

**FACULTY OF COMPUTERS, INFORMATICS,
AND MICROELECTRONICS**

**DEPARTMENT OF SOFTWARE ENGINEERING
AND AUTOMATION**

Bachelor's Degree Program

0613.3 Software Engineering

Ministry of Education and Research of the Republic of Moldova
Technical University of Moldova
Faculty of Computers, Informatics, and Microelectronics

CURRICULUM
for Bachelor's Higher Education (Cycle I) (Level 6 according to ISCED)
for Integrated Higher Education (Level 7 according to ISCED)

General Field of Study:	<i>061 Information and Communication Technologies</i>
Professional Training Field:	<i>0613 Software and Application Product Development</i>
Study Program:	<i>0613.3 Software Engineering</i>

Total number of study credits:	<i>240 ECTS</i>
Degree awarded:	<i>Bachelor of Engineering</i>
Admission basis:	<i>High school diploma or an equivalent educational document; higher education diploma</i>
Language of instruction	<i>English, Romanian</i>
Mode of education:	<i>full-time education</i>

APPROVED TUM Senate Meeting Minutes No. 9 dated April 27, 2021

Modification approved TUM Senate Meeting Minutes No. 9 dated March 28, 2023

1. ACADEMIC CALENDAR

<i>Year of study</i>	<i>Teaching Activities</i>		<i>Examination Sessions</i>		<i>Internships</i>	<i>Holidays</i>		
	<i>Sem. I</i>	<i>Sem. II</i>	<i>Sem. I</i>	<i>Sem. II</i>		<i>Winter</i>	<i>Spring</i>	<i>Summer</i>
I	1.09 - 14.12 (15 weeks)	26.01-17.05 (15 weeks)	15.12 – 25.01 (4 weeks)	18.05 – 14.06 (4 weeks)	-	25.12 – 07.01 (2 weeks)	Easter Holiday (according to the Orthodox Christian calendar)	15.06 – 30.08 (11 weeks)
II	1.09 - 14.12 (15 weeks)	26.01-17.05 (15 weeks)	15.12 – 25.01 (4 weeks)	18.05 – 14.06 (4 weeks)	1.09 - 14.12 (4 weeks)	25.12 – 07.01 (2 weeks)		15.06 – 30.08 (11 weeks)
III	1.09 - 14.12 (15 weeks)	26.01-17.05 (15 weeks)	15.12 – 25.01 (4 weeks)	18.05 – 14.06 (4 weeks)	1.09 - 14.12 (4 weeks)	25.12 – 07.01 (2 weeks)		15.06 – 30.08 (11 weeks)
IV	1.09 - 14.12 (15 weeks)	23.02 – 17.05 (11 weeks)	15.12 – 25.01 (4 weeks)	23.03 – 29.03 (1 week) 01.06-14.06 (2 weeks)	26.01 – 22.02 (4 weeks)	25.12 – 07.01 (2 weeks)		-
Total number of weeks	60 weeks	56 weeks	16 weeks	15 weeks	12 weeks	8 weeks	1 week	33 weeks

2. Curriculum Plan by Semester/Year of Study

Year I

Code	Name of the Course/Module	No/hours			Number of hours by type of activity					Evaluation Method	No. ECTS
		Total	Direct Contact Hours	Independent Study	Lecture Hours	Seminar Hours	Practical Classes	Laboratory Work	Project		
Semester I											
F.O.001	Linear Algebra and Analytic Geometry	90	45	45	30		15			E	3
G.O.001	Conceptual Design of an IT Application	120	60	60					60	E, PA	4
F.O.008	Discrete Mathematics	150	75	75	30	15	30			E	5
F.O.004	Mathematical Analysis I	120	60	60	30		30			E	4
U.A.001 U.A.101 U.A.201	Ethics and Academic Integrity /Organizational Behavior/ Engineering Psychology	60	30	30	30					E	2
D.O.001	Probability and Applied Statistics	120	60	60	30	15	15			E	4
F.O.003	Computer Programming	180	90	90	30	30	30			E	6
G.O.002	Foreign Language 1	60	30	30			30			E	2
G.O.003	Romanian Language (for non-native speakers) 1	60	30	30			30			E	2
G.O.004	Physical Education 1	60	30	30			30			E	
Total semester I		900	450	450	180	60	150	0	60	8E, 1PA	30
Semester II											
F.O.005	Special Mathematics	90	45	45	30		15			E	3
F.O.006	Mathematical Analysis II	120	60	60	30		30			E	4
F.O.002	Applied Sciences	180	90	90	30		30	30		E	6
D.O.003	Numerical Methods	90	45	45	30		15			E	3
F.O.009	Data Structures and Algorithms	150	75	75	30	15	30			E	5
F.O.007	Equivalent Models	120	60	60					60	E, PA	4
G.O.005	Communication and Academic Writing	90	45	45	30	15				E	3
G.O.006	Foreign Language 2	60	30	30			30			E	2
G.O.007	Romanian Language (for non-native speakers) 2	60	30	30			30			E	2
G.O.008	Physical Education 2	60	30	30			30			E	
Total semester II		900	450	450	180	30	150	30	60	8E, 1PA	30
Total year 1		1800	900	900	360	90	300	30	120	16E, 2PA	60

Courses that ensure training in the professional training field are called domain-specific courses (D) and are included in the formative category of Specialized Courses

Year II

Code	Name of the Course/Module	No/hours			Number of hours by type of activity					Evaluation Method	No. ECTS
		Total	Direct Contact Hours	Independent Study	Lecture Hours	Seminar Hours	Practical Classes	Laboratory Work	Project		
Semester III											
S.O.001	Basics of Application Development	60	30	30					30	E, PA	2
D.O.004	Object-oriented Programming	120	60	60	30		30			E	4
D.O.002	Computer Graphics	120	60	60	30		30			E	4
D.O.005	Database	150	75	75	30	15	30			E	5
D.O.006	Systems Analysis and Modeling	150	75	75	30	15	30			E	5
U.A.002 U.A.102	State and Law Foundations/ Intellectual Property Law	60	30	30	30					E	2
S.O.011	Technology Internship	240	0	240						E	8
G.O.009	Physical Education 3	60	30	30			30			E	
Total semester III		900	330	570	150	30	120	0	30	7E, 1PA	30
Semester IV											
S.O.002	Elaboration of Languages Specific to the Field	240	120	120					120	E, PC	8
F.O.010	Algorithm Analysis	120	60	60	30		30			E	4
D.O.007	Computer Architectures	120	60	60	30		30			E	4
D.O.008	Multimedia Technologies	150	75	75	30		45			E	5
D.O.009	Computer Networks	120	60	60	30		30			E	4
D.O.010	Formal and Automatic Languages	150	75	75	30		45			E	5
G.O.010	Physical Education 4	60	30	30			30			E	
Total semester IV		900	450	450	150	0	180	0	120	6E, 1PC	30
Total year II		1800	780	1020	300	30	300	0	150	13E, 1PA,1PC	60

Year III

Code	Name of the Course/Module	No/hours			Number of hours by type of activity					Evaluation Method	No. ECTS
		Total	Direct Contact Hours	Independent Study	Lecture Hours	Seminar Hours	Practical Classes	Laboratory Work	Project		
Semester V											
S.O.003	Secure Applications Development	60	30	30					30	E, PA	2
D.O.011	Operating Systems	120	60	60	30		30			E	4
S.O.004	Network Programming	120	60	60	30		30			E	4
D.O.012	Cryptography and Security	120	60	60	30		30			E	4
S.O.005	Software Design Mechanism and Techniques	120	60	60	30		30			E	4
U.A.003 U.A.103	Philosophy and Critical Thinking/ Philosophy and Engineering Thinking	120	60	60	30	30				E	4
S.O.010	Production Internship	240		240						E	8
	Total semester V	900	330	570	150	30	120	0	30	7E, 1PA	30
Semester VI											
S.O.006	IoT project	180	90	90					90	E, PA	6
D.O.013	Signal Processing	120	60	60	30		30			E	4
D.O.014	Electronic Circuits and Devices	150	75	75	30		15	30		E	5
S.O.007	Embedded Systems	120	60	60	30		30			E	4
S.A.001 S.A.101	Mobile Application Programming/ WEB Programming	120	60	60	30		30			E	4
D.O.015	Human Security and Sustainable Development	90	45	45	30	15				E	3
D.O.018	Software Project Management	120	60	60	30		30			E	4
	Total semester VI	900	450	450	180	15	135	30	90	7E, 1PA	30
Total year III		1800	780	1020	330	45	255	30	120	14E, 2PA	60

Year IV

Code	Name of the Course/Module	No/hours			Number of hours by type of activity					Evaluation Method	No. ECTS
		Total	Direct Contact Hours	Independent Study	Lecture Hours	Seminar Hours	Practical Classes	Laboratory Work	Project		
Semester VII											
S.O.008	Information Systems Design	300	150	150					150	E, PA	10
D.O.017	Analysis and Specification of Software Requirements	150	75	75	30	15	30			E	5
S.A.002 S.A.102	Fundamentals of Artificial Intelligence / Declarative Programming	150	75	75	45		30			E	5
S.O.009	Distributed Application Programming	150	75	75	45		30			E	5
S.A.003 S.A.103	Mixed Reality Technologies / Fundamentals of Game Development	150	75	75	45		30			E	5
	Total semester VII	900	450	450	165	15	120	0	150	5E, 1PA	30
Semester VIII											
D.O.017	Enerpreneurship	150	75	75	30		45			E	5
S.A.004 S.A.104	Software Testing / Software Quality Assurance	90	45	45	30	15				E	3
S.O.012	Degree Internship	240		240						E	8
S.O.013	Elaboration and the Defense of Bachelor's Thesis	420		420						E	14
Total semester VIII		900	120	780	60	15	45	0	0	4E	30
Total year IV		1800	570	1230	225	30	165	0	150	9E, 1PA	60
Total per study program		7200	3030	4170	1215	195	1020	60	540	52E, 6PA, 1PC	240

5. Elective Courses/Modules

Code	Name of the Course/Module	No/hours			Number of hours by type of activity					Evaluation Method	No. ECTS
		Total	Direct Contact Hours	Independent Study	Lecture Hours	Seminar Hours	Practical Classes	Laboratory Work	Project		
Year II, Semester III											
L.A.001	Interactive Programming	90	45	45	30		15			E	3
L.A.002	UX/UI design	120	60	60	30		30			E	4
Year II, Semester IV											
L.A.003	Inventics	60	30	30	15	15				E	2
L.A.004	Event-driven Programming	90	45	45	30		15			E	3
Year III, Semester V											
L.A.005	Malicious Programs and Incident Response	90	45	45	30		15			E	3
L.A.006	Cybercrime and Investigative Techniques	90	45	45	30		15			E	3
Year III, Semester VI											
L.A.007	Reverse engineering techniques	90	45	45	15		30			E	3
L.A.008	Real-time Programming	90	45	45	15		30			E	3
Year IV, Semester VII											
L.A.009	e-Governance	120	60	60	30		30			E	4
L.A.010	Wireless Digital Communications	120	60	60	30		30			E	4

6. Psychopedagogical Module Plan

<i>Code</i>	Name of the Course/Module	<i>No/hours</i>			<i>Number of hours by type of activity</i>					<i>Evaluation Method</i>	<i>No. ECTS</i>
		<i>Total</i>	<i>Direct Contact Hours</i>	<i>Independent Study</i>	<i>Lecture Hours</i>	<i>Seminar Hours</i>	<i>Practical Classes</i>	<i>Laboratory Work</i>	<i>Project</i>		
<i>F.O.001</i>	Pedagogy	240	120	120	60	60				E	8
<i>F.O.002</i>	Psychology	180	90	90	45	45				E	6
<i>F.O.003</i>	Professional Ethics and Deontology	90	45	45	30	15				E	3
<i>F.O.004</i>	Educational management	90	45	45	30	15				E	3
<i>S.O.001</i>	Didactics of Technical Disciplines	150	75	75	30		45			E	5
<i>S.O.002</i>	Problem-solving Learning	150	75	75	30		45			E	5
<i>S.O.003</i>	Pedagogical Internship I	300		300						E	10
<i>S.O.004</i>	Pedagogical Internship II	540		540						E	18
<i>S.O.005</i>	Module Completion exam	60		60						E	2
Total:		1800	450	1350	225	135	90	0	0	9E	60

7. Initial Curricular Minimum, Oriented Towards Another Field

<i>Code</i>	Name of the Course/Module	<i>No/hours</i>			<i>Number of hours by type of activity</i>					<i>Evaluation Method</i>	<i>No. ECTS</i>
		<i>Total</i>	<i>Direct Contact Hours</i>	<i>Independent Study</i>	<i>Lecture Hours</i>	<i>Seminar Hours</i>	<i>Practical Classes</i>	<i>Laboratory Work</i>	<i>Project</i>		
<i>D.O.004</i>	Object-Oriented Programming	120	60	60	30		30			E	4
<i>D.O.005</i>	Database	150	75	75	30	15	30			E	5
<i>D.O.006</i>	System Modelling and Analysis	150	75	75	30	15	30			E	5
<i>F.O.010</i>	Algorithm Analysis	120	60	60	30		30			E	4
<i>D.O.010</i>	Formal Languages and Automata	150	75	75	30		45			E	5
<i>S.O.001</i>	Basics of Application Development	60	30	30					30	E, PA	2
<i>S.O.009</i>	Distributed Application Programming	150	75	75	45		30			E	5
Total:		900	450	450	195	30	195	0	30	7E, 1PA	30

8. Courses with Recognized Credits

accumulated by graduates of postsecondary and non-tertiary postsecondary education institutions in the professional training field 0613 Product Development and Program and Application Development.

Code	Name of the Course/Module	No/hours			Number of hours by type of activity					Evaluation Method	No. ECTS
		Total	Direct Contact Hours	Independent Study	Lecture Hours	Seminar Hours	Practical Classes	Laboratory Work	Project		
Year I, Semester I											
U.A.001 U.A.101 U.A.201	Ethics and Academic Integrity / Organizational Behavior/ Engineering Psychology	60	30	30	30					E	2
Year II, Semester III											
U.A.002 U.A.102	State and Law Foundations/ Intellectual Property Law	60	30	30	30					E	2
Total:		120	60	60	60	0	0	0	0	2E	4

EXPLANATORY NOTE
The curriculum for bachelor's degree studies (cycle I)

06 Information and Communication Technologies

061 Information and Technologies

0613 Development of software products and applications

Study Program: *0613.3 Software Engineering*

1 Program description

The *Software Engineering* training curriculum has been developed according to the requirements:

1. Education Code no. 152 of July 17, 2014 (Official Monitor of the Republic of Moldova, 2014, no. 319-324, art. 634).
2. Nomenclature of vocational training areas and specialties in higher education, Government Decision No. 482/2017.
3. National Qualifications Framework of the Republic of Moldova, Government Decision No 1016/2017.
4. Framework plan for Bachelor's (cycle I), Master's (cycle II) and integrated higher education studies, approved by MECC Order no. 120 of 10.02.2020.
5. Plan - Framework for higher education studies (cycle I) and integrated applied at the Technical University of Moldova, approved at the TUM Senate meeting of October 27, 2020, minutes no. 3.
6. Regulation on the organization of bachelor's degree (first cycle) and integrated higher education studies, Order of the Ministry of Education, Culture and Research, no. 1625/2019.
7. Order on the organization of studies in double specialties, no. 669/2017.
8. Framework Regulation on the organization and conduct of distance higher education, Ministry of Education Order No. 474/2016.
9. Framework Regulation on the organization of the exam for the completion of bachelor studies, Ministry of Education Order no. 1047/2015.
10. Regulation on internships in higher education, Ministry of Education Order No. 203/2014.
11. European Credit Transfer and Credit System Users' Guide, 2015.
12. Standards and guidelines for quality assurance in the European Higher Education Area (EHEA), 2015.

1.1 Description of the Software Engineering program profile

Software Engineering (SE), together with *Information Technology*, is the science of methods and tools for processing information (*computing*) to solve specific problems related to the organization of human activities. Concerning *Information Technology*, *Software Engineering* is more theoretical and oriented towards the training of specialists whose essential mission is to develop models and techniques for software production, but whose field extends to both systems infrastructure and organizational and informational aspects of enterprises.

The more theoretical aspect of the domain is evidenced by the fact that the software development processes studied have a more grounded theoretical substrate in the Software Engineering curriculum. But the program also includes information application procedures with a specific purpose in designing, building and using information products and services, so there are common areas with the *Information Technology* program.

1.2 Description of the Software Engineering training domain

Since the dawn of electronic computing in the 1940s, computing systems and all that they entail have had a steadily increasing rate of use. Software already defines the essentials of human activities: government, communications, manufacturing, banking and finance, education, transportation, entertainment, medicine, agriculture and law. Software products help the world be more efficient, more productive. OECD data show the huge sums spent on software development. Despite these successes, during this period, there have been serious problems with the development costs, timeliness and quality of many software products. The ACM curriculum guide cites several reasons for these problems, defining the emergence of the new program:

- Software products are among the most complex man-made systems, and by their very nature, software has intrinsic, essential properties that are not easily addressed;
- Programming techniques that work in small teams and for moderate product development are not always well suited for producing large and complex systems;
- The pace of change in ICT is driving towards new and advanced products. Therefore, the expectations of beneficiaries and other driving forces in the field are putting pressure on qualitative and timely development.
- The availability of qualified software engineers has not kept pace with industry demand, so systems are often designed and built by people without appropriate training or experience.

The relevance of the study program is also provided by the USAID survey data (*Updating the IT skills gap* - O'Sullivan and Bercu, 2016), which highlights the need for more qualified specialists, specifically skilled in program product development.

The high pace of globalization of human society is largely due to information technologies, which provide new opportunities for harnessing information. Recognition of this is materialized in various national and international acts:

- *The Europe 2020 Digital Agenda* is one of the seven flagship initiatives within the EU's comprehensive and sustainable development strategy and aims to bring major economic and social benefits from a Digital Single Market, which already by mid-implementation should ensure: a) 50% of the population using e-commerce; b) 33% of small and medium-sized enterprises selling online; c) 50% of citizens benefiting from e-Government services; d) most public services being accessible online in all EU member countries, etc.
- The transformation of the Republic of Moldova into a modern and performing state is possible only through *technological modernization* at the level of society, organizations and individuals (*actions, also found in the Strategic Program for Technological Modernization of the country*).

The main goal of the study program is determined by the need for well-trained engineers in the field of professional training, able to provide advanced software solutions and innovations applied to various areas of human activity.

The Software Engineering program of study trains engineers who will demonstrate the following qualities:

- possess knowledge and skills of software engineering, and know the professional standards required to start the engineering practice;
- demonstrates understanding of and can apply theories, models and techniques that define the fundamentals for identifying, analyzing, designing, performing, implementing, verifying and documenting problems of the objective domain;
- can work both alone and in a team to develop and deliver quality software products;
- demonstrates an understanding of, and attaches importance to, negotiation and communication with stakeholders, indispensable components of a typical software development environment;
- can provide solutions for various application domains using software engineering methods, integrating ethical, social, legal and economic aspects;
- can find acceptable solutions, matching conflicting project objectives, taking into account costs, time, knowledge, and existing systems.

Therefore, the expected goals of the study program 0613.3 Software Engineering are to train young specialists, holders of the bachelor's degree in Software Engineering, who demonstrate knowledge, skills and transversal and professional competences that meet the requirements of employers, confirmed by a bachelor's

degree with 240 transferable credits and that ensure the opportunity for employment and/or further studies at the second cycle (master's degree).

2 Knowledge, skills and competences provided by the study program

The professional competences developed by the study program are determined by the definition of the Software Engineering specialty by the *ACM - Association for Computing Machinery* and *IEEE Computer Society* standards, and imply a mix of skills for solving a range of problems outlined by *key competences* on:

- scientific and engineering foundations of information technologies;
- organizational and informational aspects of systems;
- application technologies;
- software development methods and technologies;
- architecture and infrastructure of computing systems.

The professional and transversal competences are covered by fundamental, general, socio-humanistic and specialized subjects, the weights of which are under the Framework Plan. An explanation of the competences developed and their distribution by content area can be found in the grids in Annexes 1 and 2.

3 The study program objectives, including their relevance to the mission of the university

The primary goal of the study program is determined by the need for active actors in the technological modernization of society, graduates engaged in business and academic environment, well prepared in the field of professional training and competent to provide advanced solutions and innovations in the multiple practical and scientific activities of the Information Technology sector.

The general objectives of the study program include:

- studying the foundations of the socio-human and economic sciences; establishing methods of using these sciences in professional and social activity;
- description of the basic issues related to the technical and scientific development from the perspective of information technologies and adjacent areas;
- studying the role and place of data structures, algorithms and programming languages in information technologies;
- describing the problems of designing, implementing, maintaining and engineering information systems;
- presentation of methods of leadership and cooperation in teams, studying the organization of subordinates' activities and decision-making.

The quality of the educational activities is the continuous priority of the *Software Engineering and Automation* Department, as a provider unit of multiple degree programs: *Information Technology, Information Security, and Automation and Computer Science*. The quality assessment consists of a multi-criteria examination of learning outcomes expressed in *knowledge, skills and competences*. The examination components include the following:

- compliance with the Framework Plan for Higher Education (*approved by the Ministry of Education Ordinance no. 1047/2015*),
- compliance with reference standards (*Software Engineering 2014/ Curriculum Guidelines for Undergraduate Degree Programs in Software Engineering, Association for Computing Machinery (ACM), IEEE Computer Society*),
- the content and structure of the material taught - scientific topicality, integration of research results, development of skills to apply knowledge in new situations;
- performance indicators - promotion rate, admission competition, language preparation, success in national and international competitions, student satisfaction assessment (surveys), *English language program offered by the faculty*, attracting international students, etc.

4 Aligning the study program and curriculum content with international trends in the field

At the international level for the Software Engineering Qualification, the following equivalences are found:

- a) The ISCED Fields of Education and Training 2013 (ISCED-F 2013) specifies the qualification 0613 Software and applications development and analysis;
 - The Nomenclature of fields and specializations / programs of university studies in Romania (GD no. 158/2018 on the approval of the Nomenclature of fields and specializations / programs of university studies and the structure of higher education institutions for the academic year 2018-2019) provides: Undergraduate field: Computers and Information Technology, Specialization: Information Engineering.
- b) The European Skills/Competences, qualifications and Occupations (ESCO) standard includes qualifications:
 - Software and applications developers and analysts
(<https://ec.europa.eu/esco/portal/occupation?uri=http%3A%2F%2Fdata.europa.eu%2Fesco%2Fisco%2FC251&conceptLanguage=en&full=true>)

In the development of the Software Engineering qualification, the requirements of the European Standard (European Norms) EN 16234-1:2016 (E) "e-Competence Framework (e-CF) - a common European Framework for ICT Professionals in all industry sectors" have been taken into account. This European standard provides a reference to 40 competences required and applied in the workplace in the field of information and communication technologies (ICT), using a common language for competences, skills and competence levels that can be understood across Europe. As the first sector-specific implementation of the European Qualifications Framework (EQF), this European Standard aligns competence levels with the learning levels of the EQF. The Standard has been developed for application by: ICT services, user and provider organizations, ICT professionals, ICT practitioners, human resources (HR) managers and departments, vocational education and training institutions, including higher education, associated social partners, professional associations, accreditation, validation and assessment bodies.

5 Assessment of economic and social sector expectations

The curriculum for the training of the specialist in Software Engineering has been developed according to the provisions of the Framework Plan for Bachelor's Degree (cycle I), Master's Degree (cycle II) and Integrated Degree, TUM Regulation on the organization of studies based on the National System of Study Credits, developed based on the Regulation on the organization of studies in higher education based on the National System of Study Credits, the National Qualifications Framework, and the Qualifications Framework of the European Higher Education Area. Thus, the Program is oriented towards the training of engineers with the qualification corresponding to level 6 of the National Qualifications Framework/European Qualifications Framework and being in line with national and international standards for the training of specialists in the field. This allows for the compatibility of the Study Program and the contents of the programs with the respective programs of higher education institutions at the national and European level, the creation of premises for academic mobility of students, recognition and equivalence of study documents, etc. In the elaboration of the Software Engineering Study Program Plan, consultations were organized with social partners (employers) from various organizations and state and private enterprises, where graduates of the Information Technology (English-speaking branch "Computer Science") study program are working and occupying various positions in the economic units. As a result of consultations with social partners to ensure the training of specialists by the requirements of modern industry, new subjects have been included in the curriculum of the "Software Engineering" study program: Algorithm Analysis, Electronic Circuits and Devices, Systems Analysis and Modeling, Software Testing, Human Security and Sustainable Development, Linear Algebra and Analytic Geometry, Philosophy and Critical Thinking, Fundamentals of State and Law, Communication and Academic Writing, Ethics and Academic Integrity. In some specialized subjects, the content will be revised, and sections of interest to employers will be included.

6 Consulting partners in the curriculum development process (employers, teachers, alumni, students, etc.)

The Technical University of Moldova, through the Department of Software Engineering and Automatics, is the *first university* that, since 1993 prepares engineers licensed in Information Technologies. But consultations with partners (public institutions, private companies and students) have emphasized the need for new approaches: *teamwork and interdisciplinarity*.

Ongoing consultation is manifested through collaborative activities in different workshops and inter-institutional projects involving members of the department. Among the private companies that have actively collaborated in consultation or support partnerships are Orange, M - Testing, Endava, Pentalog, Winify, Amdaris, Sens Media, Crunchyroll, etc.

7 Relevance of the study program to the labor market

The qualification/specialty Software Engineering is the science of methods and tools for processing (acquisition, conversion, processing, transmission and storage) of information by using processing devices and program products to solve specific problems related to the organization of human activities. Software Engineering are both theoretical and applicative character in computer science by understanding and applying appropriate theories, models and techniques that provide a basis for problem identification and analysis, design, development, implementation, verification and documentation of problems.

8 Employment opportunities for graduates

Taking into account the growing need for qualified specialists in the national and regional market, TUM graduates have a high employability rate, according to the USAID survey. The Classification of Occupations of the Republic of Moldova approved on 03.03.2014 by the Government of the Republic of Moldova by major subgroup 25 *Specialists in information and communication technology* with minor group 251 *Software Analysts* (2511 System Analysts, 2512 Software Designers, 2513 Web and Multimedia Systems Designers, 2514 Application Programmers, 2519 Software Analysts not classified in the previous major groups) covers the basic functions/professions of graduates of the Software Engineering program.

Taking into account the competences of the program, *software engineers* are able to work in positions other than those mentioned: from professors and researchers to directors and managers at different levels.

9 Access to studies for holders of diplomas obtained after completion of the respective degree program

The declared and necessary competences of the Software Engineering study program allow graduates to continue their master's degree studies in ICT specialties in any university in the country and abroad within the framework of existing national and international partnerships.

In case a Master's program different from the field of professional training graduated in the first cycle (bachelor's degree) will be applied for in the second cycle, the candidate will have to accumulate 30 transferable study credits in the fundamental and specialized course units/ modules related to the field of study for which he/she opts for, which represents the minimum initial curriculum required as stipulated in the examined curriculum plan.

**THE MATRIX OF THE CORRELATION OF LEARNING OUTCOMES DEVELOPED IN THE
PROGRAM WITH THOSE OF THE DISCIPLINES/MODULES**

Course code	Course name	No. ECTS	Learning outcomes										
			1	2	3	4	5	6	7	8	9	10	11
<i>F.O.001</i>	Linear Algebra and Analytic Geometry	3			2	1							
<i>F.O.002</i>	Applied Sciences	6			2	2	1		1				
<i>F.O.003</i>	Computer Programming	6	2	1				1	1	1			
<i>F.O.004</i>	Mathematical Analysis I	4	1		1	1				1			
<i>F.O.005</i>	Special Mathematics	3	1		0,5	0,5				1			
<i>F.O.006</i>	Mathematical Analysis II	4	1		1	1				1			
<i>F.O.007</i>	Equivalent Models	4			1	1	1		1				
<i>F.O.008</i>	Discrete Mathematics	5	1		1				2	1			
<i>F.O.009</i>	Data Structures and Algorithms	5	1	1	1	1			1				
<i>F.O.010</i>	Algorithm Analysis	4	1		1			1	1				
<i>D.O.001</i>	Probability and Applied Statistics	4	1		1	1		1					
<i>D.O.002</i>	Computer Graphics	4	1	1		1	0,5		0,5				
<i>D.O.003</i>	Numerical Analysis	3	1		0,5				1	0,5			
<i>D.O.004</i>	Object-Oriented Programming	4	1	1	1			0,5	0,5				
<i>D.O.005</i>	Databases	5	2		1	1		1					
<i>D.O.006</i>	Systems Analysis and Modeling	5	2		1		1	1					
<i>D.O.007</i>	Computer Architectures	4	1	1				1	1				
<i>D.O.008</i>	Multimedia Technologies	5	1	1		1	1	0,5	0,5				
<i>D.O.009</i>	Computer Networks	4		1				1	1	1			
<i>D.O.010</i>	Formal and Automated Languages	5	2		1			1	1				
<i>D.O.011</i>	Operating Systems	4	1	1		1		0,5		0,5			
<i>D.O.012</i>	Cryptography and Security	4	1	1				1	0,5	0,5			
<i>D.O.013</i>	Signal Processing	4	1	1	1	1							
<i>D.O.014</i>	Electronic Circuits and Devices	5	2			1		1	1				
<i>D.O.015</i>	Human Security and Sustainable Development	3					2						1
<i>D.O.016</i>	Entrepreneurship	4					1		1		1	0,5	0,5
<i>D.O.017</i>	Analyzing and Specifying Software Requirements	5	1	1	1		2						

Course code	Course name	No. ECTS	Learning outcomes										
			1	2	3	4	5	6	7	8	9	10	11
<i>D.O.018</i>	Software Project Management	5		1	1	1	1		1				
<i>G.O.001</i>	Conceptual Design of an IT Application	4							1		1	1	1
<i>G.O.002</i>	Foreign Language 1	2										1	1
<i>G.O.003</i>	Romanian Language (for non-native speakers) 1	2										1	1
<i>G.O.004</i>	Physical Education 1	2									1	0,5	0,5
<i>G.O.005</i>	Communication and Academic Writing	3									1	1	1
<i>G.O.006</i>	Foreign Language 2	2										1	1
<i>G.O.007</i>	Romanian Language (for non-native speakers) 2	2										1	1
<i>G.O.008</i>	Physical Education 2	2									0,5	1	0,5
<i>G.O.009</i>	Physical Education 3	2									0,5	1	0,5
<i>G.O.010</i>	Physical Education 4	2									0,5	1	0,5
<i>N/A 010</i>	Technological Internship	8	1	1				1	1	1	1	1	1
<i>N/A 011</i>	Production Internship	8	1	1	1		1	1		1	1	0,5	0,5
<i>N/A 012</i>	License Internship	8	1	1	1		1	1		1	1	0,5	0,5
<i>U.O.001</i>	Ethics and Academic Integrity	2					0,5				0,5	0,5	0,5
<i>U.O.002</i>	State and Law Foundations	2					0,5				0,5	0,5	0,5
<i>U.O.003</i>	Philosophy and Critical Thinking	4					1				1	1	1
<i>N/A.001</i>	Application Development Basics	2	1				0,5	0,5					
<i>N/A 002</i>	Developing Domain-Specific Languages	8	2		1	1	1	1	1	1			
<i>N/A 003</i>	Secure Applications Development	2	1	1									
<i>N/A 004</i>	Network Programming	4	1	1	1			1					
<i>N/A 005</i>	Software Design Techniques and Mechanisms	4	1	1	1		0,5	0,5					
<i>N/A 006</i>	IoT Projects	6	2	2				1	1				
<i>N/A 007</i>	Embedded Systems	4	1	1				1	1				
<i>N/A 008</i>	Designing Information Systems	10	2	2	1		1	1	2	1			

Course code	Course name	No. ECTS	Learning outcomes										
			1	2	3	4	5	6	7	8	9	10	11
N/A 009	Programming Distributed Applications	5	1	1				1	1	1			
N/A 013	License Paper Design	12	2	2	1		1	1	1	1	1	1	1
S.A.001/ S.A.101	<i>Programming Mobile Applications/ WEB Programming</i>	4	1	1	1		1						
S.A.002/ S.A.102	<i>Fundamentals of Artificial Intelligence/ Declarative Programming</i>	5	2		1				1	1			
S.A.003/ S.A.103	<i>Mixed Reality Technologies/ Fundamentals of Game Development</i>	5	1	1	1	1		0,5		0,5			
S.A.004/ S.A.104	<i>Software Testing/ Software Quality Assurance</i>	3		1	1	0,5				0,5			

LIST OF COMPETENCIES AND LEARNING OUTCOMES

	Professional (PC) & Transversal Competencies (TC)	Learning Outcomes according to the NQF (National Qualifications Framework) Level <i>Upon completion of the program, the graduate will be able to:</i>
1.	PC1. Design and development of applications	<ul style="list-style-type: none"> - act creatively to develop applications and select appropriate technical options; - participate in other development activities; - optimize application development, maintenance and performance by using design patterns and reusing tested solutions.
2.	PC2. Integration of software components	<ul style="list-style-type: none"> - consider own- and third-party actions in the integration process; - follow appropriate control standards and procedures to maintain the integrity of the functionality and overall reliability of the system.
3.	PC3. Testing of applications and systems	<ul style="list-style-type: none"> - provide expertise to oversee complex testing programs; - ensure documentation of tests and results to provide information to relevant process/process managers such as designers, users or maintenance technicians; - ensure compliance with test procedures, including documented traceability.
4.	PC4. Implementation of IT solutions	<ul style="list-style-type: none"> - consider own actions and those of others to provide solutions and initiate communication and collaboration with stakeholders; - provide expertise to influence, through advice and assistance, the development of solutions.
5.	PC5. Development of technical documentation	<ul style="list-style-type: none"> - adapt the level of detail according to the purpose of the documentation and the intended audience;
6.	PC6. Provision of effective technical support to users	<ul style="list-style-type: none"> - manages the assistance/support process and is responsible for the validated SLA level; - plan resource allocation to achieve required service levels; - act creatively and implement constant service improvement; - manages the user support function budget.
7.	PC7. Customization of IT support services	<ul style="list-style-type: none"> - ensure system integrity by controlling the application of functional updates, software or hardware additions and maintenance activities; - respect budgetary requirements.
8.	PC8. Delivery of IT services	<ul style="list-style-type: none"> - set the schedule of operational tasks; - manage costs and allocated budget under internal procedures and external constraints; - identify the optimal number of staff required to ensure the operational management of the system infrastructure.
9.	TC1. Demonstration of autonomy and responsibility	<ul style="list-style-type: none"> - demonstrate responsible and autonomous performance of professional tasks.
10.	TC2. Effective social and professional interaction	<ul style="list-style-type: none"> - perform specific teamwork roles and activities, and distribute tasks between members at subordinate levels.
11.	TC3. Engagement in personal and professional development	<ul style="list-style-type: none"> - recognize the need for lifelong learning with effective use of learning resources and techniques for personal and professional development.