering and Electrophysics of High Voltages was headed by Prof., Ph.D. Brzezycki Volodymyr Oleksandrovych.

His research interests are metrological support for measurements of high voltages and high currents; methods of selection of non-linear over-voltage limiters for 110-750 kV electrical networks. Under his leadership, a set of measuring devices of the highest accuracy of the voltage class of 500 kV was made and implemented.

Currently, the department has a scientific school "Development of the energy conversion theory of the electromagnetic field and its practical application in electrical engineering", the founder of which is an academician of the NAS of Ukraine (1988), winner of the State Prize (1982), Vice-Rector for Research KPI 1959-1969), Head of the Department of Theoretical Foundations of Electrical Engineering (1950-1989) Chizhenko Ivan Myronovych. The scientific supervisor of the school is the head of the department of theoretical electrical engineering, doctor of technical sciences, professor Ostroverkhov Mykola Yakovych.

Research at the school is carried out in the following scientific areas, which are headed by followers of I.M.Chizhenko:

- "Theory of non-stationary electrophysical processes in energy", head: Corresponding Member of the National Academy of Sciences of Ukraine, Professor of Theoretical Electrical Engineering Shcherba Anatoliy Andriyovych;
- "Research of semiconductor converters of modulation type", head: Doctor of Technical Sciences, Professor of the Department of Theoretical Electrical Engineering Senko Vitaliy Ivanovych;
- "Electrical control systems in conditions of uncertainty of the mathematical model of the object", head: Doctor of Technical Sciences, Head of the Department of Theoretical Electrical Engineering Ostroverkhov Mykola Yakovych;
- "Converters of electric energy of compensatory type", head: Doctor of Technical Sciences, Professor of the Department of Theoretical Electrical Engineering Boyko Valeriy Stepanovych;

- "Systems and methods of purposeful identification of electrical objects", head: doctor of technical sciences, professor of the department of theoretical electrical engineering Silvestrov Anton Nikolaevich.

- "Engineering and Electrophysics of High Voltages", head: Doctor of Technical Sciences, Professor of Theoretical Electrical Engineering Brzezycki Volodymyr Oleksandrovyh.

72 candidate and 19 doctoral dissertations were defended within the school; 125 monographs, textbooks and manuals were published; there were published about 800 scientific papers in professional journals; there were received more than 100 security documents for intellectual property rights; 53 scientific articles are included in the scientometric database Scopus. The works of school scientists are cited 239 times in Scopus, in particular A.A.Shcherba has an index of Hirsch 14, and M.A.Scherba - 6.

High scientific achievements of school scientists were marked by prestigious state awards, in particular: I.M.Chizhenko, V.I.Senko, V.S.Rudenko, A.A.Shcherba, M.A.Shcherba - laureates of the State Prize of Ukraine; Y.V.Peretyatko, M.A.Shcherba - Laureates of the President of Ukraine Award for Young Scientists; V.S.Boyko, V.I.Senko and A.A.Shcherba - Laureates of the award of National Academy of Sciences of Ukraine, named after G.F.Proskury and V.M. Khrushchev. Teachers of the department M.A.Shcherba and O.O.Biletsky became the winners of the competition "Young teacher-researcher of KPI".

On the basis of the Department of Theoretical Electrical Engineering, Faculty of Electrical Engineering and Automation Igor Sikorsky KPI, the student groups such as "Semiconductor devices in electrical systems" (head Assoc. Prof. V.P.Grudska), "Theoretical and General Electrical Engineering" (head Assoc. Prof. L.Y.Spinul) and "Theory and practice theoretical foundations of electrical engineering "(supervisor Assoc. Prof. V.V.Mikhailenko) were created and conduct research work. Scientific student groups are created to enrich and consolidate the acquired knowledge and skills of students, preparing them to solve practical problems. Participants of the circles had made numerous reports at the International Scientific and Technical Conference "Modern Problems of Electrical Engineering and Automation", published scientific papers in professional journals of Ukraine. Members of the circles have repeatedly become winners and prize-winners of the All-Ukrainian and University Olympiads in Theoretical Foundations of Electrical Engineering and Electrical Engineering.

In 2018, the Department of TE becomes a graduate, opens a new majoring "Electrical devices and electrical systems" and in the same year carries out the first set of students to study.

The Department of Theoretical Electrical Engineering is one of the largest and oldest departments of the National Technical University of Ukraine "Igor Sikorsky Kyiv Polytechnic Institute», which provides basic and professionally-oriented electrical training. About 5,000 students from 53 graduating departments of 17 faculties of the university study at the department every year. This obliges the staff of the department to be responsible in the organisation of the educational process, to form

professional skills and to cultivate a conscientious attitude to the education of student youth.

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