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## AERONAUTICAL AND AEROSPACE ENGINEERING – A NEW FIELD OF STUDY IN THE SYSTEM OF THE FIELDS OF STUDY IN THE SLOVAK REPUBLIC

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*The contribution analyzes the reasons for the creation of a new field of study „AERONAUTICAL AND AEROSPACE ENGINEERING”, which was successfully included in the system of the fields of study in the SR in 2017. The new field of study was formed under the auspices of the Faculty of Aeronautics of the Technical University of Kosice as a response to the current requirements of the European labour market in the field of aeronautical and aerospace engineering. Responding to this requirement, the Faculty of Aeronautics of the Technical University of Kosice has the ambition to present a new study program "Aeronautical and Aerospace Engineering" and submit for accreditation in 2018. Successful accreditation of this study program will enable us to prepare new specialists being searched by the labour market, and thus contribute to the effort declared of the Slovak Republic to keep pace with technological development in Europe.*

**Keywords:** Faculty of Aeronautics, a New Field of Study, Aerospace Engineering, Aeronautical and Aerospace Technology, Slovak Republic

### INTRODUCTION

At the proposal of the Faculty of Aeronautics of the Technical University of Kosice and subsequently the recommendation of the Accreditation Commission of the Ministry of Education, Science, Research and Sports of the Slovak Republic a new field of study 5.02.61 AERONAUTICS AND AEROSPACE ENGINEERING was introduced. This field of study does not duplicate any existing one, but extends fields of study of the SR, already established overseas as "AEROSPACE ENGINEERING". This multidisciplinary education in aerospace engineering which forms the basis of a newly established field of study, responds to the demands of the European labour market. The new field of study will seek to develop student's knowledge of not only the principles of aircraft systems, but also the principles of aircraft engineering and space engineering. Since current aircraft systems are hybrid, integrated systems will be sought to develop a student's understanding of not only the principles of aircraft systems, but also the principles of aircraft engineering and space engineering. The Aeronautical and Aerospace Engineering has the ambition to represent a field of engineering focused on research, development, construction, testing, technology, safety and operation in aviation and space technology and cooperating ground systems and equipment. The introduction of this new field of study and the subsequent successful accreditation of the new study programs included under this field of study will allow the preparation of new job seekers for the labour market and will contribute to the declared effort of the Slovak Republic to keep pace with technological development in Europe. This is also supported by the fact that the European space-related research and market exploitation is worth 50 billion Euros and employs more than 230,000 people. The share of

European companies currently accounts 40% of the global commercial markets for the production and launch of satellites to space and the subsequent provision of satellite services.

The area of education in the given field of study also supports the efforts of the Slovak Republic to fully integrate into the European Space Agency (ESA). In the context of the Declaration on the European Space Policy Conference held on 23-24 January 2018 in Brussels named "More Space for More Europe", which devoted itself to the development of the European Space Strategy, Europe is the "space empire" from the view of research and space exploitation which accounts for approximately one fifth of the global space industry, and Slovakia certainly should not stand aside. The accreditation of this field of study will fully support this declaration.

## CONTENT OF THE FIELD OF STUDY

The new field of study Aeronautical and Aerospace Engineering includes sciences of non-living nature, science of living nature, science of constructions, technologies, materials and systems. It represents an area of engineering dealing with research, design, development, construction, testing, technology, safety and operation of aircraft and space equipment and cooperating ground systems and equipment.

Aeronautical and Aerospace Engineering began to develop as a recognized academic and scientific research activity at the beginning of the 20th century in connection with the rapid development of aviation technology which was also supported by the development of space technology in the mid-20th century. The further advancement of the Aeronautical and Aerospace Engineering has been greatly conditioned by the need for new technical, diagnostic and information systems, materials and technologies to enhance the safety, efficiency and quality of air transport and the use of space equipment. At present, Aeronautical and Aerospace Engineering is one of the most dynamically evolving industries which records continuous global qualitative and quantitative growth. This fact leads to the intensification of international cooperation in this field of study as well as in the framework of integrated scientific and pedagogical projects supported by the EU.

### **Definition of related study fields**

The affinity of the field of study that has a substantial impact on the new one can be defined in the area of transport, engineering, electronics, electrical engineering and computer sciences.

According to the existing system of fields of study in the SR it is possible to define also fields of study related to the Aeronautical and Aerospace Engineering field of study. They include existing fields of study: electronics, transport, engineering, engineering and materials, energy machines and equipment, transport machines and equipment, theoretical electrical engineering, telecommunication, mechatronics, measurement and measurement technology, information systems and applied informatics.

## REASONS FOR THE NEEDS OF THE FIELD OF STUDY: AERONAUTICAL AND AEROSPACE ENGINEERING

The global expansion of civil and military aeronautical and aerospace technology and of all related manufacturing and development sectors, everyday confirms a well-known fact that the areas in question not only complement each other but that their separate existence and development is almost impossible. A good example is AIRBUS known globally, in particular, as one of the largest civil aircraft manufacturers, but it is less known that it is one of the largest allies and supporters of the European Space Agency's most influential European space player of ESA (European Space Agency). Of course, each of these areas has its own specifics as e.g. the area of astronautics with increased demands on engineering due to environmental conditions, one-off missions and distances confirms the need to develop a new field of engineering such as aerospace engineering.

Reflecting on the above mentioned facts as well as the need for national harmonization of university education in the field of aerospace and technology and similar education in the European Union and the USA, the Faculty of Aeronautics of the Technical University in Kosice was the leader in aviation education in Slovakia in 2017 with the idea of initiating new study field Aerospace Engineering. This activity has also been supported by the fact that the field of study with the above-mentioned related space technology in the current valid structure of the fields of study in the SR has been missing. The field of aeronautical technology is currently covered by the joint field of study Transport 5.2.4 Motor Vehicles, Rolling Stock, Ships and Aircraft. However, a similar combination of study of means of transport does not exist at any of the foreign universities. Sometimes there has been a combination of motor and rail vehicles, but ships and aircraft are always studying separately. This is mainly due to the differences in design principles of individual means of transport, in particular ships and aircraft from land vehicles (motor and rail vehicles). This fact and verified experience from abroad has only confirmed the necessity to design this field of study in separate alternative branches.

Another non-negligible factor was that in 2015 Slovakia became an accession member of the European Space Agency (ESA) with which the Slovak Republic clearly declared its intention to develop space research as well as other activities related to the common European space policy. To achieve this goal, a new generation of professionals educated in a new study program should definitely help.

Taking into consideration the above-mentioned trends in the development of our society but also in support of processes and preparation of personnel for aviation and space technology for the needs of the Slovak Republic as well as the Single European Space, the Faculty of Aeronautics submitted a request for inclusion in the Ministry of Education, Science, Research and Sports of the SR with a description of the new field of study Aeronautical and Aerospace Engineering.

Another important stimulus for the emergence and introduction of the new field of study is the fact that in our national system of professions, the profession of engineer for aeronautical and aerospace engineering is not found because it is a new scientific discipline. Examples of aeronautical and aerospace engineering professions are just a few in the advanced countries in the world, Aerospace Engineer (Propulsion), Aerospace Engineer (Airframe), Structural Aerospace Engineer, Principal Aerospace Engineer.

In the European academic area, the issue is covered by a similar "Aerospace engineering" field of study at universities, Delft University of Technology, University of Sweden, University of Glasgow, Cranefield University, Superior Institute of Aerospace and Space, Technical University of Berlin, University of Stuttgart, Warsaw University of Technology, and universities in the USA, Penn State University, Ohio State University, University of Florida, University of Washington, North Carolina State University and Massachusetts Institute of Technology.

## DEFINITION OF THE GRADUATE PROFESSIONAL PROFILE

Graduates of a bachelor study program in the field of Aerospace Engineering should acquire basic knowledge of modern aeronautical and aerospace technology; control the principles and functions of their activities and the conditions of their operation. They should have knowledge of theoretical disciplines such as aerodynamics, applied mathematics, selected electronic, electro technical, instrumentation and engineering disciplines to understand the operation of technical means.

Graduates of an engineering study program should have knowledge of theoretical and practical aircraft and space engines, airframe and avionics systems in the context of understanding the purpose of aircraft flying. They should also be able to assess the functionality of both technical and computer-assisted equipment in the conditions of aeronautical equipment or other manufacturing facilities, repair facilities and special laboratories, and should also be able to communicate professionally with professional aeronautical personnel. They should be able to take part in investigating the causes of air accidents and disasters and to propose measures to prevent similar accidents.

Upon completing the engineering studies, the graduate gains adequate managerial skills focused on management in the field of technical provision of aeronautical and aerospace services, the production of aids and the quality of the use of information technologies. They should also be able to undertake conceptual and coordinating activities in international professional confrontation.

The graduates should be creative to approach interdisciplinary issues based on system engineering approaches. They should be able to independently analyse and propose theoretical and practical maintenance procedures for the application of both technical and computer-aided resources focused on specified tasks in air technology, air devices, production processes and other aeronautical and aerospace applications.

Graduates of a doctoral study program should use scientific methods of research and development in the field and demonstrate ability and readiness for independent creative and research activities in the given field of study. The graduates should be able to abstract scientific problems while studying professional literature, be prepared to form trends and concepts of development in technically and computer-aided aeronautical and aerospace constructions and technologies.

The graduates should acquire theoretical knowledge and understanding of the basic concepts, patterns and connections of the aeronautical and aerospace theory in such disciplines as: aerodynamics and flight mechanics, theory, design and management of flying means and their power units, application of CAE (Computer Aided Engineering) methods in designing, testing and diagnostics of aeronautical and aerospace technology, navigation systems of air and space technology. They gain a thorough knowledge of special aviation, engineering, avionics, information, communication and other technologies and their use in aviation and related areas of social life.

They learn the interdisciplinary nature related to applications of technical knowledge in air and space areas such as system research, measurement and measurement techniques on aircraft or space objects, advanced composite materials, air and space technologies and applied informatics in air and space operation, information retrieval and signal processing in the aviation and space field. They also find and present their own solutions of the interdisciplinary problems in research and development or in constructing of technical equipment in aeronautical and aerospace engineering. They can apply knowledge to solve projects in aviation and space practice creatively.

Based on acquired knowledge and skills, graduates in the first and second degree of study should be able to keep in touch with world developments and new trends in aeronautical and aerospace engineering on the basis of expertise studies.

### **Defining the core knowledge of the field of study**

The core topics of the knowledge of the field of study in the first and second degrees of university education are focused on the theory of basic natural sciences and technical subjects in accordance with the core knowledge of aeronautical and aerospace engineering studies.

They also focus on other special physical disciplines (principles of physical sensors, aerodynamic displaying, aerodynamics, aerospace design, propulsion units, avionics and airborne energy systems, aeronautical and aerospace materials and technologies, etc.).

Part of the core also includes subjects focused on special aeronautical, aerospace methods, technologies and resources with a reasonable alternative range of subjects according to the curriculum, such as:

- aeronautical and aerospace information, technical and navigational systems,
- sensors of aeronautical and aerospace systems,
- aircraft and spacecraft electronic systems,
- aircraft and spacecraft automatic control systems,
- aircraft and spacecraft instrumentation systems,
- spacecraft ground control systems,
- aircraft mechanisms and parts,
- theory, design, control and diagnostics of propulsion units,
- construction and strength of aviation and space technology,
- auxiliary and diagnostics systems of air and space technology,
- theory, construction and auxiliary aircraft systems,
- theory, construction and control of propulsion units,
- maintenance and aircraft repairs,
- air and space technologies and materials,
- special subjects for acquiring knowledge of aerospace technologies according to the study program,
- modelling and simulation of aerospace engineering systems,
- practice in aviation facilities and solving specific tasks within the project, as well as
- managerial knowledge (technical and economic, financial and management areas).

The core topics of the 3rd university education degree are bound to the broad interdisciplinary issues of the aeronautical and aerospace field of study, in which it develops the field in depth

to meet the profile of the graduate in the 3rd study degree with emphasis on the use of knowledge, techniques, air and space sciences.

The scientific part is focused on the research of the current scientific issues in the Aeronautical and Aerospace Engineering, and principles of scientific work, links in research, development, production, use, scientific formulation of a problem (technical assignment), legal, ethical and environmental aspects of new products, presentation of results of research work, contribution of scientific work for the further development of aeronautical and aerospace engineering field of study as well as for practice in aeronautical and aerospace areas and other related areas of transport and social life.

## THE FIELD OF STUDY DEGREES AND THE GRADUATES' CAREER OBJECTIVES

New study programs in the field of aeronautics and aerospace engineering will be studied in three degree university studies with a standard length of study programs for these degrees of university studies:

- the first degree of university studies (Bc.) with a standard length of study is 3-years, an external study is 4 years,
- the second degree of university studies (Ing.) with a standard length of study is 2 years, in an external form is 3 years,
- the third degree (PhD.) with a standard length of study is 3 years in full-time form, in an external form is 4 years.
- Graduates of Study Programs in the Field of Aeronautics and Aerospace Engineering should be able to undertake the following degree of university education:
- Bachelor in the field of Aeronautical and Aerospace Engineering (Aerospace Bachelor) – 1st degree of university education,
- Engineer in the field of Aeronautical and Aerospace Engineering (Aerospace engineer) - 2nd degree of university education,
- Philosophiae Doctor in Aeronautical and Aerospace Engineering – PhD. (Philosophiae doctor in aerospace engineering) – 3rd degree of university education.

Applicability of graduates should be primarily in the operation of aeronautical and aerospace technology, in the operation and design of diagnostic systems, in the production of technical aids in the field of air operations, maintenance and implementation of prescribed works at local and transnational level for the needs of a particular air or space operator, technical or repair workplace.

Graduates of the Bachelor's degree program will be able to continue the certification process in their further activities in the aeronautical industry thanks the EASA Part-66 certificate or work in air operation as mechanics.

Based on the acquired knowledge, graduates can independently work in the field of development and implementation of new hardware and software products for aeronautical and aerospace applications as well as in the development of new information systems in this field.

Graduates of a Ph.D. study program in aeronautical and aerospace engineering studies can work as stand-alone creative designers and developers of elements, modules, nodes and components

of aeronautical and aerospace technologies, as independent creative workers in the field of air and space software products and in the field of new information systems in these areas or as leaders of interdisciplinary research and design teams, capable of working in international research teams, in design, engineering and operational research.

The ultimate and most important goal of a university degree in a new study program is to prepare graduates to be applicable in practice as members of interdisciplinary teams in aviation and space engineering. Prepare them to be able to handle technical tasks on aircraft and space systems and their propulsion systems to behave professionally in all areas of their activities, with an emphasis on ethical standards in the area of their work contacts within manufacturing and maintenance facilities.

## CONCLUSION

The introduction of the new field of study will significantly contribute not only to the content but also to the formal adaptation of the university education of specialists in the Slovak academic area for aeronautical and aerospace technology. Future study and preparation of graduates of the new study program will be consistent with a unified approach to this specialization within universities in the EU but also in the USA. The implementation of this unified approach will also help building and partnering and exchanging experience through the Erasmus program or exchange programs and student activities within the existing network of European universities with PEGASUS (Partnership of European Group of Aeronautics and Space Universities). Upon completion of the study, this cooperation can continue in the next scientific and pedagogical work through the European platform for the support of research activities of European aviation universities, the EASN (European Aeronautics Science Network Association – Brussels).

The successful introduction of the new field of study of Aeronautical and Aerospace Engineering into the Slovak Republic's Study Branch is not only a successful conclusion of this process initiated by science and pedagogical staff at the Faculty of Aeronautics of the Technical University of Kosice, but undoubtedly, it is also the contribution of the Slovak academic team to the process of unification of access to the expansion process of research, development, and university education with a focus on aeronautical and aerospace technology throughout the European Union's academic area and eventually other advanced countries in the world.

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**AERONAUTICAL AND AEROSPACE ENGINEERING - ÚJ TANULMÁNYI SZAK A SZLOVÁK KÖZTÁRSASÁG SZAKTERÜLETEK RENDSZERÉBE**

*A cikk elemzi az „AERONAUTICAL AND AEROSPACE ENGINEERING” új tanulmányterület/tanszak létrehozásának okait, amely 2017-ben sikeresen bekerült Szlovákiai tanulmányi és szakterületek rendszerébe. A Kassai Műszaki Egyetem Légügyi Kar tagjai az európai munkaerőpiac jelenlegi követelményeire válaszként készítették az új tanulmányi programot. Ennek megfelelően a Kassa Műszaki Egyetem Légügyi Karának célja az lett, hogy bemutasson egy új tanulmányi programot, és 2018-ban be nyújtotta akkreditációra. A tanulmányi program sikeres akkreditációja lehetővé teszi számunkra, hogy új szakembereket készítsünk a munkaerőpiacon, és ezáltal hozzájáruljunk a Szlovák Köztársaság által bejelentett erőfeszítésekhez és egyaránt lépést tartsunk az európai technológiai fejlődéssel.*

**Keywords:** *Légügyi Kar, új szakterület, repülő mérnök, repülő és űrtechnológia Szlovákia*

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