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Document Purpose

This document describes guidelines for the development of training programs, including study programs and plans, with a practical profile in the MACICT Project.

Definition of Terminology (Glossary)

Development of training programs - defining the mission and purpose of the courses, the assumed learning outcomes in the context of the MACICT project, preparing a list of modules and courses, programs and course syllabuses, reviewing and revising the course syllabuses

Guidelines - a set of rules/ instructions that are given by the MACICT QA Team telling how to develop training programs, study programs and plans, a practical profile in the MACICT Project (described in a current document). They determine the course of action, aim to streamline particular processes according to the set routine and sound practice^[1].

Total Student Workload (TSW) - the number of hours which enables the achievement of the assumed learning outcomes in terms of knowledge, skills and social competences, divided into semesters and specifying the number of hours

of classes organized at the university. It encompasses both obligatory hours (e. g. attending lectures, seminars etc.) and student's own work outside the schedule

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organized by the university (e. g. homework, reading, writing, working on projects other than during classes).

OCU - Organized Classes at the University.

QA procedures & guidelines for the MSc in ICT at BY partners

The guidelines for the development of training programs, including study programs and plans, with a practical profile in the MACICT Project were sent to the Belorussian partners, as well as members of QA Teams presented their workshops, and discussed different issues during Consortium Meetings and Meetings Minutes.

The document was developed on the basis of formal documents in force under the Bologna Process, in the field of higher education in the European Union, and in particular under the ERASMUS + program, as well as on the basis of recommendations of the European University Association (EUA) and others (see References). When designing recommendations for the MACICT project, conclusions from workshops and discussions, meetings with partners, feedback from students and teachers, or the results reported by partners after the courses were also taken into account.

The Belorussian partner universities elaborated the syllabuses of the new and modernized courses based on the guidelines provided by the EU partners. Then the syllabuses are reviewed by the QA team and revised by the Belorussian partners, reviewed again and revised again, if necessary.

Coordinators and members of QA TEAM used to prepare the workshop, explaining how to use the Guideline. After the workshop the BY partners used to develop their own methods and procedures, using guidelines of QA for the modernised MSc programme in what concerns student-centred learning, teaching and assessment, teaching staff, and learning resources, and student support according to the ESG-2015 standards and guidelines. These issues were discussed

and evaluated together with EU partners. The result of these activities were A.5.2 Development of QA documents by BY partners: procedures & guidelines.

The following suggestions/tips to training programs, including study programs and plans, with a practical profile supported BY Partners in their work.

§ 1. General provisions

1. a. The following suggestions/tips apply to training programs, including study programs and plans, with a practical profile. The practical profile is a profile of the education program, including modules of classes aimed at the acquisition of knowledge, practical skills, and social competences by the student, implemented on the assumption that more than half of the study program specified in ECTS points (§ 2 point 8 of these guidelines) covers classes practical shaping these skills and competences, including the skills acquired during workshop classes, which are conducted by people with professional experience gained outside the University of Technology which is the Project BY Partner, hereinafter referred to as the "University".

1.1. The current study contains guidelines and suggestions, which, however, should be correlated with the act and regulations on the law on higher education in force in a given country, as well as the Statute and didactic regulations in force at a given University.

1.2. The current project concerns the Modernization of the Master's Program in Information and Communication Technologies to increase the employability of students / science, thus second-cycle studies with a practical profile, as part of engineering studies, at the University.

1.3. According to the results of international European University Association (2018) research on universities educated in accordance with the recommendations of the European Commission and the Bologna Process^[2], there are some common/similar trends. Trends 2018 data (Gaebel et al. 2018) show that despite the diversity among national systems and socio-economic differences between them there are several countries in the European Higher Education Area having common development trends.

2. Trends in 2018 also indicate the importance and value of partnerships and cooperation at all levels: within institutions, between institutions, within higher education systems and local, regional and international communities engaged in learning and teaching, for example, approximately

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- 2.1. First-cycle studies with a practical profile, as part of the fields of study, usually last:
- 1) for full-time studies - 6 semesters in bachelor studies and 7 semesters in engineering studies; in exceptional, duly justified cases, the Rector may increase the number of semesters in a given field of study to 7 or 8, respectively;
 - 2) in the case of part-time studies - 6 or 7 semesters in bachelor's studies and 7 or 8 semesters in engineering studies.
3. Second-cycle studies with a practical profile, within the fields of study, usually last:
- 3.1. in the case of full-time studies - 3 semesters of studies ending with the obtaining of the professional title of magister in engineering or 4 semesters of studies ending with the obtaining of the professional title of magister; in exceptional, duly justified cases, the Rector may increase the number of semesters in a given field of study to 4 or 5, respectively;
 - 3.2. in the case of part-time studies - 3 or 4 semesters of studies leading to a master's degree engineer, and 4 or 5 semesters of studies leading to a master's degree.
4. The number of hours of Organized Classes at the University (hereinafter referred to as "OCU") for full-time first and second cycle studies should not exceed 360 in one semester. It is recommended that the average number of OCU hours per week for the entire study period is 24 hours.
5. In the first and second cycle studies, a division into specializations within the field of study may be introduced.
6. It is a good didactic practice when the faculty, as part of the practical profile studies, provides students with apprenticeships provided for in the educational program for a total of at least three months at each level of education.
7. The Faculty, as part of the studies with a practical profile, may organize education alternately in the form of didactic classes at the University and in the form of apprenticeships at the employer's, taking into account the

implementation of all learning outcomes provided for in the education program for this field and level of education.

8. Education programs for engineering studies should contain not less than 50% of the number of ECTS credits, covering the content leading to the acquisition of engineering competences.
9. A proven effective teaching practice is when at least 40% of class hours should be seminars, exercises, laboratory or project classes.
10. It is good if the study program includes modules of classes related to practical professional preparation to which ECTS points have been assigned, in the amount greater than 50% of the number of ECTS points referred to in § 2 if 7 point 2 of these guidelines, aimed at acquiring practical and social skills by the student.
11. The teaching and learning process is effective when the activities related to practical vocational preparation, provided for in the study program for the field of study with a practical profile, are conducted:
 - a. in conditions appropriate for the given scope of professional activity;
 - b. in a manner enabling the performance of practical activities by students;
 - c. by people, most of whom have professional experience gained outside the university, corresponding to the scope of the classes.
12. Many universities in the EU apply the principle, which QA Team recommends that if the faculty conducts studies at a given field and level of education with general academic and practical profiles, the description of the assumed learning outcomes is prepared separately for each profile.
13. In full-time and part-time studies, the number of ECTS points should be 30 per semester^[3].

14. It is a good practice when the faculty can conduct practical studies with the participation of business entities.

15. In the case of conducting studies with the participation of business entities, the method of conducting and organizing studies should be specified in a written agreement between the faculty and the business entity. The contract may specify:

- a. the possibility of conducting classes with students, in particular practical classes by employees of business entities;
- b. participation of the economic entity in the development of the education program;
- c. the method of co-financing studies by an economic entity;
- d. learning outcomes;
- e. the manner of implementing apprenticeships and internships.

§ 2. Educational programs

1. a. Educational programs for studies with a practical profile are a description of coherent learning outcomes specific to the area or areas of education, defined by the authorities of a given University, usually the Senate, in accordance with the so-called National Qualifications Framework for higher education in a given country.

b. Apart from the learning outcomes, the education program should contain a description of the learning process leading to the achievement of these outcomes.

c. The program should contain a description of the principles and forms of apprenticeship, along with the ECTS points assigned to individual modules of this process and apprenticeship.

d. It is usually adopted by the faculty council for a given field of study, specialization, a form of study, and level of education (separately for full-time and part-time studies).

2. When creating learning outcomes including knowledge, skills, and social competences, universal characteristics and key

competencies should be taken into account, which, on the one hand, should result from the teaching assumptions of the Bologna Process, and on the other hand, should take into account the laws, legal provisions and regulations of the Minister of Science and Higher Education of a given country. Usually, these provisions are included in the so-called A country's Qualification Framework and apply to the country's higher education.

3. The European Reference Framework sets out eight key competences^[4]:
 1. Communication in the mother tongue;
 2. Communication in foreign languages;
 3. Mathematical competence and basic competences in science and technology;
 4. Digital competence;
 5. Learning to learn;
 6. Social and civic competences;
 7. Sense of initiative and entrepreneurship;
 8. Cultural awareness and expression.

4. All key competences are equally important as they contribute to the development of the knowledge society. In addition to basic competences such as language skills, literacy and numeracy, information and communication technologies (ICT) constitute the necessary basis for learning, and the ability to learn supports all educational activities. During the college education process, critical thinking, creativity, initiative, problem solving, risk assessment, decision making and constructive emotional management play a role in all eight core competencies, for example, for future engineers.

They are the basis for the development of human capital and knowledge-based societies.

5. In many EU countries, the intended learning outcomes for a given field of study and specialization are proposed by the competent faculty council in accordance with the mission and development strategy of the faculty and on the basis of the rules applicable to the National Qualifications Framework, and usually adopted by the University Senate.

In many EU countries, faculty councils, in order to achieve the intended results of education in a given field, specialty, form and level of study, create and adopt, after consulting the faculty body of the student government, study programs and plans.

6. It is a good EU practice that European project Partners contact to faculties providing education in a given field of study and level of education with a practical profile are obliged to include in the education program at least three months of apprenticeship.

For example, a given department may organize education alternately in the form of didactic classes at the University and in the form of apprenticeships at the employer's, but it must take into account the implementation of all learning outcomes provided for in the education program for this field, level and profile of education.

7. If the University runs full-time and part-time studies, the following conditions should be met in the same field of study: BY project partners should submit to their faculties for approval such programs that can be implemented in a given field of study in a full-time and part-time form and which must ensure the achievement of the same learning outcomes in both of these forms.

8. The study program for the field of study, level and profile of practical education should specify:

- 1) form of studies,

- 2) the number of semesters and the number of ECTS points necessary to obtain qualifications corresponding to the level of education,

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- 3) modules of classes - classes, groups of classes or specialties - together with assigning to each module the assumed learning outcomes and program content, forms and methods of education, ensuring the achievement of these effects, as well as the number of ECTS points,
 - 4) methods of verification and evaluation of the achievement by the student of the assumed learning outcomes throughout the entire education process,
 - 5) study plan, taking into account the modules of the classes referred to in point 3, and in the case of first-cycle studies conducted in the full-time form - also physical education classes to which ECTS points are not assigned,
 - 7) the total number of ECTS points that the student is obliged to obtain in the classes that require the direct participation of academic teachers and students,
 - 8) the total number of ECTS points that the student is obliged to obtain in the course of basic sciences relevant for a given field of study, to which the learning outcomes for a specific field and level of education relate, as part of practical classes, including laboratory, workshop and project classes,
 - 9) the minimum number of ECTS points that the student is obliged to obtain by completing the modules of classes offered in university-wide classes or in another field of study,
 - 10) the number of ECTS points that a student is obliged to obtain in the course of classes in the areas of humanities or social sciences, not less than 5 ECTS points - in the case of fields of study assigned to areas other than humanities or social sciences, respectively,
 - 11) the number of ECTS points that the student is required to obtain in a foreign language course
 - 12) the dimension, rules and form of apprenticeships and the number of ECTS points that the student is required to obtain under these apprenticeships.
9. QA MACICT recommends that, before creating new programs under the MACICT program, contact the relevant departments in your Universities or other institutions that monitor the professional careers of the University's graduates, conduct labor market research and monitor the needs of the socio-economic environment, because when creating education programs it should take into account:

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- 1) compliance of the assumed learning outcomes with the needs of the labor market;
 - 2) the results of the analysis of the monitoring of graduates' professional careers;
 - 3) the results of the evaluation and improvement of the education program in the context of the needs of the socio-economic environment.

10. It happens that a given field of study is assigned to more than one area of education. Then it is a good practice to define for each of these areas the percentage share of ECTS points in the total number of ECTS points.

11. The study plan (see Table 1) should include the obligatory number of hours of the Total Student Workload (hereinafter referred to as "TSW"), which enables the achievement of the assumed learning outcomes in terms of knowledge, skills and social competences, divided into semesters and specifying the number of hours of classes organized at the university.

12. Typically, a typical timetable for first or second year students of a technical university is about 25 to 30 contact hours per week. They usually include lectures, problem exercises, drawing and design sessions, and laboratory exercises. In addition, students perform 5 to 10 hours of assessed classes in the form of laboratory reports, computational tasks and design exercises. Often this is complemented by a further 5 to 10 hours of consultation - work on problems, in addition to the lectures. In the third year, formal class time is usually slightly reduced, but can still exceed 15 hours per week, and class commitments are increased in the form of the student's own workload to compensate for this. When analyzing the study programs, it can be noticed that they do not differ much from the framework favored back in the 1980s (Cawley, 1988)^[5]. However, new forms and techniques of education, such as e-learning, or TSW, have been developed.

13. Initially, the Bologna reforms focused on comparable degrees for mobility and cooperation. Over time, learning outcomes and student-centred learning were added. Learning and teaching have also been addressed through European instruments such as the Standards and Guidelines for

Quality Assurance in the European Higher Education Area and the European Qualifications Frameworks. This is reflected in the preparation of curricula and study plans.

14. In many leading technical universities the number of hours per schedule appears to be comparable. E.g the study plan could be created according to the following principles:

a. the number of TSW hours is usually from 600 to 900 semesters in total and consists of: classes organized at the University, the student's own work at the University and outside it, apprenticeship, engineer / bachelor's or master's thesis, credits and exams;

b. the number of TSW hours should be specified for each module of classes (determined with the obligatory participation of statutory student representatives);

c. for part-time studies, the number of OCU hours should not be less than 60% of the number of OCU hours for the corresponding full-time studies, including the number of contact hours using electronic media;

d. one ECTS point corresponds to 25-30 hours of student work (TSW) and includes in total classes organized at the University (OCU) resulting from the study plan and own work.

15. First, the learning outcomes for the field of study and specialization should be determined, and the appropriate modules should be selected. Then, you should develop course cards for individual courses or groups of courses. It is recommended to prepare tables reflecting the rules and guidelines adopted at a given University in the area of developing curricula. So it is good to work out the tables and the assumed learning outcomes

The tables should take into account:

- a) area of general education subjects
- b) minimum number of OCU hours
- c) number of TSW hours
- d) number of ECTS credits.

Table 1. A model example of a plan by one of the leading technical universities in the European Union

Area of general education subjects	Minimum number of OCU hours	Number of TSW hours	Number of ECTS credits.
First-cycle studies in humanities / social sciences	50	160	5
Second-cycle studies in humanities / social sciences	20	135	5
Information technologies (first cycle studies)	20	70	2
A foreign language during first-cycle studies	100 – level B2	170	5
A foreign language in second-cycle studies	20 – level B2+,	25	1
	30 – second language level A1/ A2	75	2
Sports activities at first-cycle studies	30	30	0

Area of general education subjects	Minimum number of OCU hours	Number of TSW hours	Number of ECTS credits.
Mathematics and physics / chemistry (first and second cycle studies together), including:	240	480	16
in first-cycle studies	100 hours of math and 60 hours of physics	335	11
in second-cycle studies	15 hours of math	30	1
in second-cycle studies	15 hours of physics / chemistry	30	1

Examples

* At many universities in the EU, a foreign language in first-cycle studies is conducted for 2 semesters, while in the first semester of teaching a foreign language, classes are often assigned 2 ECTS points, and in the following semester more, if classes end with an examination - 3 ECTS points.

** The remaining number of hours may be realized in first and/or second-cycle studies. Often in technical universities, it is recommended to divide them between mathematics and physics/chemistry, e.g. in a 4/3 or 3/2 ratio

15. Usually, deviations from the guidelines for foreign studies require the consent of the University authorities.

The following courses listed in table below had been developed according to the guidelines described above. Subsequently, the syllabuses of the courses were reviewed in October 2020 by QA team members, revised and reviewed again in December 2020 and in 2021. The final versions of syllabuses are congruent both with MACICT project requirements and meet the criteria established by Bellorussian universities.

The results of internal results were described in following deliverables: D5.5, D5.6, D5.7, D5.8, D5.9, D5.11

Name of the course	Number of ECTS points	Status of the course
Brest State Technical University		
Special Mathematics training	6	new
Mobile Applications Architecture & Development	3	improved
Software Verification & Certification	3	improved
Neural Network Modeling & Data Processing	12	improved
Improved SQL databases	6	new
Fundamentals of Systems Engineering	3	new

Psychology of Human-Machine Interaction	3	new
Theory of Solving Inventive Problem	6	improved
Authorship & Licensing of Software Products	5	no data
Academic Writing & Presentations	3	new
Gomel State Technical University		
Mathematical modeling	6	improved
Software Verification and Certification	3	new
Neural network data processing	6	new
Cloud technologies and tools for processing large amounts of information	6	new
Management and marketing of software products	3	new
Presentation of results and presentations	3	new
NoSQL databases	4	new
Theory and practice of protecting new technical solutions	3	new
Continuous integration	3	new
Professional development and career in IT	3	new

Yanka Kupala State University of Grodno		
Design of Experiment	3	new
Enterprise Informatization Systems	6	new
Database Design and Maintenance	3	new
Information Architecture and Interface Prototyping	3	new
Strategy and Management of IT Projects and Systems	6	new
Rhetoric and Academic Writing	3	new
Commercialization of Research Results	6	new
Intercultural, business and personal communications	3	new
IT Career Management	3	new
Business Presentation Technologies	3	new
Belarusian State University of Informatics and Radioelectronics		
Swarm Behavior Algorithms	3	new
Neural Networks and Deep Learning	3	new
Computer Vision Systems	3	new

Computer System Virtualization Technologies	3	new
Distributed Computing and Data Analysis Technologies	3	new
Virtual Instrument Development Technologies	3	new
Neural network text processing	3	new
Neural network decision making technologies	12	new
Computer algebra system	3	new
Models and methods of schedule theory	3	new
Pskov State University		
Formal Grammar	3	improved
Architectural solutions and platforms for big data processing	6	new
Project Management	3	new
Software Testing	3	improved
Intellectual Image Processing	6	new
Professional Development & Career	3	new

Psychology of interpersonal & intercultural communication	6	new
Critical Theory & Thinking	3	new
Entrepreneurship and Product Commercialization	3	new
Academic Writing & Presentations	3	new
Business and Management	3	new

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Beneficiary	Name of Reviewers	Role	Status
HSEL	Juho Mäkiö	Coordinator	
HSEL	Evgeniia Surkova	LPM	cognizanced
UWR	Jolanta Kowal	LPM	Changed due to suggestions, approved
ITU/LUT	Maria Paasivaara	LPM	
PSU	Siarhei Piashun	QA controller	
BSUIR	Alexandra Sidorovich	LPM	Approved
PSU	Rykhard Bogush	LPM	
GSTU	Kanstantsin Kurachka	LPM	Approved
BrSTU	Svetlana Lebed	LPM	Approved
YKSUG	Lada Rudikova	LPM	Approved

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