**MINISTRY OF EDUCATION AND SCIENCE OF UKRAINE**

**National Aerospace University**

**“Kharkiv Aviation Institute”**

**APPROVED**
Academic Council
National Aerospace University
“Kharkiv Aviation Institute”

February 24, 2021, Minutes № 7

# EDUCATIONAL AND SCIENTIFIC PROGRAM

Aircraft Engine and Power Plant Production Technologies

**Level of higher education – the second (master's)**

**in the specialty 134 Aerospace and Rocket Engineering**

**of the field of knowledge 13 Mechanical Engineering**

**Qualification:** Master of Aerospace and Rocket Engineering in the educational program "Technologies for Production of Aircraft Engines and Power Plants"

The program is valid
from September 01, 2021

Rector
National Aerospace University
“Kharkiv Aviation Institute”

_____ M. V. Nechyporuk
order No. 106 dated 25.02.2021

Kharkiv 2021

## PREFACE

Educational and scientific program "Aircraft Engine and Power Plant Production Technologies" in the specialty 134 "Aerospace and rocket engineering" for the training of masters is developed by the group of development and support of the National Aerospace University "Kharkiv Aviation Institute" ESP consisting of:

a) development and support group:

| | | | |
|---|---|---|---|
| 1 | Head (guarantor) of the educational program | | |
| | | Dolmatov A. I. | – Dr. of Eng., Professor, Department of Aircraft Engine Production Technology |
| 2 | Development and support team members: | | |
| | | Knyazyev M. K. | – PhD, Professor, Department of Aircraft Engine Production Technology |
| 3 | | Danko K. A. | – PhD, Associate Professor, Department of Aircraft Engine Production Technology |



## INTRODUCTION

According to the Article 1 "Basic terms and their definitions" of the Law of Ukraine "On Higher Education" dated 01.07.2014 No. 1556-VII (as amended) an educational program is a system of educational components at the appropriate level of higher education within the specialty that determines the requirements for the education level of persons who can start studying under this program, the list of disciplines and the logical sequence of their study, the number of ECTS credits required for this program, as well as the expected learning outcomes (competencies) that must be mastered by the applicant.

The educational program is used during:

- accreditation of the educational program, inspection of educational activity by specialty and specialization;
- development of curriculum, plans of academic disciplines and practices;
- development of diagnostic tools for the quality of higher education;
- determining the content of training in the system of retraining and advanced training;
- professional orientation of applicants for the specialty.

The educational and scientific program takes into account the requirements of the Law of Ukraine "On Higher Education" dated 01.07.2014 No. 1556-VII (as amended), the Resolution of the Cabinet of Ministers of Ukraine "On approval of the National Qualifications Framework" dated 23.11.2011 No. 1341 and establishes:

- volume and term of master's studies;
- general competencies;
- professional competencies;
- program learning outcomes;
- the list and volume of academic disciplines for mastering the competencies of the educational and scientific program;
- requirements for the structure of academic disciplines.

Educational and scientific program is used for:

- drawing up curricula and work curricula;
- formation of individual plans of students;
- formation of work plans of academic disciplines, practices;
- determination of the information base for the formation of diagnostic tools;
- accreditation of educational and scientific program;
- internal and external quality control of training;
- certification of masters in the educational and scientific program "Aircraft Engine and Power Plant Production Technologies" in the specialty 134 "Aerospace and rocket engineering ".

Users of the educational and scientific program are:

- applicants for higher education studying at the National Aerospace University "Kharkiv Aviation Institute";
- scientific and pedagogical workers who train masters in the educational and scientific program "Aircraft Engine and Power Plant Production Technologies" in the specialty 134 "Aviation and rocket and space technology";

- examination commission of specialty 134 "Aerospace and rocket engineering ";
- Admissions Committee of the National Aerospace University "Kharkiv Aviation Institute".

The educational and scientific program extends to the departments of the University involved in the training of specialists with a master's degree in the educational and scientific program "Aircraft Engine and Power Plant Production Technologies" in the specialty 134 "Aerospace and rocket engineering ".

## 1 REGULATORY REFERENCES

The educational and scientific program is developed on the basis of the following normative documents and recommendations:

1.1 Law of Ukraine "On Higher Education" No. 1556-UII dated 01.07.2014 (as amended).

1.2 Resolution of the Cabinet of Ministers of Ukraine "On approval of the National Qualifications Framework" dated 23.11.2011 No. 1341.

1.3 Resolution of the Cabinet of Ministers of Ukraine "On approval of the list of branches of knowledge and specialties in which the training of higher education seekers are realized" from 29.04.2015 no. 266.

1.4 Resolution of the Cabinet of Ministers of Ukraine "On approval of the Regulations on the procedure for exercising the right to academic mobility" dated 12.08.2015 No. 579.

1.5 National Classifier of Ukraine. Classifier of professions DK 003: 2010 approved by the order of Derzhspozhyvstandart of Ukraine dated 28.07.2010 No. 327 (as amended).

1.6 Methodical recommendations for the development of standards of higher education approved by the higher education sector of the Scientific and Methodological Council of the Ministry of Education and Science of Ukraine, Minutes dated 29.03.2016 No. 3

1.7 Regulation "On the organization of the educational process" QMS KHAI-NMV-P / 002: 2020 of the National Aerospace University "Kharkiv Aviation Institute" approved by the Academic Council of the University, Minutes No. 11 dated 27.05.2020.

1.8 A Tuning Guide to Formulating Degree Program Profiles Including Program Competences and Program Learning Outcomes. – Bilbao, Groningen and The Hague, 2010.

1.9 A TUNING-AHELO conceptual framework of expected / desired learning outcomes in engineering. OECD Education Working Papers, No. 60, OECD Publishing 2011. http://dx.doi.org/10.1787/5kghtchn8mbn-en

1.10 National Qualifications Framework. Appendix to the Resolution of the Cabinet of Ministers of Ukraine of November 23, 2011, No. 1324.

1.11 Development of educational programs. Methodical recommendations / V. M. Zakharchenko, V.I. Lugovyi, Yu. M. Rashkevych, Zh. V. Talanova / Ed. V. G. Kremin. – Kyiv: State Enterprise "Prioritety", 2014. – 120 p.

1.12 Order of the Ministry of Education and Science of Ukraine "On the peculiarities of the introduction of the list of branches of knowledge and specialties for which training of seekers for higher education is realised, approved by the Cabinet of Ministers of Ukraine dated April 29, 2015 No. 266" dated 06.11.2015 No. 1151.

1.13 Classification of economic activities: DK 009: 2010. – Valid from 01.01.2012. – (National Classifier of Ukraine).

1.14 Classifier of professions: DK 003: 2010. - Valid from 01.11.2010. - (National Classifier of Ukraine).

1.15 National educational glossary: higher education / 2nd ed., Revised and extra / V. M. Zakharchenko, S. A. Kalashnikova, V.I. Lugovyi, A. V. Stavytsky, Yu. M. Rashkevych, Zh. V. Talanova / Ed. V. G. Kremin. – Kyiv: Pleiady Publishing House Ltd., 2014. – 100 p.

## 2 PROFILE OF THE EDUCATIONAL AND SCIENTIFIC PROGRAM "AIRCRAFT ENGINE AND POWER PLANT PRODUCTION TECHNOLOGIES" BY SPECIALTY 134 "AEROSPACE AND ROCKET ENGINEERING"

| 1 - General information | |
|---|---|
| **Full name of the higher educational institution and structural subdivision** | National Aerospace University. "Kharkiv Aviation Institute"<br>Department of Aircraft Engine Production Technology |
| **Degree of higher education and title of qualification in the** | Degree of higher education – master<br>Qualification: Master of Aerospace and Rocket Engineering in the educational program "Aircraft Engine and Power Plant Production Tech- |

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| **original language** | nologies"<br>Qualification: *Master in Aerospace Engineering* |
| **The official name of the educational and scientific program** | *Aircraft Engine and Power Plant Production Technologies* |
| **Type of diploma and scope of educational and scientific program** | Single, 120 ECTS credits / 1 year 9 months |
| **Availability of accreditation** | Accreditation certificate: UD series No. 21008029, issued on January 8, 2019 on the basis of the order of the Ministry of Education and Science of Ukraine dated 08.01.2019 No.13, decision of the Accreditation Commission dated 27.12.2018, Minutes No. 133<br>The certificate is valid until July 01.07.2024. |
| **Cycle / level** | The second (master's) level<br>NRC of Ukraine – level 8, FQ-EHEA – second cycle, EQF-LLL – level 7 |
| **Prerequisites** | A person has the right to obtain a master's degree if he has a bachelor's degree |
| **Language (s) of instruction** | The language of instruction is the state language.<br>In order to create conditions for international academic mobility, it may be decided to teach one or more disciplines in English and / or other foreign languages, while ensuring the knowledge of the respective discipline delivered in the state language. |
| **Validity of the educational and scientific program** | Till the introduction of a new educational program |
| **Internet address of the permanent placement of the description of the educational and scientific program** | Website address: *https://khai.edu/ua/education/osvitni-programi-i-komponenti/osvitni-programi-magistriv/* |
| **2 - The purpose of the educational program** | |
| Training of specialists capable of solving complex tasks and problems of aerospace and rocket technology in the field of production of aircraft engines and power plants, involving research and / or innovation and characterized by uncertainty of conditions and requirements.<br>Formation of the personality of the expert capable to use professional-profile knowledge and practical skills for the solution of innovative problems to ensure quality of production and services. | |

| **3 - Characteristics of the educational and scientific program** | |
|---|---|
| **Subject area** | **Subject of study and activity:** phenomena and problems related to the stages of the life cycle of aviation and space technology, which require updating and integration of knowledge in terms of incomplete / insufficient information and contradictory requirements.<br><br>**Learning objectives:** training of specialists capable of solving complex tasks and problems in professional activities related to the development, production and (or) certification of aerospace and rocket technology, its engines and power plants, structures and systems or in the educational process, which are related to research and / or innovation and are characterized by uncertainty of conditions and require- |

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| | ments.<br><br>**Theoretical content of the subject area:** models of physical processes in the objects of aviation and rocket and space technology, modern concepts of deformed solid mechanics, aero- and gas dynamics, thermophysics and electrical engineering.<br><br>**Methods, tools and technologies:** modern analytical, numerical and experimental methods of research of the subject area, methods and technologies for solving complex tasks and problems related to the stages of the life cycle of aviation and rocket and space technology.<br><br>**Instruments and equipment:** laboratory equipment with measuring instruments including hydraulic stands, wind tunnels, equipment for research of material properties, stress-strain state of structures; equipment for assembly and testing of aviation and rocket and space technology; computers with information and specialized software for the design and manufacture of aviation and rocket and space technology. |
| **Orientation of the educational and scientific program** | Educational and scientific |
| **The main focus of the educational and scientific program (specialization)** | The educational and scientific program establishes qualification requirements for social and production activities of graduates of the higher education institution in the specialty 134 "Aerospace and Rocket Engineering" with a master's degree and state requirements for the properties and qualities of a person who has obtained a certain educational level. educational and scientific program "Aircraft Engine and Power Plant Production Technologies". |
| **Features of the program** | The practice is carried out at enterprises of various industries. The program provides strengthening of relevant knowledge and competencies in classical and modern achievements in the field of engine building, is based on a set of methods and tools for practical solutions of tasks and problems in the field of engine building, conducting research and innovation. |
| **4 - Suitability of graduates for employment and further study** | |
| **Suitability for employment** | Work in the specialty is in accordance with the qualification of Master of Aerospace and Rocket Engineering in the educational program "Aircraft Engine and Power Plant Production Technologies" and provides positions:<br>engineer-technologist, design engineer on the basis of the Classifier of professions DK 003: 2010<br>Work in the specialty is in accordance with the qualification "Master" and may hold positions:<br>2145.1 – researchers (engineering mechanics);<br>2145.2 – mechanical engineers<br>2149.1 – Researchers (other branches of engineering)<br>2149.2 – engineers (other branches of engineering)<br>2310 – teacher of universities and higher educational institutions |
| **Further training** | A person has the right to continue education at the third (educational and scientific) level to obtain the degree of Doctor of Philosophy. |
| **5 - Teaching and assessment** | |

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| **Teaching and learning** | Student-centered learning, self-study, problem-oriented learning aimed at the development of critical and creative thinking, learning through laboratory practice, dual, distance education, etc. Lectures, multimedia lectures, laboratory works, seminars, practical classes in small groups, independent work on the basis of textbooks and summary lectures, consultations with teachers, preparation of master's thesis. |
| **Evaluation** | Written exams, credit exams, assessment tests, practice reports, presentations, current (modular) control, thesis (diploma project) and its defense. |
| **6 - Program competencies** | |
| **Integral competence** | Ability to solve complex tasks and problems in professional activities characterized by uncertainty of conditions and requirements for the development, production and (or) certification of aerospace and rocket engineering, its engines and power plants, structures and systems or in the educational process, which related to research and / or innovation and are characterized by uncertainty of conditions and requirements. |
| **General competence (GC)** | GC1 - the ability to search, process and analyze information from various sources.<br>GC2 - the ability to conduct research.<br>GC3 - the ability to learn and master modern knowledge.<br>GC4 - the ability to communicate in a foreign language in the professional sphere.<br>GC5 - the ability to generate new ideas (creativity).<br>GC6 - the ability to make substantiated decisions.<br>GC7 - ability to communicate with representatives of other professional groups of different levels (with experts from other fields of knowledge / types of economic activity).<br>GC8 - the ability to work in a team, make decisions, including in extreme situations, and be responsible for them.<br>GC9 - the ability to make long-term planning and develop a strategy for professional activities.<br>GC10 - the ability to conduct professional including research activities in an international environment.<br>GC11 - ability to develop and manage projects.<br>GC12 - the ability to show initiative and entrepreneurship.<br>GC13 - the ability to assess and ensure the quality of work performed.<br>GC14 - the desire to preserve the environment.<br>GC15 - the ability to identify the scientific essence and solve problems in the professional sphere<br>GC16 - ability to investigate problems using systems analysis, synthesis, computer modeling and optimization methods<br>GC17 - the ability to further autonomous and independent learning based on the latest scientific and technical achievements |
| **Professional competencies of the specialty (PC)** | PC1 - the ability to demonstrate comprehensive knowledge in the field of aviation and rocket and space technology and prospects for its development.<br>PC2 - the ability to apply their knowledge and understanding to identify, formulate and solve complex engineering problems using special and commonly used methods.<br>PC3 - the ability to systematically study and analyze scientific and technical information, domestic and foreign experience in the field of aerospace and rocket engineering. |

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| | PC4 - the ability to analyze the necessary information, technical data, indicators and results, systematize and summarize them in order to improve the technological characteristics of parts of aerospace and technological equipment, create new technologies and modernize production.<br>PC5 - the ability to develop and implement energy-saving technologies and energy-saving measures during the design of technological processes for the manufacture of parts of aerospace and rocket engineering and technological equipment.<br>PC6 - the ability to organize work on the completion and development of technological processes during the installation and commissioning of the main and auxiliary equipment, to ensure the competitiveness of products in the field of aerospace and rocket engineering.<br>PC7 - the ability to plan experimental technological research, develop experimental research schemes, measurement schemes, choose measuring instruments, conduct experimental research, record measurement results, keep an experimental protocol, choose and develop methods and ways of processing experimental data, analyze experimental results, compare them with results of theoretical research and modeling, to compile a report on the results of experimental technological research .<br>PC8 - the ability to develop methods of calculation and research in the design and operation of facilities and systems in the field of aerospace and rocket engineering using modern CAD / CAM / CAE (information) systems.<br>PC9 - the ability to analyze competitive developments and provide a feasibility study, organize and perform research related to the development and implementation of innovative projects and programs in the field of aerospace and rocket engineering.<br>PC10 - the ability to carry out patent research, prepare applications for inventions and industrial designs, organize work on the implementation of author's supervision in the manufacture, installation, commissioning, testing and commissioning of facilities and products of aerospace and rocket engineering.<br>PC11 - the ability to make optimal decisions in the production of energy and technological products taking into account the requirements of quality, reliability and cost, timing, labor protection and environmental friendliness of production in the field of aerospace and rocket engineering.<br>PC12 - the ability to develop physical and mathematical models of processes in energy and technological equipment with the analysis of results and the development of methods for calculating the equipment (by comparison with the results of experimental research).<br>PC13 - the ability to prepare scientific and technical publications and reports on the results of research with public presentation.<br>PC14 - ability to formulate the purpose and objectives of the study, to identify priorities for solving problems, to select and create evaluation criteria.<br>PC15 - ability to apply modern research methods, evaluate and present the results of work performed |
| **7 - Program learning outcomes** | |

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| | PLO1 - the ability to solve complex engineering problems and problems of aviation and/or rocket and space technology, which requires updating and integration of knowledge including the conditions of incomplete insufficient information and conflicting requirements.<br>PLO2 - the ability to critically comprehend the problems of aviation and / or rocket and space technology including on the border with related industries, engineering, physics, chemistry, ecology, economics.<br>PLO3 - skills of compiling reporting documentation on the results of work on professional (scientific and technical) tasks, preparation of scientific and technical publications, reports and presentations on the results of research.<br>PLO4 - understanding and ability to use modern methods of solving inventive problems. Be able to apply various methods of intellectual property protection to technical solutions created in the course of professional (scientific and technical) activities.<br>PLO5 - the ability to use the latest specialized software to solve complex problems in professional (scientific and technical) activities in accordance with the educational program.<br>PLO6 - decision-making skills in the event of non-standard complex tasks in professional (scientific and technical) activities at uncertainty of conditions and requirements, the availability of a range of opinions and limited time.<br>PLO7 - the ability to clearly and unambiguously convey their own conclusions on the problems of aviation and space technology, as well as the knowledge and explanations that substantiate them, to specialists and non-specialists, in particular to students.<br>PLO8 - the ability to be responsible for the development of professional knowledge and practices of the team in aviation and / or rocket and space technology, assessment of its strategic development.<br>PLO9 - readiness for further training in the field of aerospace and rocket engineering, mechanical engineering and related fields of knowledge, which is largely autonomous and independent.<br>PLO10 - knowledge of a foreign language at a level that provides the opportunity to communicate in a professional environment and use scientific and technical documentation in the subject area.<br>PLO11 - the ability to analyze advanced scientific and technical achievements in the field of design and manufacture of elements and objects of aerospace and rocket technology in different stages of development, using historical, patent, scientific and technical literature.<br>PLO12 - the ability to reasonably assign a class of materials for elements and systems of aerospace and rocket engineering, to have the skills to choose methods of modifying their properties.<br>PLO13 - the ability to calculate the economic efficiency of production of elements and systems of aviation, rocket and space technology.<br>PLO14 - understanding of the principles, skills of reasonable assigning of quality indicators of objects of aviation, rocket and space equipment.<br>PLO15 - the ability to apply the requirements of industry and international regulation documents on the formulation and solution of scientific and technical problems of design, manufacture, repair, assembly, testing and (or) certification of elements and objects of aerospace and rocket technology at all stages of its life cycle.<br>PLO16 - the ability to determine the initial parameters for the for- |

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| | mation of the appearance of aviation, rocket and space objects on the basis of skills to assess the stability and controllability of the aircraft in accordance with existing methods.<br>PLO17 - skills of the organization of performance of difficult tasks in professional activity by consistent and qualitative performance of their separate stages including involvement of collective of executors.<br>PLO18 - ability to apply modern methods and means of design and technological preparation of production, including computerised flexible production, assembly and testing of elements and systems of aviation, rocket and space technology for modern equipment with numerical program control.<br>PLO19 - the ability to calculate the stress-strain state, to determine the bearing capacity of structural elements and the reliability of aerospace and rocket systems and means of industrial production using the latest software used in the industry.<br>PLO20 - the ability to use in practice modern methods, techniques and means of design, manufacture, repair, assembly, testing and (or) certification of elements and systems of aerospace and rocket objects for various types of industrial production.<br>PLO21 - awareness of theoretical and instrumental support for the interchangeability of parts of aerospace and rocket objects based on modern international standards and the use of the latest metrological support.<br>PLO22 - the ability to analyze the risks of threats and dangers at workplaces and production facilities, to develop and implement measures to eliminate the causes of accidents, to implement organisational and technical measures to improve occupational safety, using the regulatory framework, modern methods and techniques.<br>PLO23 - skills and abilities to develop and optimise the parameters of manufacturing processes including the use of automated computer-aided design of the production of components, units and systems of aviation, rocket and space objects.<br>PLO24 - the ability to formulate and solve scientific and technical problems for the development of the latest models of systems and elements of aerospace and rocket objects based on knowledge and understanding of the peculiarities of their design and work processes. |
| **8 - Resource support for program implementation** | |
| **Staffing** | Research and teaching staff involved in the teaching of professionally oriented disciplines have academic degrees and / or academic titles and meet licensing requirements. |
| **Material and technical support** | Training is carried out in educational laboratories (mechanical processing – 133 mb, assembly of gas turbine engines – 127 mb, scientific laboratory of electrohydraulic forming – 100 mb), in computer rooms (computer rooms 119 mb, 121 mb, 224 mb, 242 mb). |
| **Information, educational and methodical support** | The use of virtual learning environment of the National Aerospace University "Kharkiv Aviation Institute" and author's developments of scientific and pedagogical staff:<br>WORD text editor, EXCEL spreadsheets, solid state modelling systems AutoCAD, UGS NX, COMPASS, ANSYS package for calculating the dynamics of liquids and gases.<br>Professional periodicals ("Aerospace Engineering and Technology", |

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| | "Bulletin of Engine Building", "Internal Combustion Engines", "Engine Building", "Mechanical Engineering Problems", "Strength Problems", "Information Technologies", "Management and Informatics Problems", "Cybernetics and systems analysis", "Control systems and machines").<br>Methodical manuals, lecture notes of the fund of the methodical office of the department of aircraft engines production technologies.<br>Articles, patents and dissertations of the scientific and methodological staff of the Aircraft Engine Design Department. |
| **9 - Academic mobility** | |
| **National credit mobility** | Based on bilateral agreements between the National Aerospace University "Kharkiv Aviation Institute" and educational technical institutions of Ukraine. |
| **International credit mobility** | Based on bilateral agreements between the National Aerospace University "Kharkiv Aviation Institute" and educational institutions of partner countries. |
| **Training of foreign applicants for higher education** | Education of foreign citizens is carried out in the state language. In certain cases it may be decided to teach one or more disciplines in English and / or other foreign languages, while ensuring the knowledge of the respective discipline delivered in the state language. |

## 3. LIST OF COMPONENTS OF THE EDUCATIONAL AND SCIENTIFIC PROGRAM (ESP) AND THEIR LOGICAL SEQUENCE

### 3.1 List of ESP components

| CEP code | Components of the educational program (academic disciplines, course projects (works), practices, qualification work) | Number of credits | Form of final check (semester) |
|---|---|---|---|
| **1** | **2** | **3** | **4** |
| **ESP mandatory components** | | | |
| **MC1** | Human factor engineering | 4 | Exam, 1s. |

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| **MC2** | Foreign language for professional application | 4 | Credit exam, 1s. |
| **MC3** | Scientific engineering development and intellectual property | 4 | Credit exam, 2s. |
| **MC4** | Master's thesis | 30 | defense of qualifying master's thesis, 4 s. |
| **MC5** | Pre-diploma practice | 10 | Diff. credit exam, 3s. |
| **MC6** | Modelling and calculations of processes in aerospace and rocket engineering (ASRE) | 6 | Exam, 2 s. |
| **MC7** | Design, testing and certification of ASRE objects | 6 | Exam, 1s. |
| **MC8** | Systems of technical preparations for production of aerospace and rocket equipment | 5 | Exam, 2 s. |
| **MC9** | Scientific and pedagogical probation | 5 | Credit exam, 3 s. |
| **MC10** | Scientific experiment planning | 6 | Exam, 3 s. |
| **The total amount of mandatory components:** | | **80** | |
| | | | |
| **ESP selective components** | | | |
| ***Selective unit 1*** | | | |
| **SU1.1** | Planning of operations on machines with programming control in engine-building | 7 | Exam, 1s. |
| **SU1.2** | Planning of operations on machines with programming control in engine-building (CP) | 2 | Diff. credit exam, 1 s. |
| **SU1.3** | Planning, organisation and reporting of research activities | 7 | Exam, 2 s. |
| **SU1.4** | Technology of production and repair of aviation engines and power plants | 7 | Exam, 1 s. |
| **SU1.5** | Technology of production and repair of aviation engines and power plants (CP) | 2 | Diff. credit exam, 2 s. |
| **SU1.6** | Technology of assembly and testing of engines and power plants | 6 | Exam, 2 s. |
| **SU1.7** | Numerical methods in engineering calculations | 4 | Credit exam, 3 s. |
| **SU1.8** | Introduction of scientific achievements into educational process and engineering practice | 5 | Exam, 3 s. |
| **The total amount of selective components:** | | **40** | |
| | | | |
| ***Selective unit 2*** | | | |
| **SU2.1** | Computer-integrated designing systems | 7 | Exam, 1s. |
| **SU2.2** | Computer-integrated designing systems (CP) | 2 | Diff. credit exam, 1 s. |
| **SU2.3** | Systems of automated designing of manufacturing processes for production of aviation engines and power plants | 7 | Credit exam, 1s. |
| **SU2.4** | Perspective technologies for production of aircraft engines and power plants | 5 | Exam, 2 s. |
| **SU2.5** | Planning, processing and analysis of experimental results | 5 | Exam, 2 s. |

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| **SU2.6** | Scientific research of technologies for production of aircraft engine elements | 5 | Exam, 2 s. |
| **SU2.7** | Scientific research of technologies for production of aircraft engine elements (CP) | 4 | Diff. credit exam, 3 s. |
| **SU2.8** | Efficiency and reliability of aviation equipment | 7 | Exam, 3 s. |
| **The total amount of selective components:** | | **40** | |
| **TOTAL VOLUME OF THE EDUCATIONAL PROGRAM** | | **120** | |

3.2 ESP structural and logical scheme

The structural and logical scheme of the educational program reflects the sequence of studying its components and is given in Appendix A. The scheme contains mandatory components and components of selective unit 1, because this unit for the educational program is the basic (priority). If another selective unit is chosen by the applicant for higher education, the individual trajectory of study is determined and an individual plan is drawn up.

3.3 The structure of the curriculum by semesters and content of the ESP components

| **No.** | **COP code** | **The name of the ESP component** | **The objective and tasks of the ESP component** | **Formation of competencies** | |
|---|---|---|---|---|---|
| | | | | **general** | **professional** |
| **I semester** | | | | | |

| No. | COP code | The name of the ESP component | The objective and tasks of the ESP component | Formation of competencies | |
|---|---|---|---|---|---|
| | | | | general | profes-sional |
| 1 | **MC1** | Human factor engineering | **Objective:** theoretical and practical training of applicants for the use of advanced concepts and principles of human factor engineering and cognitive ergonomics for the organisation and optimasation of human interaction and complex technical systems<br>**Task:** formation of system of scientific knowledge and professional skills in the field of efficiency, reliability and safety of complex human-machine systems. | GC2<br>GC4<br>GC5<br>GC6<br>GC9 | FC3<br>FC7<br>FC9<br>PLO2<br>PLO3<br>PLO4<br>PLO9<br>PLO10<br>PLO11<br>PLO15<br>PLO24 |
| 2 | **MC2** | Foreign language for professional application | **Objective**: mastering knowledge of a foreign language to study specialties in a foreign language.<br>**Task**: to study the basic terms of the specialty with the help of a foreign language. | GC3<br>GC4 | FC5<br>PLO3<br>PLO10 |
| 3 | **MC7** | Design, testing and certification of aerospace and rocket engineering objects | **Objective: to** provide knowledge and practical skills in the design, development and use of software for specialised automated systems, such as: automated process control systems, embedded systems, as well as to acquaint students with the features of software development taking into account the increased requirements for reliability, efficiency and predictability.<br>**Task:** to teach students to understand the principles of real-time software systems, to give an idea of the inherent features of software construction, to teach to solve these problems in software projects of real-time systems. | GC1<br>GC3<br>GC4<br>GC11 | FC3<br>FC4<br>FC5<br>FC7<br>FC11<br>PLO5<br>PLO7<br>PLO8<br>PLO9<br>PLO18<br>PLO20<br>PLO23 |
| 4 | **SU1.1** | Planning of operations on machines with programming control in engine-building | **Objective:** to theoretically and practically prepare future specialists for independent use of computer systems for designing the operations on machines with programming control in engine building.<br>**Task:** consideration and solution of the problem of designing opera- | GC1<br>GC3<br>GC5<br>GC6<br>GC7<br>GC8<br>GC9<br>GC10 | FC1<br>FC2<br>FC3<br>FC4<br>FC5<br>FC6<br>FC7<br>FC8 |

| No. | COP code | The name of the ESP component | The objective and tasks of the ESP component | Formation of competencies | |
|---|---|---|---|---|---|
| | | | | general | profes-sional |
| | | | tions on machines with programming control using computer systems. | GC11<br>GC12<br>GC13<br>GC14 | FC11<br>PLO5<br>PLO12<br>PLO18<br>PLO21<br>PLO23 |
| 5 | **SU1.2** | Planning of operations on machines with programming control in engine-building (CP) | **Objective:** to theoretically and practically prepare future specialists for independent use of computer systems for designing the operations on machines with programming control in engine building.<br>**Task:** consideration and solution of the problem of designing operations on machines with programming control using computer systems. | GC1<br>GC3<br>GC5<br>GC6<br>GC7<br>GC8<br>GC9<br>GC10<br>GC11<br>GC12<br>GC13<br>GC14 | FC1<br>FC2<br>FC3<br>FC4<br>FC5<br>FC6<br>FC7<br>FC8<br>FC11<br>PLO5<br>PLO12<br>PLO18<br>PLO21<br>PLO23 |
| 6 | **SU1.3** | Planning, organisation and reporting of research activities | **Objective:** to provide knowledge on the methods of planning theoretical and experimental research, organisation of research activities in the country and research institutions, types and forms of reporting on the results of research work<br>**Tasks:** to study the structure of research activities in the country, the structure and organisation of scientific departments of the university, forms of funding for scientific activities; methods of planning of theoretical, computational and experimental research; rules for drawing up scientific reports , writing articles, conference reports, etc. | GC1<br>GC2<br>GC5<br>GC7<br>GC9<br>GC15<br>GC16 | FC4<br>FC7<br>FC8<br>FC9<br>FC10<br>FC13<br>PLO3<br>PLO6<br>PLO8<br>PLO11<br>PLO24 |
| 7 | **SU2.1** | Computer-integrated designing systems | **Objective:** to acquire the knowledge and skills required to perform engineering calculations of the main parts of aircraft gas turbine engine in the software package ANSYS.<br>**Task** : to study the features of engineering calculations in the software package ANSYS. | GC1<br>GC2<br>GC3<br>GC4<br>GC8 | FC2<br>PLO1<br>PLO5<br>PLO6<br>PLO12<br>PLO17<br>PLO19 |

| No. | COP code | The name of the ESP component | The objective and tasks of the ESP component | Formation of competencies | |
|---|---|---|---|---|---|
| | | | | general | profes-sional |
| | | | | | |
| 8 | **SU2.2** | Computer-integrated designing systems (CP) | **Objective:** acquisition of knowledge and skills required to perform engineering calculations of the main parts of aircraft gas turbine engine in the software package ANSYS.<br>**Task** : to study the features of engineering calculations in the software package ANSYS. | GC1<br>GC2<br>GC3<br>GC4<br>GC8 | FC2<br>PLO1<br>PLO5<br>PLO6<br>PLO12<br>PLO17<br>PLO19 |
| 9 | **SU2.3** | Systems of automated designing of manufac-turing processes for production of aviation engines and power plants | **Objective:** to provide students of this specialty with knowledge and skills in the field of analysis and partial synthesis of ACS for avia-tion gas turbine engines, while determining the impact of the spe-cifics of the latter on the ACS classical methods.<br>**Tasks:** structures and features of realisation of hydromechanical and digital ACS of different types of gas turbine engines; to build ACS mathematical models with the aid of computer, to perform analysis of their properties by ana-lytical and frequency methods. | GC1<br>GC5<br>GC8 | FC1<br>FC4<br>FC5<br>PLO1<br>PLO5<br>PLO9<br>PLO24 |
| **II semester** | | | | | |
| 10 | **MC3** | Scientific engineering development and intel-lectual property | **Objective:** mastering modern research tools for effective per-formance of experimental work in the field of mechanical engi-neering. Digestion of knowledge on the legal regulation of rela-tions that take place during the creation, use and protection of objects of intellectual property<br>**Tasks: to** study the content and methods of scientific research in the field of mechanical engineer-ing, as well as methods of gener-alisation, description and draw-ing-up of research results in the form of scientific and technical report and features of mathemat-ical (analytical and simulation) | GC1<br>GC4<br>GC5<br>GC6<br>GC9 | FC2<br>FC4<br>FC7<br>FC10 FC12<br>FC13<br>PLO3<br>PLO7<br>PLO11<br>PLO15 |

| No. | COP code | The name of the ESP component | The objective and tasks of the ESP component | Formation of competencies | |
|---|---|---|---|---|---|
| | | | | general | profes-sional |
| | | | modelling methods for analysis of technical systems; study of methods of planning and use of experimental researches. Formation of applicants' special knowledge on the general provisions of intellectual property law and its types and content, the concept of objects and subjects of intellectual property law, the grounds, conditions and procedure for using its results, legal regulation taking into account the provisions of international legal protection. | | |
| 11 | **MC6** | Modelling and calculations of processes in aerospace and rocket engineering | **Objectives:** acquisition of knowledge and skills necessary for qualified analysis of modelling and calculation of processes in the ASRE and ideas about the design of technological systems and other objects of the ASRE<br>**Tasks:** to study the principles of operation and mathematical modelling of manufacturing processes and other ASRE systems and to perform quality analysis of modelling | GC1<br>GC2<br>GC3<br>GC11 | FC5<br>FC7<br>FC11<br>FC12<br>PLO4<br>PLO5<br>PLO8<br>PLO14<br>PLO16<br>PLO17 |
| 12 | **MC8** | Systems of technical preparations for production of aerospace and rocket equipment | **Objectives:** development of designs of aerospace and rocket engineering using the latest production methods. Study of a complex of information technologies and systems of technical and technological preparations for production of products, which is a global direction of improvement of world production of aerospace and rocket engineering<br>**Task**: mastering the system of technical preparations of the latest methods of production | GC1<br>GC3<br>GC12<br>GC13 | FC3<br>FC4<br>FC5<br>FC8<br>PLO1<br>PLO4<br>PLO5<br>PLO20<br>PLO23 |
| 13 | **SU1.4** | Technology of production and repair of aviation engines and power plants | **Objective:** development of scientific and methodological bases and acquisition of skills of organisation of technological preparations of production and repair | GC1<br>GC2<br>GC3<br>GC5 | FC1<br>FC2<br>FC3<br>FC4 |

| No. | COP code | The name of the ESP component | The objective and tasks of the ESP component | Formation of competencies | |
|---|---|---|---|---|---|
| | | | | general | profes-sional |
| | | | of aviation engines and power plants; mastering the skills of rational methods of designing the plans of manufacturing processes using modern technologies that improve exploitation characteristics of parts.<br>**Task:** to acquire by students the necessary competencies and skills to effectively design and implement in production modern manufacturing processes and operations for production and repair (restoration) of aviation engine parts and power plants. | GC6<br>GC8<br>GC9<br>GC10<br>GC11<br>GC12<br>GC13<br>GC14 | FC5<br>FC6<br>FC8<br>FC9<br>FC10<br>FC11<br>FC12<br>FC13<br>PLO1<br>PLO4<br>PLO8<br>PLO16<br>PLO19<br>PLO22<br>PLO23<br>PLO24 |
| 14 | **SU1.5** | Technology of production and repair of aviation engines and power plants (CP) | **Objective:** development of scientific and methodological bases and acquisition of skills of organisation of technological preparations of production and repair of aviation engines and power plants; mastering the skills of rational methods of designing the plans of manufacturing processes using modern technologies that improve exploitation characteristics of parts.<br>**Task:** to acquire by students the necessary competencies and skills to effectively design and implement in production modern manufacturing processes and operations for production and repair (restoration) of aviation engine parts and power plants. | GC1<br>GC2<br>GC3<br>GC5<br>GC6<br>GC8<br>GC9<br>GC10<br>GC11<br>GC12<br>GC13<br>GC14 | FC1<br>FC2<br>FC3<br>FC4<br>FC5<br>FC6<br>FC8<br>FC9<br>FC10<br>FC11<br>FC12<br>FC13<br>PLO1<br>PLO4<br>PLO8<br>PLO16<br>PLO19<br>PLO22<br>PLO23<br>PLO24 |
| 15 | **SU1.6** | Technology of assembly and testing of engines and power plants | **Objective:** to study the theoretical foundations of the technology for assembly and testing of aviation engines, modern methods of designing the manufacturing processes, methods of combining the main pairs of gas turbine engines, unit and general assembly.<br>**Tasks:** study and mastering of one of the final stages of industrial production of aviation en- | GC1<br>GC3<br>GC5<br>GC6<br>GC7<br>GC8<br>GC9<br>GC10<br>GC11 | FC1<br>FC2<br>FC3<br>FC4<br>FC5<br>FC6<br>FC7<br>FC8<br>FC11 |

| No. | COP code | The name of the ESP component | The objective and tasks of the ESP component | Formation of competencies | |
|---|---|---|---|---|---|
| | | | | general | profes-sional |
| | | | gines (AE), training in methods and techniques of rational design of manufacturing processes of assembly, training of students for independent solution of questions on designing of assembly manufacturing processes. | GC12<br>GC13<br>GC14 | PLO14<br>PLO16<br>PLO18<br>PLO19<br>PLO20 |
| 16 | **SU2.4** | Perspective technologies for production of aircraft engines and power plants | **Objective:** to study the theoretical foundations of the technology of assembly of aircraft engines, modern methods of designing the manufacturing processes, methods of combining the main pairs of AE and PP.<br>**Tasks:** study and mastering of one of the final stages of industrial production of AE and PP , training in methods and techniques of rational design of manufacturing processes of assembly, training of students for independent solutions of design of assembly manufacturing processes. | GC1<br>GC2<br>GC5<br>GC6 | FC3<br>FC6<br>PLO9<br>PLO11<br>PLO18 |
| 17 | **SU2.5** | Planning, processing and analysis of experimental results | **Objective:** to provide knowledge of methods of planning the scientific experiments, their preparation and implementation, measurements, methods of processing the measurement results and their analysis in the chosen scientific field<br>**Tasks:** to acquire knowledge of experimental planning methods, including multifactorial, experimental design, selection and development of experimental equipment, preparation and testing, selection of methods and measuring instruments, methods of processing the measurement results to determine errors and reliability of results, analysis of results including comparative in the chosen scientific field | GC1<br>GC5<br>GC6<br>GC9<br>GC11<br>GC15<br>GC17 | FC3<br>FC5<br>FC7<br>FC8<br>FC10<br>FC14<br>FC15<br>PLO1<br>PLO3<br>PLO4<br>PLO6<br>PLO11<br>PLO15<br>PLO24 |
| 18 | **SU2.6** | Scientific research of technologies for production of aircraft engine elements | **Objective:** to provide knowledge of methods and methods of research of technologies for production of elements of air- | GC1<br>GC2<br>GC3 | FC2<br>FC3<br>FC4 |

| No. | COP code | The name of the ESP component | The objective and tasks of the ESP component | Formation of competencies | |
|---|---|---|---|---|---|
| | | | | general | profes-sional |
| | | | craft engines<br>**Task:** to master the methods and techniques of theoretical, computational and experimental research of technologies for cutting, metalworking, coating deposition | GC5<br>GC6 | FC15<br>PLO4<br>PLO5<br>PLO9<br>PLO17<br>PLO18<br>PLO20<br>PLO23 |
| **III semester** | | | | | |
| 19 | **MC5** | Pre-diploma practice | **Objective:** to practically prepare future specialists for independent research and engineering work in production and research teams of enterprises and organisations.<br>**Tasks:** consolidation of theoretical knowledge and skills, mastering the methods of work in real conditions of practical activity of specialists, development of creative abilities, ability to apply the acquired knowledge in practice, collection of materials necessary for qualification master's thesis | GC1<br>GC2<br>GC3<br>GC5<br>GC6<br>GC7<br>GC8<br>GC9<br>GC10<br>GC11<br>GC13<br>GC14 | FC1<br>FC2<br>FC3<br>FC4<br>FC5<br>FC6<br>FC7<br>FC9<br>FC11<br>FC12<br>PLO1<br>PLO2<br>PLO3<br>PLO6<br>PLO14<br>PLO21 |
| 20 | **MC9** | Scientific and pedagogical probation | **Objective:** to provide students with practical skills in carrying out scientific activities and conducting educational classes<br>**Tasks:** to conduct theoretical, computational and experimental research, to prepare and deliver a lecture, to conduct laboratory and practical classes, to develop a segment of educational book | GC1<br>GC2<br>GC7<br>GC9<br>GC15<br>GC16 | FC2<br>FC4<br>FC7<br>FC8<br>FC14<br>FC15<br>PLO3<br>PLO5<br>PLO7<br>PLO8<br>PLO11<br>PLO17<br>PLO22<br>PLO24 |

| No. | COP code | The name of the ESP component | The objective and tasks of the ESP component | Formation of competencies | |
|---|---|---|---|---|---|
| | | | | general | profes-sional |
| 21 | **MC10** | Planning a scientific experiment | **Objective:** to provide knowledge of methods of planning the scientific experiments, their preparation and implementation, measurements, methods of processing the measurement results and their analysis<br>**Tasks:** to acquire knowledge of experimental planning methods including multifactorial experimental design, selection and development of experimental equipment, preparation and testing, selection of methods and measuring instruments, methods of processing the measurement results to determine errors and reliability of results, analysis of results including comparative | GC1<br>GC3<br>GC7<br>GC9<br>GC11<br>GC15 | FC3<br>FC4<br>FC7<br>FC9<br>FC12<br>FC14<br>FC15<br>PLO4<br>PLO5<br>PLO9<br>PLO11<br>PLO14<br>PLO17<br>PLO21<br>PLO24 |
| 22 | **SU1.7** | Numerical methods in engineering calculations | **Objective:** to provide knowledge of numerical methods for solving the complex mathematical equations for engineering problems<br>**Tasks:** to master the methods of creation of difference schemes of differential and integral equations, calculations by means of the modern computer software, carrying out numerical experiment | GC3<br>GC16<br>GC17 | FC8<br>FC12<br>FC15<br>PLO1<br>PLO4<br>PLO5<br>PLO19<br>PLO23 |
| 23 | **SU1.8** | Introduction of scientific achievements into educational process and engineering practice | **Objective:** to provide knowledge on the forms and methods of implementing the scientific advances in educational process and engineering practice of the aerospace industry<br>**Tasks:** to master the methods of creating the engineering methods of calculations based on the results of scientific research, forms and methods of technology transfer, innovations in aerospace branch, methods of applying the scientific equipment in educational process, methods of developing the educational literature based on scientific research and engineering methods of calculations | GC3<br>GC5<br>GC7<br>GC10<br>GC12<br>GC17 | FC1<br>FC2<br>FC5<br>FC11<br>FC15<br>PLO1<br>PLO2<br>PLO4<br>PLO15<br>PLO18<br>PLO20 |
| 24 | **SU2.7** | Scientific research of | **Objective:** to acquire practical | GC1 | FC2 |

| No. | COP code | The name of the ESP component | The objective and tasks of the ESP component | Formation of competencies | |
|---|---|---|---|---|---|
| | | | | general | professional |
| | | technologies for production of aircraft engine elements (CP) | skills in conducting the scientific research<br>**Tasks:** to gain the practical skills in analysis of literature sources, setting the goals and tasks of study, conducting theoretical and experimental research, development of recommendations for implementation of research results | GC2<br>GC3<br>GC5<br>GC6 | FC3<br>FC4<br>FC15<br>PLO4<br>PLO5<br>PLO9<br>PLO17<br>PLO18<br>PLO20<br>PLO23 |
| 25 | **SU1.8** | Efficiency and reliability of aviation equipment | **Objective:** to provide knowledge on methods and ways to assess the efficiency and reliability of aircraft engines and other equipment<br>**Tasks:** to master the methods and techniques for determining the efficiency and reliability of aircraft engines, calculations of reliability indicators, indicators of technical and economic efficiency of aircraft samples, comparative analysis | GC3<br>GC7<br>GC10<br>GC13<br>GC14 | FC5<br>FC6<br>FC11<br>PLO2<br>PLO12<br>PLO13<br>PLO14<br>PLO16<br>PLO22 |
| **IV semester** | | | | | |
| 26 | **MC4** | Master's thesis | **Objective:** to determine the level of student readiness to solve a set of modern scientific and applied problems in accordance with the generalised object of activity based on the application of theoretical knowledge and practical skills acquired during the entire period of study in accordance with the standard of higher education.<br>**Tasks:** systematisation, consolidation and expansion of theoretical knowledge gained in the educational process under the educational-scientific program "Aircraft Engine and Power Plant Production Technologies" training master's degree, and their practical use in solving specific scientific, applied, engineering, economic, so- | GC1<br>GC2<br>GC3<br>GC4<br>GC5<br>GC6<br>GC7<br>GC8<br>GC9<br>GC10<br>GC11<br>GC12<br>GC13<br>GC14<br>GC14<br>GC15 | FC1<br>FC2<br>FC3<br>FC4<br>FC5<br>FC6<br>FC8<br>FC9<br>FC12<br>FC13<br>FC14<br>FC15<br>PLO3<br>PLO4<br>PLO5<br>PLO7<br>PLO8 |

| No. | COP code | The name of the ESP component | The objective and tasks of the ESP component | Formation of competencies | |
|---|---|---|---|---|---|
| | | | | general | professional |
| | | | cial and production issues arising in the course of professional activity of specialists in the field of aerospace and rocket engineering; development of skills of independent work, mastering the technique of researches and experimentation, physical or mathematical modelling, use of modern information technologies in the course of the solution of problems, which are provided by the task for diploma development; determining the compliance of the graduate level of training with the requirements of educational degrees, the characteristics of specialist, his readiness and ability to work independently in a market economy, modern production, progress of science, technology and culture. | | PLO11<br>PLO13<br>PLO15<br>PLO17<br>PLO18<br>PLO22<br>PLO23 |

## 4 FORM OF CERTIFICATION OF HIGHER EDUCATION APPLICANTS

Certification of graduates under the educational and scientific program "Aircraft Engine and Power Plant Production Technologies" in the specialty 134 "Aerospace and rocket engineering" is carried out in the form of defense of master's thesis and ends with the issuance of a standard document on awarding the master's degree in aerospace and rocket engineering under the educational and scientific program " Aircraft Engine and Power Plant Production Technologies ".

Certification is carried out openly and publicly.

## 5. MATRIX OF CONFORMITY OF PROGRAM COMPETENCES TO COMPONENTS OF EDUCATIONAL AND SCIENTIFIC PROGRAM

*Table 5.1*

| Components / Competencies | MC1 | MC2 | MC3 | MC4 | MC5 | MC6 | MC7 | MC8 | MC9 | MC10 | SU1.1 | SU1.2 | SU1.3 | SU1.4 | SU1.5 | SU1.6 | SU1.7 | SU1.8 | SU2.1 | SU2.2 | SU2.3 | SU2.4 | SU2.5 | SU2.6 | SU2.7 | SU2.8 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GC1 | | | + | + | + | + | + | + | + | + | + | + | + | + | + | + | | | + | + | + | + | + | + | + | |
| GC2 | + | | | + | + | + | | | + | | | | + | + | + | | | | + | + | | + | | + | + | |
| GC3 | | + | | + | + | + | + | + | | + | + | + | | + | + | + | + | + | + | + | | | | + | + | + |
| GC4 | + | + | + | + | | | + | | | | | | | | | | | | + | + | | | | | | |
| GC5 | + | | + | + | + | | | | | | + | + | + | + | + | + | | | | | + | + | + | + | + | + |
| GC6 | + | | + | + | + | | | | | | + | + | | + | + | + | | | | | | + | + | + | + | |
| GC7 | | | | + | + | | | | + | + | + | + | + | | | | | + | | | | | | | | + |
| GC8 | | | | + | + | | | | | | + | + | | + | + | + | | | + | + | + | | | | | |
| GC9 | + | | + | + | + | | | | + | + | + | + | + | + | + | + | | | | | | | + | | | |
| GC10 | | | | + | + | | | | | | + | + | | + | + | + | | + | | | | | | | | + |
| GC11 | | | | + | + | + | + | | | + | + | + | | + | + | + | | | | | | | + | | | |
| GC12 | | | | + | | | | + | | | + | + | | + | + | + | | | | | | | | | | + |
| GC13 | | | | + | + | | | + | | | + | + | | + | + | + | | + | | | | | | | | |
| GC14 | | | | + | + | | | | | | + | + | | + | + | + | | + | | | | | | | | |
| GC15 | | | | + | | | | | + | + | | | + | | | | | | | | | | + | | | |
| GC16 | | | | + | | | | | + | | | | + | | | | + | | | | | | | | | |
| GC17 | | | | | | | | | | | | | | | | | + | | | | | | + | | | + |
| PC1 | | | | + | + | | | | | | + | + | | + | + | + | | | | | + | | | | | + |

| | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PC2 | | | + | + | + | | | | + | | + | + | | + | + | + | | | + | + | | | | + | + | + |
| PC3 | + | | | + | + | | + | + | | + | + | + | | + | + | + | | | | | | + | + | + | + | |
| PC4 | | | + | + | + | | + | + | + | + | + | + | + | + | + | + | | | | | + | | | + | + | |
| PC5 | | + | | + | + | + | + | + | | | + | + | | + | + | + | | + | | | + | | + | | | + |
| PC6 | | | | + | + | | | | | | + | + | | + | + | + | | + | | | | + | | | | |
| PC7 | + | | + | | + | + | + | | + | + | + | + | + | | | + | | | | | | | + | | | |
| PC8 | | | | + | | | | + | + | | + | + | + | + | + | + | + | | | | | | + | | | |
| PC9 | + | | | + | + | | | | | + | | | + | + | + | | | | | | | | | | | |
| PC10 | | | + | | | | | | | | | | + | + | + | | | | | | | | + | | | |
| PC11 | | | | | + | + | + | | | | + | + | | + | + | + | | + | | | | | | | | + |
| PC12 | | | + | + | + | + | | | | + | | + | | + | + | | + | | | | | | | | | |
| PC13 | | | + | + | | | | | | | | + | + | + | + | | | | | | | | | | | |
| PC14 | | | | + | | | | | + | + | | | | | | | | | | | | | + | | | |
| PC15 | | | | + | | | | | + | + | | | | | | | + | | | | | | + | + | + | + |

## 5. MATRIX OF COMPLIANCE OF PROGRAM LEARNING OBJECTIVES (PLO) WITH THE RELEVANT COMPONENTS OF THE EDUCATIONAL AND SCIENTIFIC PROGRAM

*Table 5.2*

| Program competencies | Components of educational program | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | MC1 | MC2 | MC3 | MC4 | MC5 | MC6 | MC7 | MC8 | MC9 | MC10 | SU1.1 | SU1.2 | SU1.3 | SU1.4 | SU1.5 | SU1.6 | SU1.7 | SU1.8 | SU2.1 | SU2.2 | SU2.3 | SU2.4 | SU2.5 | SU2.6 | SU2.7 | SU2.8 |
| PLO1 | | | | | + | | | + | | | | | | + | + | | + | | + | + | + | | + | | | + |
| PLO2 | + | | | | + | | | | | | | | | | | | | + | | | | | | | | + |
| PLO3 | + | + | + | + | + | | | | + | | | | + | | | | | | | | | | + | | | |
| PLO4 | + | | | + | | + | | + | | + | | | | + | + | | + | | | | | | + | + | + | + |
| PLO5 | | | | + | | + | + | + | + | + | + | + | | | | | + | | + | + | + | | | + | + | |
| PLO6 | | | | | + | | | | | | | | + | | | | | | + | + | | | + | | | |
| PLO7 | | | + | + | | | + | | + | | | | | | | | | | | | | | | | | |
| PLO8 | | | | + | | + | + | | + | | | | + | + | + | | | | | | | | | | | |
| PLO9 | + | | | | | | + | | | + | | | | | | | | | | | + | + | | + | + | |
| PLO10 | + | + | | | | | | | | | | | | | | | | | | | | | | | | |
| PLO11 | + | | + | + | | | | | + | + | | | + | | | | | | | | | + | + | | | |
| PLO12 | | | | | | | | | | | + | + | | | | | | + | + | + | | | | | | |
| PLO13 | | | | + | | | | | | | | | | | | | | + | | | | | | | | |
| PLO14 | | | | | + | + | | | | + | | | | | | + | | + | | | | | | | | |
| PLO15 | + | | + | + | | | | | | | | | | | | | | | | | | | + | | | + |
| PLO16 | | | | | | + | | | | | | | | + | + | + | | + | | | | | | | | |
| PLO17 | | | | + | | + | | | + | + | | | | | | | | | + | + | | | | + | + | |
| PLO18 | | | | + | | | + | | | | + | + | | | | + | | | | | | + | | + | + | + |
| PLO19 | | | | | | | | | | | | | | + | + | + | + | | + | + | | | | | | |
| PLO20 | | | | | | | + | + | | | | | | | | + | | | | | | | | + | + | + |
| PLO21 | | | | | + | | | | | + | + | + | | | | | | | | | | | | | | |
| PLO22 | | | | + | | | | | + | | | | | + | + | | | + | | | | | | | | |
| PLO23 | | | | + | | | + | + | | | + | + | | + | + | | + | | | | | | | + | + | |
| PLO24 | + | | | | | | | | + | + | | | + | + | + | | | | | | + | | + | | | |

**Appendix A**

**STRUCTURAL AND LOGICAL SCHEME OF EDUCATIONAL AND SCEINTIFIC PROGRAM**