

**ERASMUS +  
SPACECOM PROJECT**

Co-funded by the  
Erasmus+ Programme  
of the European Union



## **HIGHER EDUCATION CAPACITY BUILDING**

**Erasmus+ Project**

**New study program in space systems and  
communications engineering  
(SPACECOM)**

### **Information Management Package**

*Recommendations and informational materials regarding implementation of  
project activities according to the Bologna Process principles E+ Program  
Guide and guidelines of European Education, Audiovisual and Culture  
Executive Agency*

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(SPACECOM)  
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**Table 1. Project Activities incl. deadlines and distribution of responsibilities among consortium partners**

№	Activities	Responsible Partners:	Ref. №	Term of implementation (up to...)	Clarification notes
1	Each target university/organization has to develop its own internal plan of activities of the project	P1, P8-12	1.1 - 5.3	15.12.2019	<p>- Assign responsible persons as a work group for the execution of each work package (WP1 – WP5 (Ref. 1.1. – 5.3.): See Table 2 and 10</p> <p>- Identify a project coordinator at the University, according to local conditions organize the project work group (under participation of university management, target departments /entities, representatives of teachers, students/graduate students, potential employers)</p>
2	Make a list of valid subjects/courses for analysis and future updates	P1, P8-12	1.1	20.12.2018	Use valid University courses closest to the theme of the project.
3	<p>a) Develop questionnaires for analysis of existing curricula/disciplines (questionnaire for teachers, students, graduates, young professionals, alumni;</p> <p>+ a questionnaire for interested in project non-academic partners: potential employers, local associations, representatives of industrial enterprises, other parties that can somehow relate to the topic of the project</p> <p>b) Develop a schedule to conduct surveys</p> <p>c) Conduct surveys of various target groups</p> <p>d) Analyze the answered questionnaires</p>	P1, P8-12, P13-P14	1.1	<p>a) 31.12.2019</p> <p>b) 31.12.2019</p> <p>c) 15.01.2020</p> <p>d) 14.02.2021</p>	<p>a) The survey questionnaire should reflect quality level of the analyzed curricula/discipline fully.</p> <p>Possible questions for the questionnaire: the name of discipline, what are the relevant faculties and departments, since which year is discipline taught the number of enrolled students, the balance of practical/theoretical hours and student workload. The existence, year of introduction and “freshness” of technical training tools, computers, software products, educational literature, the use of periodic national, foreign thematic/scientific/technical journals, the availability of trainee position...</p> <p>The practical performance of students in small groups, the number of such works.</p> <p>c) Conduct a survey of teachers/lecturers at the university</p> <p>- Conduct a survey of young professionals/graduates</p>

					<p>- Conduct a survey of potential employers to clarify requirements to competences/ skills of graduates</p> <p>d) Conduct a meeting of teachers, students, alumni and employers to discuss and analyze results of surveys to take into account their views at updating of relevant subjects.</p>
4	<p>- Develop an analytical report on the results of the analysis of existing curricula/disciplines</p> <p>- Make a list of curricula that you plan to upgrade</p> <p>- Develop a schedule for updates of the selected curricula</p>	P1, P8-12, P13-P14	1.1	29.02.2020	Target universities should create Power Point presentation with the results of 1.1 based on the analytical report, curricula that is planned to upgrade and schedule for updates. The presentation (.ppt file) must be sent to P6.
5	To develop and adopt an agreement and guidelines on instructional strategies for new BA/MSc course designs using modern educational technologies	All Partners	1.2.	16.03.2020	Draft of agreement will be prepared by P6 up to 14.02.2020
6	<p>a) The EU Universities should develop draft of curricula/syllabi description and transmit draft content to the target universities (P1, P8-12)</p> <p>b) Each target University examines and adopts the received materials, decides what components can be integrated/updated in the curricula and develops on this basis their own syllabi design</p>	<p>a) P2-P5</p> <p>b) P1, P8-12</p>	2.1	<p>a) 16.03.2020</p> <p>b) 30.04.2020</p>	<p>The draft of curricula/syllabi description should be developed in accordance with the Bologna recommendations course description in English and national languages including the ECTS points (Table 3).</p> <p>The draft of syllabi description (.doc file) should be sent by P2-P5, P1, P8-12 to P6 for further placement on the project web page.</p> <p>P2-P5 should place the draft of syllabi description on the University web page.</p>
7	Course content design: develop curricula description (CD) for modernized and new curricula, make a report on updating, develop a CD of each updated and new curriculum in English and national languages including the ECTS points (Table 3) in accordance with the Bologna recommendations	P1, P8-12	2.2	31.10.2020	- Select and appoint a leader/specialist for the development of the updated and new curricula in the university and teachers responsible for the development and introduction of updated/new disciplines, courses and curricula. It is advisable to involve these teachers in training in European universities (see 2.5)

					- Develop a schedule of CD for updated and new curricula
8	<p>a) The EU Universities are responsible for the content/teaching materials of the new curricula. P2-P5 should develop and transmit draft content and curricula description to the target universities (P1, P8-12) + teaching materials</p> <p>b) Each target University (P1, P8-12) examines and adopts the received materials and develops on this basis their own new courses, curricula, modules and curricula description</p> <p>c) Target universities should develop digital versions-drafts (.doc files) of their OWN manuals/text books/methodological recommendations for students and teachers for each of the curricula/course/module</p>	a-b) P2-P5 c) P1, P8-12	2.2, 2.3	<p>a) 30.04.2020</p> <p>b) 31.03.2021</p> <p>c) 30.04.2021</p>	<p>The lists of new subjects/courses see Table 4</p> <p>a) P2-P5 should prepare a list of topics for theoretical and practical/laboratory classes, curricula description for each disciplines incl. ECTS (Table 3), the list of the recommended teaching materials (literature, text books etc.), presentations in .ppt for each of the topics -&gt; deliver all the materials to P1, P8-12.</p> <p>c) Prepare draft of curricula descriptions of new core curricula and transferable modules inclusive innovative teaching/learning facilities.</p> <p>P1, P8-12 should place on the University web page the list of the new/upgraded courses, modules for pilot training, that will start from September 2021.</p>
9	E-learning materials development, lectures recording, presentations preparation, creating Web application	all Partners	2.3	31.07.2021	P2 and P6 coordinate the plan of E-learning materials preparation
10	<p>a) Prepare a set of documentation for Ground Station Laboratory (GSLab) and Satellite Construction Laboratory (SatLab) in each target universities</p> <p>b) Purchase the equipment incl. software; install the equipment</p>	P1, P8-12, P2, P6	2.4	<p>a) 15.09.2020</p> <p>b) 15.01.2021</p>	<p>a) Typical layout of the rooms and basic requirements to them will be given to the target universities by P2 and P6. Select and appoint a leader/specialist for GSLab and SatLab in each target universities. The contact data of the responsible person at the partner universities must be sent to P6.</p> <p>b) P1, P2, P6, P8-12 are responsible for the contracting, purchase and delivery of equipment.</p>
11	a) Develop criteria for the selection of teachers to participate in trainings	a-b) P1, P8-12 c)P2-P5	2.5	<p>a) 28.02.2020</p> <p>b) 31.03.2020</p>	Example of selection criteria: the age-not more than..., competences in

	<p>planned at EU universities</p> <p>b) Plan and carry out actions to prepare the selected candidates to participate in trainings including language training</p> <p>c) EU universities will develop training programs/schedule of trainings and inform target universities</p> <p>d) Retrain academic teachers in new curricula using innovative teaching/ learning facilities and agreed instructional strategies</p>	d) all Partners		<p>c) 28.02.2020</p> <p>d) from 01.04.2020 up to 30.04.2021</p>	<p>English, experience in teaching - not less ..., Publications, own plan for future improvement.</p> <p>In EU universities 3 trainings of teachers are planned. 2 to 3 teachers from each target University can participate in the trainings, i.e. total of 6 to 9. A larger number of participants is possible on the basis of co-financing. Duration of trainings: from 7 till 14 days.</p> <p>After the end of training to organize a meeting for sharing of the knowledge gained in the target universities</p>
12	<p>a) Starting performance of demonstration master classes (MC) for new subjects/modules</p> <p>b) Pilot operation of GSLab and SatLab</p>	<p>a) all Partners</p> <p>b) P1, P8-P12</p>	2.6	<p>a) Start: 01.11.2020</p> <p>b) Start: 30.04.2021</p>	<p>MCs are carried out in the form of demonstration lessons with students in the target universities. The MC will be conducted by professors from European universities, responsible for the content of the curricula. Participants of MC should be students and teachers from the target universities. New technical equipment purchased in the frame of the project will be used during the MCs.</p>
13	Pilot teaching/operation of GSLab and SatLab	P1, P8-P12	2.7	Start: 01.09.2021	In order to assess quality of pilot teaching, each target university should provide periodical surveys of the involved students and teachers
14	<p>a) Development of a quality assurance plan/strategy for the project</p> <p>b) Development of quality assurance plan in each target university</p> <p>c) Development of recommendations for quality indicators for peer review of new curricula/courses</p> <p>d) Periodical surveys of students (P1, P8-P12 should prepare a questionnaire) in order to assess quality of master</p>	<p>a) P6</p> <p>b) P1, P8-P12</p> <p>c) P6</p> <p>d) P1, P8-P12, P2, P4, P5, P6</p>	3.1	<p>a) 30.12.2019</p> <p>b) 28.02.2020</p> <p>c) 28.02.2020</p> <p>d) Start 31.03.2020</p>	<p>a) P6 is responsible</p> <p>b) On the basis of the project's QA plan to develop a QA plan in each of the universities. P1, P8-P12 should create a quality group which will ensure high quality level of project implementation</p> <p>c) P6 provides recommendations; P1, P8-P12 organize peer review of new and updated courses</p> <p>d) Template /recommendations for a questionnaire will be provided by P2, P4, P5, P6</p>

	classes; lectures during the pilot teaching				
15	a) Internal quality evaluation b) External quality evaluation	a) all Partners b) P1, P2, P6	3.2	a) Start 15.11.2019 b) Start 01.03.2020	a) P6 will develop and send to all Partners a schedule and forms for a periodic report on the progress of the project (every 6 months (M) M6, M12, M18, M24, M30, M36) b) Consortium will define an external expert; the expert will work on sub-contract basis
16	a) Development of the project Web page b) Maintenance of the project Web page	a) P2, P6 b) all Partners	4.1	a) Start pilot version in function 31.01.2020 b) Till 14.11.2022	
17	a) Maintenance, information updates regarding projects progress of target partners universities Web pages b) Project newsletters design	a) P1, P8-P12 b) P1, P2, P6	4.2	a) Start 01.02.2020 b) Start 12.12.2019	
18	a) Develop a plan/strategy for dissemination and sustainability of the project b) Develop a plan for dissemination and sustainability of the project in each target university, including activities on involving new participants in the project c) Operation starting of the first version of the joint project WEB platform	a) P1, P2, P6 b) P1, P8-P12, P13-P14 c) P1, P8-P12, P13-P14	4.3	a) 12.02.2020 b) 28.02.2020 c) 15.01.2020	Recommended components of the dissemination and sustainability plan of the project:  - Each university should assign a “blogger”, who will responsible for the posting information about the project in the Internet -Plan of publications (e.g.1 publication every 6 months). - Schedule of local sustainability activities and dissemination of the project results (e.g.– one event per quarter). - Plan of local and regional meetings. It is recommended to use scheduled periodic internal and external events (meetings, conferences, various meetings). - Post information about participation in the project on the universities’ website (with a link to the project page) - Post on social networks (Facebook): each university should create a page on Facebook dedicated to the

					project and post there regularly  Consortium members must provide informational materials for posting on the website of the project.
19	Organize distribution of leaflets, booklets about the project progress among target groups.	All Partners	4.3	Start 12.02.2020	Recommendations for the design of information materials about the project are given in Table 6
20	a) Information conferences, dissemination events  b) Organization of International BA/MSc Summer Schools	a) All Partners b) P1, P2, P7, P8-P12	4.4	a) Start 01.03.2020 b) Start: 01.04.2021	The schedule for the first project year will be defined in the first kick-off meeting. The schedule for the second and third years will be provided in the annual meeting at the end of the first project year.
21	a) Develop and approve a package of organizational documents for the creation of C-Office in each target University. b) Purchase and install equipment for C-Office c) Establish networking of C-Offices	P1, P8-P12, P6	4.5	a) 15.04.2020 b) 15.04.2021 c) 31.01.2022	a) Activities, structural division, job descriptions should be included in the organizational documents for C-Offices. Learn more about C-Office: see Table 5  c) Develop a Memorandum of creation of a network of C-Offices
22	a) Planning exploitation after the project end b) Exploitation report	a) P1, P2, P6 b) P2	4.6	a) Start 15.11.2021 b) 14.10.2022	a) - P1, P2, P6 develop the business model draft, the schedule of activities and conduct the associated workshop - Based on the provided information, each target university with the support of European partners develops own documents regarding the exploitation after the project end
23	-Exploitation Agreement - Involvement of new partners from outside of the project activities based on "SPACECOM Plus" Agreement - Creation of the university-enterprise cooperation Agreement	All Partners	4.7	Start 15.09.2020	P6 develops the draft of "SPACECOM Plus" and university-enterprise cooperation Agreement in accord with the partners, conducts the workshop based on the agreements.
24	a) Conduct training for employees of C-Offices b) Start pilot operation of C-Offices	a) P1, P8-P12, P2, P6 b) P1, P8-P12	4.8	a) 29.10.2021 b) Start: 15.11.2021	
25	Refresh training courses for graduates in C-Offices	P1, P8-P12 with support by P2-P7	4.8	Start: 01.10.2021	Each target university selects target groups of graduates and develops a program for the training courses, and conducts them.



26	<p>a) Accreditation of developed and updated subjects/courses/programmes in accordance with valid University rules</p> <p>b) Accreditation at the national level in case of request of national authorities</p>	P1, P8-12, P13-P14	4.9	<p>a) 15.07.2021</p> <p>b) 15.07.2022</p>	<p>- Each target university develops a document describing the accreditation procedure according to the system of its university and send to P6 (deadline 30.10.2020)</p> <p>- Develop an accreditation schedule</p> <p>- Select and appoint a leader/specialist, responsible for the accreditation process</p> <p>- Issue a document describing the accreditation procedure</p>
27	Management of the project including project management online, daily project administration and coordination	P1, P8-P12	5.1	Throughout the project	Preparing documentation, such as agenda, list of participants and minutes, of the management events and activities of the project incl. preparation of minutes by the local coordinator.
28	Coordination meetings	All partners	5.2	Throughout the project	Development of meeting plan will be created every year (incl. international, regional and local meetings).
29	Ensure using online conference tools (e.g. Zoom) to held meetings of the project consortium team.	All partners	5.2	Throughout the project	The schedule for the online meetings will be defined in the first kick-off meeting. Online meetings of local coordinators should be conducted at least every 3 months
30	Monitoring and controlling of project activities: development of questionnaires for partner universities regarding project implementation	P1, P6, P8-P12	5.3	<p>First template will be sent in March 2020</p> <p>Schedule for the reporting: M6, M12, M18, M24, M30, M36</p>	<p>- P6 develops a questionnaire for each 6-month-period that partner universities should fill in until the given deadlines, reporting on the implementation of the project in the university. The complete reports should be sent back to P6.</p> <p>- The evaluation of reports will be provided according to quality assurance plan strategy.</p> <p>- P6 will conduct the workshop regarding the monitoring and controlling of project activities for the project partners.</p>
31	Develop an agreement on the continued cooperation of the project participants for the development of its results after the ERASMUS+ financing	All partners	5.3	14.11.2022	Sign an Agreement in the Final conference

## Table 2. Recommendations regarding work groups

The first step for the organization of the project implementation is to select and appoint a leader/specialist, responsible for each activity and to form a project work group in every university.

According to the existing experience and recommendations of the national Erasmus+ office, a work group can consist of approximately 7-11 persons. The leader/specialist should be chosen and the groups should be formed and approved until 31.12.2019.

### List of the participants of the work group should include:

- Coordinator + contact person of the project
- Academic leader responsible for the development and implementation of updated/new teaching modules/curricula/courses content of the project. Should have experience in these activities
- Teachers, who possess knowledge of the project themes
- Student representatives
- Representatives of the administration
- Representatives of potential employers who are interested in the results of the project

Participants of the work group should possess competence, which respond to the requirements of the implementation of the project work plan. It is necessary to allocate responsibilities among the participants of the work group regarding the implementation of the activities of the project work packages, taking into consideration the deadlines of each of the activities.

## Work Groups of Partner University/Template

№	Name, Surname, email	Position in the university	Responsibility (Work Packages tasks according to the Work Plan)

Approved by: \_\_\_\_\_ (Signature, Stamp)

## Table 3. Template of the Curriculum/Module Description

Pay a special attention to the usage of verbs in “Learning outcomes of module”.  
The recommended verbs are highlighted in blue

Short Name of the University/Country code Date (Month/Year)	
Title of the Curricula/Module	Code
Intelligent Mechatronic Systems	

Teacher(s)	Department
<b>Coordinating:</b> Fedoreev Sergey <b>Others:</b> Goman Viktor MuhutdinovRuslan	Information and Communications Technology

Study cycle	Level of the module	Type of the module
BA/MA/PhD	Bachelor	

Form of delivery	Duration	Language(s)
offline	16weeks	Russian

Prerequisites	
<b>Prerequisites:</b> To know: Electronics and Electrical Engineering Programming Fundamentals Mathematical Modelling of Engineering System Possess: basic programming skills	<b>Co-requisites (if necessary):</b>

ECTS (Credits of the module)	Total student work load hours	Contact hours	Individual work hours
5	180	34	146

Aim of the module (course unit): competences foreseen by the study programme
This course forms the skills for selecting and applying various elements of mechatronic systems, applying modern methods of machine learning for the intellectualization of mechatronic systems. The knowledge obtained as a result of mastering the discipline is necessary for solving practical problems in the field of professional activity, designing and developing intelligent mechatronic systems

Learning outcomes of module (course unit)	Teaching/Learning methods	Assessment methods
<b>To know:</b> <b>To point:</b> <ul style="list-style-type: none"> <li>the field of application of mechatronic and robotic systems;</li> </ul> <b>To explain:</b> <ul style="list-style-type: none"> <li>structure of modern mechatronic and robotic systems;</li> </ul> <b>To numerate:</b> <ul style="list-style-type: none"> <li>principles of the action of sensors used in mechatronic systems and industrial automation systems, the structure of measurement systems</li> </ul> <b>To recognize:</b> <ul style="list-style-type: none"> <li>types of actuators in mechatronic systems and industrial automation systems;</li> </ul> <b>To give examples of:</b> <ul style="list-style-type: none"> <li>types of control and communication devices in mechatronic systems and industrial automation systems.</li> </ul> <b>To describe:</b> <ul style="list-style-type: none"> <li>basic methods and algorithms for constructing artificial intelligence systems, control systems with fuzzy logic, expert</li> </ul>	Lectures, independent study of the material	Quiz

systems and neural network control systems, genetic algorithms; <b>To formulate:</b> • basic principles, methods and tasks of machine learning.		
To be able to: • calculate and select the necessary types of mechatronic systems and their elements in the solution of a specific problem; • develop and analyze intelligent management systems using MATLAB software packages; • develop algorithms for control systems with fuzzy logic and neural networks in their structure; • use modern methods of machine learning for the practical solution of data analysis problems.	Implementation of the training project	Presentation of an educational project
Possess: • <b>To build</b> of intelligent control systems; • <b>To develop</b> of tools for machine learning and data mining; • <b>To evaluate</b> of various mechatronic systems and their elements for suitability for a specific task.	Implementation of the training project	Presentation of an educational project

Themes	Contact work hours							Time and tasks for individual work	
	Lectures	Consultations	Seminars	Practical work	Laboratory work	Placements	Total contact work	Individual work	Tasks
Fundamentals of mechatronics	3	0	0	3	0	0	6	24	Development of a mechatronic system for a technological facility; Development and research of the positioning system based on the electric drive with the position sensor; Development of a control system for interconnected electric drives.
Elements of mechatronic systems	5	0	0	5	0	0	10	40	Development of a mechatronic system based on proportional hydraulic drives/pneumatic actuators; Calculation and adjustment of the servomotor; Forming the trajectory of moving the manipulator on the basis of analyzing the images of products in the work area;

									Calculation and selection of actuators of mechatronic systems; Programming of logic controllers.
The Basics of Artificial Intelligence	4	0	0	4	0	0	8	36	Application of machine learning technologies in robotics; Application of an artificial neural network to control the mechatronic system; Application of fuzzy logic to control the mechatronic system; Application of the genetic algorithm for optimizing the projected mechatronic system.
Introduction to machine learning	5	0	0	5	0	0	10	46	Studying methods and tools for data preprocessing; The application of the probabilistic model of learning; Solution of problems of the equipment cassation with the use of neural networks; Application of learning algorithms for static multilayer neural networks for controlling the mechatronic system; Application of dynamic learning algorithms for multi-layer neural networks for controlling the mechatronic system.
<b>Total</b>	<b>17</b>	<b>0</b>	<b>0</b>	<b>17</b>	<b>0</b>	<b>0</b>	<b>34</b>	<b>146</b>	

Assessment strategy	Weight in %	Deadlines	Assessment criteria
Running control 1	15	8 weeks	Preliminary presentation of the project
Running control 2	70	14 weeks	Presentation of an educational project
Final exam	15	16 weeks	Final quiz

Compulsory literature/Author	Year of issue	Title	№ of periodic or volume	Place of printing. Printing house or internet link
T.I. Gorbenko	2012	Fundamentals of mechatronics and robotics		Tomsk, TSU, <a href="http://e.lanbook.com/book/44908">http://e.lanbook.com/book/44908</a>
P. Plakh	2015	Machine learning		Moscow

L.N. Yasnitskiy	2012	Artificial Intelligence		Moscow, <a href="http://www.biblioclub.ru/book/115598/">http://www.biblioclub.ru/book/115598/</a>
V.P. Ivshin	2014	Modern automation in process control systems		Moscow
<b>Additional literature</b>				
N. Virt	2010	Algorithms and data structures		Moscow, <a href="http://www.biblioclub.ru/book/86483/">http://www.biblioclub.ru/book/86483/</a>
V.V. Viugin	2013	Mathematical Fundamentals of Machine Learning and Forecasting		Moscow, <a href="http://e.lanbook.com/books/element.php?pl1_id=56397">http://e.lanbook.com/books/element.php?pl1_id=56397</a>
M.T. Jons	2011	Программирование искусственного интеллекта в приложениях		Moscow, <a href="http://e.lanbook.com/books/element.php?pl1_cid=25&amp;pl1_id=1244">http://e.lanbook.com/books/element.php?pl1_cid=25&amp;pl1_id=1244</a>

#### ANOTATION /course summery

This course forms the skills for selecting and applying various elements of mechatronic systems, applying modern methods of machine learning for the intellectualization of mechatronic systems. The knowledge obtained as a result of mastering the discipline is necessary for solving practical problems in the field of professional activity, designing and developing intelligent mechatronic systems

#### List of themes and short description

Themes	Contact work hours
<b>Fundamentals of mechatronics</b> Basic terminology. Origin and development of the concept of "Mechatronics." General trends in the development of mechatronic systems. Integration, intellectualization, miniaturization of mechatronic systems. Levels of integration. The concept of constructing mechatronic systems. Structure and elements of mechatronic and robot-technical systems: mechatronic modules of motion, information-measuring systems, control systems.	6
<b>Elements of mechatronic systems</b> Classification of sensors in mechatronic systems and automation systems. Typical signals and methods for connecting sensors. Structure of theme assuring channel. Features of analog-to-digital conversion of signals from analog sensors. The main types of actuators in mechatronic systems (electro-, hydro-, pneumatic actuators). Comparison. Classification of programmable logic controllers. Devices of human-machine interaction, personal and built-in industrial computers. The review of industrial networks of data transmission of field and first level and applied communication devices.	10
<b>The Basics of Artificial Intelligence</b> Thinking and intellect. The definition of artificial intelligence (AI). Terminology. Philosophical aspects, problems of artificial intelligence systems (possibility of existence, safety, usefulness). History and prospects of the development of AI systems, the field of their practical use. Architecture and the main components of AI systems. Expert systems. Basic ideas and practical application no fuzzy logic. Linguistic variables and their description. Operations over fuzzy sets. The basic structure and principle of the fuzzy logic system. Fuzzification, rules of logical inferences and defuzzification. Example of using a system with fuzzy logic. Genetic algorithms.	8
<b>Introduction to machine learning</b> Basic terminology. The notion of Big Data. Trees of solutions. Logical models of machine-learning. Probabilistic learning models. Metric models. Artificial neural networks. Neuron and his model. The simplest perceptron. Systems such as Adaline. Adaline with a sigmoid at the exit. Classification of artificial neural networks. Static linear single-layer neural networks. Static multi-layer neural networks. Algorithms for the training of static multilayer neural networks. Dynamic learning algorithms for multi-layer neural networks. An algorithm or back propagation of an error.	10

**Table 4. List of new curricula SPACECOM**

9 Core Curricula:	7 Elective Curricula:
<ol style="list-style-type: none"> <li>1. “Satellite Technologies” (BA/MA) - 8 ECTS, 64 contact hours, 74 hours praxis, 64 hours student workload;</li> <li>2. “Digital communications” (BA/MA) - 6 ECTS, 72 contact hours, 40 hours praxis, 42 hours student workload;</li> <li>3. “Remote sensing and earth observation” (BA/MA/Graduates/Researcher) - 6 ECTS, 72 contact hours, 40 hours praxis, 42 hours student workload;</li> <li>4. “Satellite communication” (BA/MA) - 8 ECTS, 64 contact hours; 74 hours praxis; 64 hours student workload;</li> <li>5. “Electronic Design and Assembly of communications systems” (BA/MA) - 4 ECTS, 48 contact hours, 36 hours praxis, 40 hours student workload;</li> <li>6. “Data protection” (MA/Graduates/Researcher) - 3 ECTS, 48 contact hours, 36 hours praxis, 40 hours student workload;</li> <li>7. “Celestial mechanics for space mission engineering (BA) - 7 ECTS, 64 contact hours, 74 hours praxis, 64 hours student workload;</li> <li>8. “Advanced Microelectronics: design of custom integrated circuits in CMOS technologies for space applications” (BA/MA) - 6 ECTS, 72 contact hours, 40 hours praxis, 42 hours student;</li> <li>9. “Development of space-grade embedded systems (MA/researcher &amp; teacher/industrial partners)- 3 ECTS, 30 contact hours, 34 hours praxis, 32 hours student workload.</li> </ol>	<ol style="list-style-type: none"> <li>1. “CAD tools for design of systems on chip” (BA/MA) - 2 ECTS, 30 contact hours; 20 praxis; 20 student workload;</li> <li>2. “Applied Project Management for Space System” (MA/Graduates/Researcher) - 2 ECTS, 30 contact hours; 20 praxis; 20 student workload;</li> <li>3. “Soft skills for engineers/Start-up initiatives for engineers” (BA/MA/staff/Graduates/Researcher)- 2 ECTS, 30 contact hours; 20 praxis; 20 student workload;</li> <li>4. “Hot topics in satellite communication system using D- Star technology” (BA/MA/researcher/staff/industrial, partners), 30 contact hours; 20 praxis; 20 student workload;</li> <li>5. “Theory of Inventive Problem Solving (TIPS)” (BA/MA/staff/industrial partners)- 1,5 ECTS, 20 contact hours; 15 praxis; 20 student workload;</li> <li>6. “Programming Principles &amp; Object Oriented programming” (BA/MA) - 2 ECTS, 30 contact hours; 20 praxis; 20 student workload;</li> <li>7. “Educational digital tools &amp; blended learning tools for engineering education” (MA/teacher) - 2 ECTS, 30 contact hours; 20 praxis; 20 student workload.</li> </ol>

**Table 5. Concept/objectives of C-Office**

A Career-Center (C-Office) will be established at each partner university and a network will be build/or existing network will be used to ensure a future close cooperation between the HE and industry.

C-Office main objective is to forecast and determine the current and future needs of Labor Market, establish direct connection between the universities and enterprises, increase the competitiveness of the students and graduates in Labor Market and to create conditions for the development of the project results after its completion.

Through the C-Office students and graduates will have the opportunity to get information about available vacancies, or support in finding an internship or employment. Teachers will be trained on new methodologies and pedagogical approaches with the use of learning outcomes and on the development of e-learning materials.

The activities to involve the target groups in using the outputs and results of the project after its completion are mostly the same as during the project. However, the activities sequence differs: the active networking among academic communities and stakeholders in the target and

neighbouring countries tends to become the most important. This will create a stimulating environment for experience exchange and promotion of the new teaching methodology including technical and vocational training schools, universities from neighbouring cities and countries, partnering enterprises, representatives from local communities as policymakers and developing links between university and Labour Market.

The following activity stay relevant serving the multiplication of the project results: trainings for industrial enterprises and non-university technical staff organized by C-Office, established in frames of the project. These centres will serve the further developing of connection between the universities and Labour Market.

### **Table 6. Recommendations for the design of information materials on the project**

Each university should select a “blogger” who will post information about the project in the Internet.

It is recommended to specify the following information:

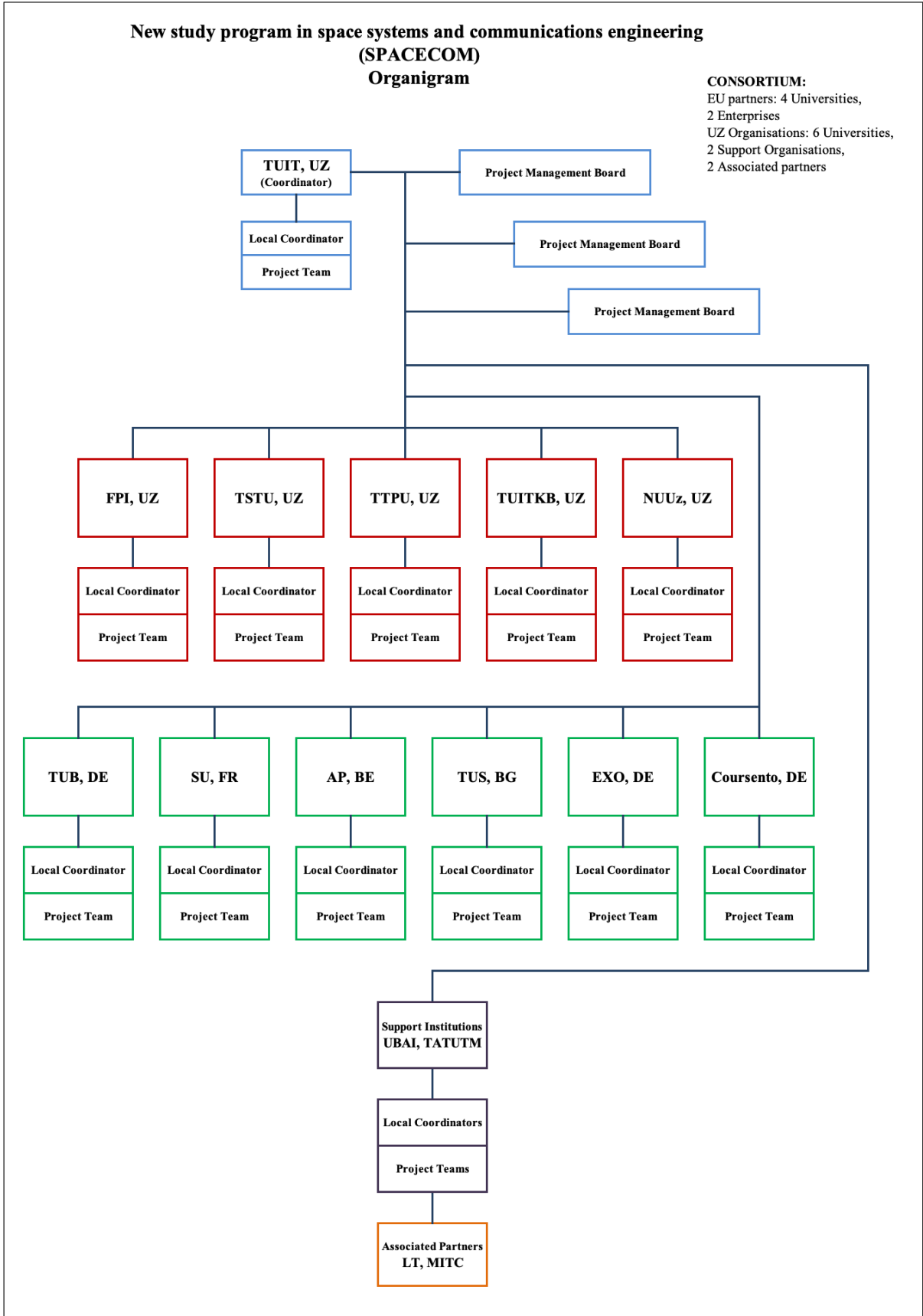
- The name of the project - New study program in space systems and communications engineering (SPACECOM);
- Official Internet website of the project (will be available in January 2020)
- Creation of a Facebook page about the project
- Logo of the project and address of the main website of the project in all electronic resources should be mentioned
- Logo of the ERASMUS+ programme - available to download from the website of EACEA  
[https://eacea.ec.europa.eu/about-eacea/visual-identity-and-logos-eacea/erasmus-visual-identity-and-logos\\_en](https://eacea.ec.europa.eu/about-eacea/visual-identity-and-logos-eacea/erasmus-visual-identity-and-logos_en)
- The following disclaimer shall be added to the inner pages of the publications and studies written by external independent bodies with support from the European Commission:  
“The European Commission support for the production of this publication does not constitute an endorsement of the contents which reflects the views only of the authors, and the Commission cannot be held responsible for any use which may be made of the information contained therein.”
- Flags of the participating countries and/or logos of the organizations participating in the project
- Next, depending on the specific objectives and the availability of space for placement of information: the composition of the project consortium, project implementation, goals and objectives of the project achieved/planned results, upcoming events.
- Photos of the project team, faculty and staff involved in the project
- Photos of project events
- Details of contact person for further information.

### **Model Press Release on the events of the project in the target universities for placement on the website of the project:**

- a) Name of the event, date and venue
- b) Programme (agenda) of the event
- c) List of participants (name, organization, position)/measurement of audience size
- d) Short description of the activity: goals/objectives, outcomes of the event
- e) Photos of the event (2-5 pictures); videos



**Table 7. Organigram of Consortium SPACECOM**



**Table 8. Project Partners**

<b>№</b>	<b>Name of the organization/university</b>	<b>Abbreviation</b>	<b>Location</b>
P1	Tashkent University of Information Technologies	TUIIT Coordinator	Tashkent/Uzbekistan
P2	Technische Universität Berlin	TUB	Berlin/Germany
P3	Sorbonne Université	SU	Paris/France
P4	Artesis Plantijn Hogeschool Antwerpen	AP	Antwerp/Belgium
P5	Technical University of Sofia	TUS	Sofia/Bulgaria
P6	EXOLAUNCH GmbH	EXO	Berlin/Germany
P7	COURSENTO	Coursento	Berlin/Germany
P8	Ferghana Polytechnical Institute	FPI	Fergana/Uzbekistan
P9	Tashkent State Technical University named after Islam Karimov	TSTU	Tashkent/Uzbekistan
P10	Turin Polytechnic University in Tashkent	TTPU	Tashkent/Uzbekistan
P11	Qarshi branch of Tashkent University of Information Technologies named after Muhammad al-Khwarizmi	TUITKB	Tashkent/Uzbekistan
P12	National University of Uzbekistan	NUUz	Tashkent/Uzbekistan
P13	Ulugh Beg Astronomical Institute of the Uzbekistan Academy of Sciences	UBAI	Tashkent/Uzbekistan
P14	The branch center for Retraining and In-Service Training of Academic Staff under Tashkent University of Information Technologies	TATUTM	Tashkent/Uzbekistan

**Table 9. Associated Partners**

<b>Name of organisation</b>	<b>Website</b>	<b>Location</b>	<b>Role in the project</b>	<b>Activities and related Work Packages</b>
Light Technologies LTD (LT)	<a href="http://ltc.uz/ru/">http://ltc.uz/ru/</a>	Tashkent/Uzbekistan	- Support of the university teachers in learning outcomes definition and courses content development; - Quality control	- Support in developing Joint web platform, training programs for mentors and recruitment mentors in its own place; at monitoring program developments (quality control) and introducing the results and outcomes of the project to the HE institutions in WP2; - Assistance in Quality control in WP3.

The Ministry for Development of Information Technologies and Communications of the Republic of Uzbekistan (MITC)	<a href="http://mitc.uz/en/">http://mitc.uz/en/</a>	Tashkent/Uzbekistan	- Monitoring programme developments (quality control); - Introducing the results and outcomes of the project to the HE institutions in UZ	- Collaboration at the accreditation of the new curricula on national level in WP2; - Assistance in WP 3 and 4 at Quality control and Dissemination of the project results.
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**Table 10. Work Plan**

No	Activities	Start	End
1.1 Prep.	Need analyses/review the current curricula in target area	15.11.2019	29.02.2020
1.2 Prep.	Learning outcomes definition	15.11.2019	31.03.2020
2.1 Dev.	Syllabi design	01.02.2020	30.06.2020
2.2 Dev.	Course contents design	01.03.2020	31.01.2021
2.3 Dev.	E-learning materials development, lectures recording, presentations preparation, creating Web application	01.11.2020	31.07.2021
2.4 Dev.	a) Prepare a set of documentation for GSLab/SATLab; b) Purchase/install the equipment for GSLab/SATLab	a) 01.06.2020 b) 01.06.2020	a) 31.10.2020 b) 31.01.2021
2.5 Dev.	Retrain academic teachers/mentors in new curricula, methodology	01.11.2020	30.04.2021
2.6 Dev.	Master Classes in new curricula held in GSLAB/SATLAB; pilot operation of GSLAB/SATLAB	01.11.2020	31.07.2022
2.7 Dev.	Pilot teaching	01.09.2021	14.11.2022
3.1 Quality	a) Quality control framework; b) Quality assurance strategy	a) 15.11.2019 b) 01.11.2020	a) 30.09.2021 b) 30.09.2021
3.2 Quality	a) Internal evaluation b) External evaluation	a) 15.11.2019 b) 01.11.2020	a) 14.11.2022 b) 14.11.2022
4.1 Diss.	a) Development of the project Web page; b) Maintenance of the project Web page	a) 15.11.2019 b) 15.11.2019	a) 31.10.2020 b) 14.11.2022
4.2 Diss.	a) Maintenance of partners Web pages; b) Project newsletters design	a) 15.11.2019 b) 15.11.2019	a) 14.11.2022 b) 31.10.2020
4.3 Diss.	Dissemination materials	15.11.2019	14.11.2022
4.4 Diss.	Information conferences/dissemination events	15.11.2019	14.11.2022
4.5 Diss.	a) Develop documentation/purchase/install equipment for C-Office; b) Establish networking of C-Office	a) 01.01.2020 b) 01.01.2020	a) 30.09.2020 b) 31.05.2021
4.6 Diss.	a) Planning exploitation after the project end; b) Exploitation report	a) 01.08.2021 b) 01.11.2021	a) 31.10.2021 b) 31.08.2022
4.7 Diss.	Exploitation agreement	01.11.2021	14.11.2022

4.8 Diss.	Staff training/pilot operation of C-Office/network of C-Offices	01.08.2021	14.11.2022
4.9 Diss.	Accredit curricula on a) institutional; b) national level	01.09.2021	a) 31.07.2021 b) 31.08.2022
5.1 Manag.	Daily project administration and coordination	15.11.2019	14.11.2022
5.2 Manag.	Coordination meetings	15.11.2019	14.11.2022
5.3 Manag.	Project reports	01.02.2020	14.11.2022