

**MINISTRY OF EDUCATION AND SCIENCE OF UKRAINE  
NATIONAL TECHNICAL UNIVERSITY OF UKRAINE  
«IGOR SIKORSKY KYIV POLYTECHNIC INSTITUTE»**

APPROVED BY  
Academic Council of Igor Sikorsky Kyiv Polytechnic Institute  
(Prot. № 3 from 15.03.2021)  
Head of the Academic Council  
\_\_\_\_\_ Mykhailo ILCHENKO

**ACOUSTIC ELECTRONIC SYSTEMS AND ACOUSTIC  
INFORMATION PROCESSING TECHNOLOGY**

**EDUCATIONAL PROGRAM**

**for second (Master) level of higher education**

**Specialty**                    **171 Electronics**  
**Field of knowledge**   **17 Electronics and telecommunications**  
**Qualification**            **Master on Electronics**

Entered into force from  
2021/2022 academic year  
by order of the rector  
Igor Sikorsky Kyiv Polytechnic Institute  
from 19.04.2021, № HOH/89/2021

Kyiv – 2021

## PREAMBLE

### DEVELOPED by the project team:

*Project team leader:* Naida Serhii Anatoliyovych, Head of the Department of Acoustic and Multimedia Electronic Systems, Doctor of Technical Sciences, Professor.

*Members of the project team:*

Drozdenko Oleksandr Ivanovych, Associate Professor of the Department of Acoustic and Multimedia Electronic Systems, Ph.D., Assoc. Prof.

Zhelyaskova Tetyana Mykolayivna, Associate Professor of the Department of Acoustic and Multimedia Electronic Systems, Ph.D.

Parenjuk Dmytro Volodymyrovych, graduate student of the Department of Acoustic and Multimedia Electronic Systems

The Department of Acoustic and Multimedia Electronic Systems is responsible for the training of applicants for higher education according to the educational program.

### AGREED:

Scientific and Methodological Commission of the University, specialty 171 Electronics

Head of the SMCU 171 \_\_\_\_\_ Yulia YAMNENKO

(Prot. № 4 from 02.02. 2021)

Methodical Council of Igor Sikorsky KPI.

Head of the Methodical Council

\_\_\_\_\_ Yurii YAKYMENKO

(Prot. № 6 from 25.02. 2021)

1. Methodical recommendations of the higher education sector of the Scientific and Methodological Council of the Ministry of Education and Science of Ukraine

<https://mon.gov.ua/ua/osvita/visha-osvita/naukovo-metodichna-rada-ministerstva-osviti-i-nauki-ukrayini/metodichni-rekomendaciyi-vo>

2. Standard of higher education in the specialty 171 Electronics of the second (master's) level

<https://mon.gov.ua/storage/app/media/vyshcha/standarty/2020/05/2020-zatverd-standart-171-m.pdf>

3. Comments and suggestions taken into account:

- K.B. Kovalchuk, Acting Director of the State Enterprise "Kyiv State Research Institute of Hydraulic Devices" (State Concern "Ukroboronprom"), Candidate of Technical Sciences;

- G.G. Lutsenko, director of ULTRAKON-SERVICE LLC;

- O.Yu. Asanova, director of MAG AUDIO LLC;

- applicants for higher education who study in educational programs specialty 171 Electronics.

Feedback reviews and support letters from stakeholders are attached.

Agreed with members of the scientific-methodical commission and the support group of the specialty 171 Electronics Igor Sikorsky Kyiv Polytechnic Institute.

The educational program was considered at the meeting of the Department of Acoustic and Multimedia Electronic Systems., Protocol № 8 of January 20, 2021.

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# 1. PROFILE OF THE EDUCATIONAL PROGRAM

## in the specialty 171 Electronics

| <b>1 - General information</b>   |   |
|--|---|
| Full name of institution of higher education and institute / faculty   | National Technical University of Ukraine “Igor Sikorsky Kyiv Polytechnic Institute”, Faculty of Electronics |
| Higher education degree and title of qualification in the original language  | Degree – Master<br>Educational qualification – Master of electronics  |
| The official name of the educational program   | Acoustic electronic systems and acoustic information processing technologies                                |
| Type of diploma and scope of the educational program   | Master's degree, single, 120 credits, term of study 1 years and 9 months                                    |
| Availability of accreditation  | Certificate of accreditation of the specialty ND 1192632, valid until 01.07.2023                            |
| Cycle / level of higher education  | NFC of Ukraine – level 7<br>QF-EHEA – the second cycle<br>EQF-LLL – 7 level                                 |
| Prerequisites  | The presence of a bachelor's degree   |
| Teaching languages   | Ukrainian / English   |
| Validity of the educational program  | Until the next accreditation  |
| Internet address of the permanent placement of the educational program   | <a href="https://osvita.kpi.ua/171">https://osvita.kpi.ua/171</a>   |
| <b>2 - The purpose of the educational program</b>  |   |
| Training of highly qualified electronics specialists capable of solving complex research and innovation problems based on the use of deep fundamental and practical knowledge, and application of modern methods of modeling electronic speakers and experimental research, in terms of sustainable innovative scientific and technical development of society and high adaptability higher education in the context of labor market transformation through interaction with employers and other stakeholders. |   |

### 3 - Characteristics of the educational program

|   |   |
|---|---|
| Subject area                              | <p><i>Object of activity:</i> basic physical processes and phenomena on which the functioning of electronic devices, devices and systems, electroacoustic energy conversion, primary and secondary information conversion systems, analog and digital components, processes and systems of collection, storage, protection, processing, transmission of acoustic information and integration of these systems for automation of engineering tasks with use of modern computer equipment and software.</p> <p><i>Learning objectives:</i> acquisition of theoretical and practical knowledge and skills, abilities and other competencies for successful professional activity: use of technologies, materials and devices of electronic equipment; design, manufacture, testing, installation and installation, operation, restoration and modernization of electronic acoustic systems.</p> <p>Theoretical content of the subject area: fundamental principles of construction of modern acoustic electronic systems, control and management systems, methods of modeling objects and processes and their optimization, modern computer and information technologies of acoustic information processing, tools of engineering and scientific research, theory of planning and conducting experiments.</p> <p><i>Methods, techniques and technologies:</i> research of processes in electroacoustic devices, devices and systems; planning an experiment with processing the results; modern multimedia, computer and information technologies; application of acoustic information processing technologies in the design of acoustic electronic devices, devices, components and systems.</p> <p><i>Tools and equipment:</i> electronic instruments, devices, components and systems, control and measuring equipment, acoustic electronic systems for various purposes, including equipment for non-destructive acoustic control, registration and display of information, technical vision, microcontroller control systems, software for analysis, calculation and modeling of acoustic processes electronic devices and systems.</p> |
| Orientation of the educational program    | Educational-scientific program  |
| The main focus of the educational program | <p>The program is aimed at forming the competencies necessary for: planning experiments, processing their results with general and applied software for the development and maintenance of design documentation and for the selection and justification of optimal circuit solutions for creating acoustic electronic devices and systems.</p> <p><b>Keywords:</b> Acoustic electronic systems; Acoustic information processing technologies; Electroacoustic devices and systems; Acoustic non-destructive testing; Acoustoelectronics; Medical acoustics; Hydroacoustics; Electroacoustics; Acoustic monitoring; Innovative activity.</p>   |

|  |  |
|--|--|
| Features of the program  | <p>The program is based on the requirements of the European Qualifications Framework for Lifelong Learning (EQF-LLL). Possibility of obtaining higher education in dual form. Participation of students in certificate programs. Students receive special knowledge of modern technologies for processing and protection of acoustic information, electroacoustic devices and systems that belong to the field of electronic acoustic systems and can work at Ukrainian enterprises in the relevant profile. The uniqueness of the program is determined by its content. During the preparation of masters, educational components in the field of such areas of electronics as acoustoelectronics, electroacoustics, medical electronic systems, hydroacoustic systems, electronic means of acoustic control, processing of acoustic signals, etc. are combined. The available material and technical base of educational and scientific laboratories is used for development of competences of a practical direction. The implementation of the program involves the involvement of specialists and experts in the field of 171 Electronics, as well as representatives of stakeholders.</p> |
| <b>4 - Suitability of graduates for employment and further study</b> |  |
| Suitability for employment   | <p>2144 Professionals in electronics and telecommunications:</p> <ul style="list-style-type: none"> <li>– Researcher (electronics, telecommunications)</li> <li>– Junior researcher (electronics, telecommunications)</li> <li>– Researcher-consultant (electronics, telecommunications)</li> <li>– Electronics and Telecommunications Engineer;</li> <li>– Recording engineer</li> <li>– Electronics engineer</li> <li>– Electronics engineer of non-traditional and renewable energy production systems</li> <li>– Design Engineer (Electronics)</li> </ul> <p>2149 Professionals in other fields of engineering:</p> <ul style="list-style-type: none"> <li>– Research engineer</li> <li>– Debugging and testing engineer (electronics)</li> <li>– Standardization and quality engineer</li> <li>– Engineer</li> <li>– Operation and Repair Engineer (Electronics)</li> </ul>   |
| Further training   | The Master of Electronics has the right to study according to the program of the Doctor of Philosophy  |

| <b>5 - Teaching and assessment</b>    |   |
|---------------------------------------|---|
| Teaching and learning                 | <p>General learning style - task-oriented. Teaching is carried out in the form of: lectures, seminars, practical classes, laboratory classes, independent work with the possibility of consultation with the teacher, individual classes, application of information and communication technologies (e-learning, online lectures, OCW, distance learning courses) for individual educational components.</p> <ul style="list-style-type: none"> <li>-lectures, practical and seminar classes, computer workshops, laboratory and calculation works, practices, interactive workshops - in classroom, remote, mixed format;</li> <li>-conducting classroom classes with the involvement of professionals-practitioners of the industry, including in the territories of partner companies;</li> <li>-participation in scientific, scientific and technical international and interdisciplinary conferences, seminars, projects, trainings;</li> <li>-independent work with the use of methodical and scientific information sources;</li> <li>-participation in research project development groups;</li> <li>-consultations with scientific and pedagogical workers.</li> </ul> <p>The study ends with the writing and public defense of a qualifying work - a master's thesis.</p> |
| Evaluation                            | <p>Assessment of students' knowledge is carried out in accordance with the Regulations on the system of assessment of learning outcomes in KPI. Igor Sikorsky for all types of classroom and extracurricular work (current, calendar, semester control); oral and written exams, tests.</p>   |
| <b>6 - Program competencies</b>       |   |
| Integral competence                   | <p>Ability to solve complex specialized problems and practical problems characterized by complexity and uncertainty of conditions during professional activities in the field of electronics, or in the learning process involving research and / or innovation in the application of theories and methods of electronics.</p>  |
| <b>General Competences (GC)</b>       |   |
| GC 1                                  | Ability to abstract thinking, analysis and synthesis  |
| GC 2                                  | Ability to communicate in the state language both orally and in writing.  |
| GC 3                                  | Ability to communicate in a foreign language both orally and in writing   |
| GC 4                                  | Ability to conduct research at the appropriate level  |
| GC 5                                  | Ability to search, process and analyze information from various sources   |
| GC 6                                  | Ability to generate new ideas (creativity)  |
| GC 7                                  | Ability to interpersonal interaction  |
| GC 8                                  | Ability to communicate with representatives of other professional groups of different levels (with experts from other fields of knowledge / types of economic activity)   |
| <b>Professional competencies (PC)</b> |   |
| PC 1                                  | Ability to assess the level of existing technologies of the electronic industry in the field of professional activity, the effectiveness of technical solutions   |
| PC 2                                  | Ability to plan and implement innovative projects in the field of electronics, protect intellectual property rights.  |
| PC 3                                  | Ability to systematically solve problems of development, analysis, calculation, modeling of electronic devices, components, devices and systems for various purposes  |

|                                      |  |
|--------------------------------------|--|
| PC 4                                 | Ability to use information, computer and multimedia technologies, methods of modeling, intellectualization, artificial intelligence, experimental methods for research and analysis of processes in electronic devices, components, devices and systems.                       |
| PC 5                                 | Ability to ensure the efficiency and quality of measurements in electronic devices, components, devices and systems.   |
| PC 6                                 | Ability to find the necessary information with the help of modern information resources, analyze and evaluate it.  |
| PC 7                                 | Ability to solve problems of processing and displaying information in modern electronic devices, devices and systems.  |
| PC 8                                 | Ability to assess problem situations and shortcomings in the development, design, commissioning, operation and operation of electronic devices, devices and systems, to formulate proposals for solving problems   |
| PC 9                                 | Ability to take into account in design and technological, engineering and scientific and technical solutions requirements for safety of life, protection of intellectual property, energy efficiency and environmental friendliness  |
| PC 10                                | Ability to present research results to specialists and non-specialists, to lead a discussion and argue their own position.   |
| PC 11                                | Ability to plan and conduct research using modern experimental methods and tools and methods of computer modeling, analyze research results, substantiate conclusions and recommendations.   |
| PC12                                 | Ability to analyze, synthesize and optimize modern electronic and acoustic systems, control and management systems, as well as to process information in them.   |
| PC 13                                | Ability to develop design and technological documentation for the manufacture of electronic acoustic systems designed to work in gases, liquids, and solids, in accordance with industry regulations; to carry out their testing, certification and examination.               |
| PC 14                                | Ability to apply modern methods for the development of new electroacoustic technologies, devices and systems designed for acoustic non-destructive testing, acoustoelectronics, medical acoustics, hydroacoustics, electroacoustics, architectural acoustics, acoustic ecology |
| PC 15                                | Ability to formulate the novelty and relevance of research work, to conduct a scientific discussion and present the results of research on a given topic in the field of electronic acoustic systems and acoustic information processing technologies.                         |
| <b>7 - Program learning outcomes</b> |  |
| O1                                   | Implement projects to modernize production and technology in the field of electronics, implement the latest information and communication technologies, multimedia   |
| O2                                   | Model and experimentally study phenomena and processes in electronic devices, devices and systems, in technologies of electronic industry  |
| O3                                   | Collaborate with the customer during the formulation of the terms of reference and discussion of technical solutions and results of projects, to lead a reasoned professional and scientific discussion  |
| O4                                   | Develop low-waste, energy-saving and environmentally friendly technologies, taking into account the requirements of safety of human life, rational use of raw materials, energy and other resources  |
| O5                                   | Ensure energy and economic efficiency of development, production and operation of electronic equipment   |
| O6                                   | Ensure professional development of team members taking into account the world level of scientific and engineering achievements in the field of development and operation of electronic devices, devices and systems  |



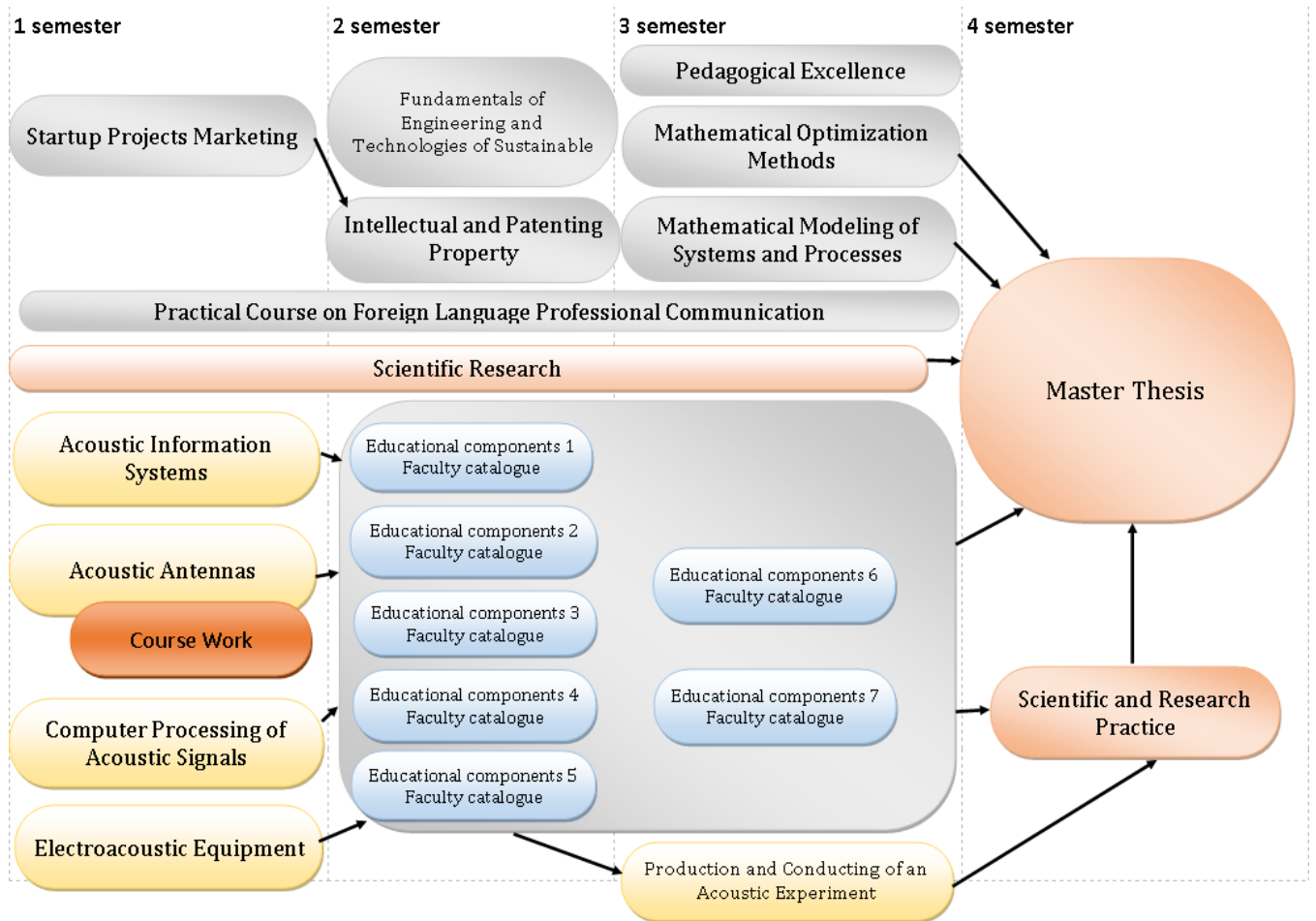
|  |  |
|--|--|
| O 7  | Carry out information and scientific research using scientific, technical and reference literature, databases and knowledge, other sources of information, critically comprehend and interpret existing knowledge and data, form directions of research and development taking into account domestic and foreign experience                |
| O8   | Carry out and coordinate the development, selection, use and modernization of the necessary equipment, tools and methods during the organization of the production process, taking into account technical and technological capabilities, modern science-intensive methods, tools and technical solutions.                                 |
| O9   | Coordinate the work of teams of performers in the field of research, design, development, analysis, calculation, modeling, production and testing of electronic components, devices and systems, taking into account the requirements of civil and moral values, human rights and freedoms, the rule of law                                |
| O10  | Choose the best research methods, modify, adapt and develop new methods  |
| O11  | Analyze technical and economic indicators, reliability, ergonomics, patent purity, market needs, investment climate and compliance of design solutions, research and development with certain goals and norms of the legislation of Ukraine  |
| O12  | To generalize modern scientific knowledge in the field of electronics and apply them to solve complex scientific and technical problems, bringing the obtained solutions to the level of competitive developments, implementation of results in business projects  |
| O13  | Organize and manage research, innovation and investment activities, business projects and production processes taking into account technical, technological and economic factors   |
| O14  | Investigate processes in electronic components, devices and systems using modern experimental methods and equipment, computer modeling methods, perform statistical processing and analysis of experimental results and calculations.  |
| O15  | Participate in the development and implementation of projects of international scientific cooperation and academic mobility.   |
| O16  | Analyze, synthesize and optimize modern electronic and acoustic systems, control and management systems, as well as process information in electronic acoustic systems.  |
| O 17   | Develop design and technological documentation for the manufacture of electronic acoustic systems designed to work in gases, liquids, and solids, in accordance with industry regulations; to carry out their testing, certification and examination   |
| O 18   | Apply modern methods for the development of new electroacoustic technologies, devices and systems designed for acoustic non-destructive testing, acoustoelectronics, medical acoustics, hydroacoustics, electroacoustics, architectural acoustics, acoustic ecology  |
| O 19   | To formulate novelty and urgency of research work, to conduct scientific discussion and to present results of researches on the set subjects in the field of acoustic electronic systems and technologies of processing of acoustic information.   |
| <b>8 - Resource support for program implementation</b> |  |
| Staffing   | In accordance with the personnel requirements for ensuring the implementation of educational activities for the relevant level of HE, approved by the Resolution of the Cabinet of Ministers of Ukraine dated 30.12.2015 № 1187 as amended in accordance with the Resolution of the Cabinet of Ministers of Ukraine №347 dated 10.05.2018. |

|   |   |
|---|---|
| Logistics   | In accordance with the technological requirements for material and technical support of educational activities of the relevant level of HE, approved by the Resolution of the Cabinet of Ministers of Ukraine dated 30.12.2015 № 1187 as amended in accordance with the Resolution of the Cabinet of Ministers of Ukraine № 347 dated 10.05.2018.<br>Use of equipment for lectures in the format of presentations, network technologies, in particular on the Sikorsky distance learning platform, demonstration industry equipment during laboratory workshops |
| Information and educational and methodical support  | In accordance with the technological requirements for educational and methodological and informational support of educational activities of the relevant level of HE (Annex 5 to the License Terms), approved by the Resolution of the Cabinet of Ministers of Ukraine dated 30.12.2015 № 1187 as amended in accordance with the Resolution of the Cabinet of Ministers of Ukraine № 347 from 10.05.2018<br>Use of the Scientific and Technical Library of KPI Igor Sikorsky  |
| <b>9 - Academic mobility</b>                        |   |
| National credit mobility                            | Possible subject to the conclusion of relevant agreements   |
| International credit mobility                       | A framework agreement on cooperation between the University of Le Mans (France) and NTUU "KPI" dated June 23, 2015 on international cooperation and a double master's degree in acoustoelectronics  |
| Training of foreign applicants for higher education | Possibility of teaching in Ukrainian in general training groups or in English with the provision of learning Ukrainian as a foreign language  |

## 2. LIST OF COMPONENTS OF THE EDUCATIONAL PROGRAM

| Code n / a   | Components of the educational program (academic disciplines, practices, qualification work) | Number of credits | Form of final control |
|--|---|-------------------|-----------------------|
| 1  | 2   | 3                 | 4                     |
| <b>1. Compulsory educational components</b>  |   |                   |                       |
| 1.1. General training cycle  |   |                   |                       |
| GT 1   | Intellectual property and patent science  | 3                 | Credit                |
| GT 2   | Fundamentals of engineering and technology of sustainable development                       | 2                 | Credit                |
| GT 3   | Practical course of foreign language scientific communication                               | 4.5               | Credit                |
| GT 4   | Marketing startup projects  | 3                 | Credit                |
| GT 5   | Pedagogical skills  | 2                 | Credit                |
| GT 6   | Mathematical methods of optimization  | 4                 | Exam                  |
| GT 7   | Mathematical modeling of systems and processes  | 4                 | Exam                  |
| 1.2. Vocational training cycle   |   |                   |                       |
| VC 1   | Acoustic information systems  | 5                 | Exam                  |
| VC 2   | Acoustic antennas   | 6                 | Exam                  |
| VC 3   | Course project on acoustic antennas   | 1.5               | Credit                |
| VC 4   | Computer processing of acoustic signals   | 5                 | Exam                  |
| VC 5   | Electroacoustic equipment   | 5                 | Credit                |
| VC 6   | Staging and conducting an acoustic experiment   | 7.5               | Exam                  |
| Research (scientific) component  |   |                   |                       |
| VC 7   | Scientific work on the topic of master's dissertation                                       | 10.5              | Credit                |
| VC 8   | Research practice   | 10                | Credit                |
| VC 9   | Completion of a master's dissertation   | 16                | Defence               |
| <b>2. Optional educational components</b>  |   |                   |                       |
| 2.1. Vocational training cycle (Optional subjects from Faculty catalogue)                              |   |                   |                       |
| VO 1   | Educational component 1 of the F-Catalog  | 5                 | Exam                  |
| VO 2   | Educational component 2 of the F-Catalog  | 5                 | Exam                  |
| VO 3   | Educational component 3 of the F-Catalog  | 5                 | Exam                  |
| VO 4   | Educational component 4 of the F-Catalog  | 4                 | Credit                |
| VO 5   | Educational component 5 of the F-Catalog  | 4                 | Credit                |
| VO 6   | Educational component 6 of the F-Catalog  | 4                 | Credit                |
| VO 7   | Educational component 7 of the F-Catalog  | 4                 | Credit                |
| <b>The total amount of Compulsory educational components:</b>  |   |                   | <b>89</b>             |
| <b>The total amount of optional components:</b>  |   |                   | <b>31</b>             |
| <b>The amount of educational components that ensure the acquisition of competencies of certain SVO</b> |   |                   | <b>59</b>             |
| <b>TOTAL VOLUME OF THE EDUCATIONAL PROGRAM</b>   |   |                   | <b>120</b>            |

### 3. STRUCTURAL AND LOGICAL SCHEME OF THE EDUCATIONAL PROGRAM



### 4. FORM OF CERTIFICATION OF APPLICANTS FOR HIGHER EDUCATION

Certification of higher education students under the educational-scientific program "Acoustic electronic systems and acoustic information processing technologies " specialty "Electronics" is carried out in the form of public defense (demonstration) of qualification work - master's dissertation and ends with the issuance of a standard document for master's degree Master of Electronics in the educational and scientific program "Acoustic electronic systems and acoustic information processing technologies."

Certification is carried out openly and publicly. The master's dissertation is checked for plagiarism and after defense is placed in the repository of the NTB of the university for free access.

## 5. MATRIX OF CORRESPONDENCE OF PROGRAM COMPETENCIES TO THE COMPONENTS OF THE EDUCATIONAL PROGRAM

|       | GT 1 | GT 2 | GT 3 | GT 4 | GT 5 | GT 6 | GT 7 | VC 1 | VC 2 | VC 3 | VC 4 | VC 5 | VC 6 | VC 7 | VC 8 | VC 9 |
|-------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|
| GC 1  |      |      |      | +    |      | +    | +    | +    |      | +    | +    | +    | +    | +    | +    | +    |
| GC 2  | +    | +    |      | +    | +    | +    | +    | +    | +    | +    | +    | +    | +    | +    | +    | +    |
| GC 3  |      |      | +    |      |      |      |      |      |      |      |      |      |      | +    |      |      |
| GC 4  | +    | +    |      |      |      |      |      |      |      |      |      |      | +    | +    | +    | +    |
| GC 5  | +    | +    |      | +    |      |      |      |      |      |      |      |      | +    | +    | +    | +    |
| GC 6  | +    | +    |      | +    | +    |      |      |      |      |      |      |      | +    | +    | +    | +    |
| GC 7  |      |      |      | +    | +    |      |      |      |      |      |      |      |      |      | +    | +    |
| GC 8  |      |      | +    |      |      |      |      |      |      |      |      |      |      | +    | +    | +    |
| PC 1  | +    |      |      | +    |      |      |      | +    |      |      | +    | +    |      | +    | +    | +    |
| PC 2  | +    |      |      | +    |      |      |      |      |      |      |      |      |      | +    |      |      |
| PC 3  |      |      |      |      |      |      | +    | +    | +    | +    | +    | +    | +    | +    | +    |      |
| PC 4  |      |      |      |      |      | +    | +    | +    | +    | +    | +    | +    | +    | +    | +    | +    |
| PC 5  |      |      |      |      |      |      |      |      |      |      |      | +    | +    |      | +    |      |
| PC 6  | +    |      |      |      |      |      |      | +    | +    | +    | +    | +    | +    | +    | +    | +    |
| PC 7  |      |      |      |      |      |      |      | +    | +    |      |      | +    |      |      |      |      |
| PC 8  |      |      |      |      |      |      |      | +    |      |      |      | +    | +    | +    | +    | +    |
| PC 9  | +    |      |      |      |      |      |      | +    |      |      | +    |      |      |      | +    | +    |
| PC 10 |      |      |      | +    | +    |      |      |      |      | +    |      |      |      |      |      | +    |
| PC 11 |      |      |      |      |      |      | +    |      |      |      |      |      | +    |      | +    | +    |
| PC 12 |      |      |      |      |      | +    | +    | +    | +    | +    | +    | +    |      |      |      | +    |
| PC 13 | +    |      |      |      |      |      |      |      | +    | +    |      | +    |      |      |      | +    |
| PC 14 |      |      |      |      |      |      |      | +    | +    | +    | +    | +    | +    | +    | +    | +    |
| PC 15 |      |      |      |      |      |      |      |      |      |      |      |      |      | +    | +    | +    |

## 6. MATRIX OF PROVIDING PROGRAM LEARNING OUTCOMES WITH RELEVANT COMPONENTS OF THE EDUCATIONAL PROGRAM

|     | GT 1 | GT 2 | GT 3 | GT 4 | GT 5 | GT 6 | GT 7 | VC 1 | VC 2 | VC 3 | VC 4 | VC 5 | VC 6 | VC 7 | VC 8 | VC 9 |
|-----|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|
| O1  |      |      |      | +    |      |      |      | +    |      |      | +    | +    | +    |      | +    | +    |
| O2  |      |      |      |      |      |      | +    | +    |      |      | +    | +    | +    |      | +    | +    |
| O3  | +    |      | +    | +    | +    |      |      |      |      |      |      |      |      |      | +    | +    |
| O4  |      | +    |      |      |      |      |      | +    | +    | +    |      | +    | +    | +    | +    |      |
| O5  |      | +    |      | +    |      |      |      | +    |      |      |      | +    |      |      |      |      |
| O6  | +    |      | +    | +    | +    |      |      |      |      |      |      |      |      | +    | +    | +    |
| O7  | +    |      | +    |      |      |      |      | +    | +    | +    | +    | +    | +    | +    | +    | +    |
| O8  |      |      |      |      |      |      |      |      |      |      | +    | +    | +    |      | +    | +    |
| O9  | +    |      |      | +    |      |      |      |      |      |      |      |      |      |      | +    |      |
| O10 |      |      |      |      |      | +    |      | +    |      |      |      |      |      | +    | +    |      |
| O11 | +    |      |      | +    |      |      |      |      |      |      |      |      |      |      | +    |      |
| O12 |      |      |      | +    |      |      |      | +    | +    | +    | +    | +    |      | +    |      | +    |
| O13 |      |      | +    | +    |      |      |      |      |      |      |      |      |      |      |      | +    |
| O14 |      |      |      |      |      | +    | +    | +    |      |      | +    | +    | +    |      | +    | +    |
| O15 |      |      | +    | +    |      |      |      |      |      |      |      |      |      |      | +    |      |
| O16 |      |      |      |      |      |      |      | +    | +    | +    | +    | +    |      |      | +    | +    |
| O17 |      |      |      |      |      |      |      | +    | +    | +    | +    | +    |      |      |      | +    |
| O18 |      |      |      |      |      |      |      | +    | +    | +    | +    | +    |      | +    | +    | +    |
| O19 |      |      |      |      |      |      |      |      |      |      |      |      |      | +    | +    | +    |