



**BSU**

**ERASMUS+**



---

**Project 561525-EPP-1-2015-1-LV-EPPKA2-CBHE-JP**  
**Improvement of master-level education in the field**  
**of physical sciences in Belarusian universities**  
**15/10/2015 – 14/10/2018**

**WP2: Development and Implementation of Curricular**

**Prof. A.K. Fedotov (BSU)**  
**[fedotov@bsu.by](mailto:fedotov@bsu.by)**



**BSU**

**ERASMUS+**



---

## **Goal of presentation:**

- **Objectives of the project: indicators and measuring of the progress**



**BSU**

**ERASMUS+**



---

## **Goal of presentation:**

- **Objectives of the project: indicators and measuring of the progress**
- **Identifying the principles of higher education in Belarus: before and after**



**BSU**

**ERASMUS+**



---

## **Goal of presentation:**

- **Objectives of the project: indicators and measuring of the progress**
- **Identifying the principles of higher education in Belarus: before and after**
- **Description of WP2: main tasks, results and important activities**



**BSU**

**ERASMUS+**



---

## **Goal of presentation:**

- **Objectives of the project: indicators and measuring of the progress**
- **Identifying the principles of higher education in Belarus: before and after**
- **Description of WP2: main tasks, results and important activities**
- **Resume**



**BSU**

**ERASMUS+**



---

**Objectives of the project:  
indicators and measuring of the progress**



**BSU**

**ERASMUS+**



---

## Wider objective of the project:

- **To upgrade curricula in physical sciences in four universities of Belarus according to Bologna practices,**
- **to enhance the quality and relevance of education in the field of physics by modernisation of study programs, the enhanced use of ICT and networking activities to the labour market needs.**



**BSU**

**ERASMUS+**



---

## Indicators of progress:

- **Developed, tested and formally approved *curricula and study materials* in accordance to labour market needs basing on Bologna practices;**





**BSU**

**ERASMUS+**



---

## Indicators of progress:

- Developed, tested and formally approved *curricula and study programs* in accordance to labour market needs basing on Bologna practices;
- Developed *didactic materials* (e-Books, guides for laboratory works, lecture synopsises, etc.) for upgrading master-level education in the field of physical sciences (functional nanomaterials, photonics, applied physics, etc.);



**BSU**

**ERASMUS+**



## Indicators of progress:

- Developed, tested and formally approved *curricula and study materials* in accordance to labour market needs basing on Bologna practices;
- Developed *didactic materials* (e-Books, guides for laboratory works, lecture synopsises, etc.) for upgrading master-level education in the field of physical sciences (functional nanomaterials, photonics, applied physics, etc.);
- **Readiness for transition from existing “5 + 1” system of education to a new training system “4 + 2” (4 years for bachelors and 2 years for master students study)**



**BSU**

**ERASMUS+**



---

## How indicators will be measured:

- ***University's registries*** (educational plans and programs).
- ***Interim and final evaluation reports***, including feedback from students, teachers, student's governance and also industry and Non-Governmental Organisations representatives



**BSU**

**ERASMUS+**



---

## Special objectives of the project:

- ***To develop modern master programs*** in the field of functional nanomaterials, photonics and applied physics for four Belarusian universities, which respects principles of the Bologna process;



**BSU**

**ERASMUS+**



---

## Special objectives of the project:

- *To develop modern master programs* in the field of functional nanomaterials, photonics and applied physics for four Belarusian universities, which respects principles of the Bologna process;
- *To develop and update courses and teaching materials* for two master-level model (standard) educational programs for specialities “Functional nanomaterials” and “Photonics”;



**BSU**

**ERASMUS+**



---

## Special objectives of the project:

- *To develop modern master programs* in the field of functional nanomaterials, photonics and applied physics for four Belarusian universities, which respects principles of the Bologna process;
- *To develop and update courses and teaching materials* for two master-level model (standard) educational programs for specialities “Functional nanomaterials” and “Photonics”;
- *To improve teachers’ qualifications and skill;*



**BSU**

**ERASMUS+**



---

## Special objectives of the project:

- *To develop modern master programs* in the field of functional nanomaterials, photonics and applied physics for four Belarusian universities, which respects principles of the Bologna process;
- *To develop and update courses and teaching materials* for two master-level model (standard) educational programs for specialities “Functional nanomaterials” and “Photonics”;
- *To improve teachers’ qualifications and skill;*
- *To improve teachers/students skill in practical English;*



**BSU**

**ERASMUS+**



---

## Special objectives of the project:

- *To develop modern master programs* in the field of functional nanomaterials, photonics and applied physics for four Belarusian universities, which respects principles of the Bologna process;
- *To develop and update courses and teaching materials* for two master-level model (standard) educational programs for specialities “Functional nanomaterials” and “Photonics”;
- *To improve teachers’ qualifications and skill*;
- *To improve teachers/students skill* in practical English;
- **To enhance Belarusian academic staff competences for teaching of the developed courses in English;**





**BSU**

**ERASMUS+**



---

## Special objectives of the project:

- To implement *modern technical infrastructure* for teaching and learning;



**BSU**

**ERASMUS+**



---

## Special objectives of the project:

- To implement *modern technical infrastructure* for teaching and learning;
- To develop *innovative ICT-based teaching and learning environment*;



**BSU**

**ERASMUS+**



---

## Special objectives of the project:

- To implement *modern technical infrastructure* for teaching and learning;
- To develop *innovative ICT based teaching and learning environment*;
- To bring the Higher Education Institutions (HEIs) of Belarus closer *to the Labour Market needs*.



**BSU**

**ERASMUS+**



---

## Special objectives of the project:

- To implement *modern technical infrastructure* for teaching and learning;
- To develop *innovative ICT based teaching and learning environment*;
- To bring the Higher Education Institutions of Belarusian closer *to the Labour Market needs*.
- To bring the HEI of Belarus closer *to Bologna system principles*.



**BSU**

**ERASMUS+**



---

## Special objectives of the project:

- To implement *modern technical infrastructure* for teaching and learning;
- To develop *innovative ICT based teaching and learning environment*;
- To bring the Higher Education Institutions of Belarusian closer *to the Labour Market needs*.
- To bring the Higher Education Institutions (HEIs) of Belarus closer *to Bologna system principles*.
- To enhance the ICT skill that are required for new graduates *to make easier their way into the industrial/scientific institutions*.



**BSU**

**ERASMUS+**



---

# **Identifying the principles of Higher Education in Belarus: before and after**



**BSU**

**ERASMUS+**



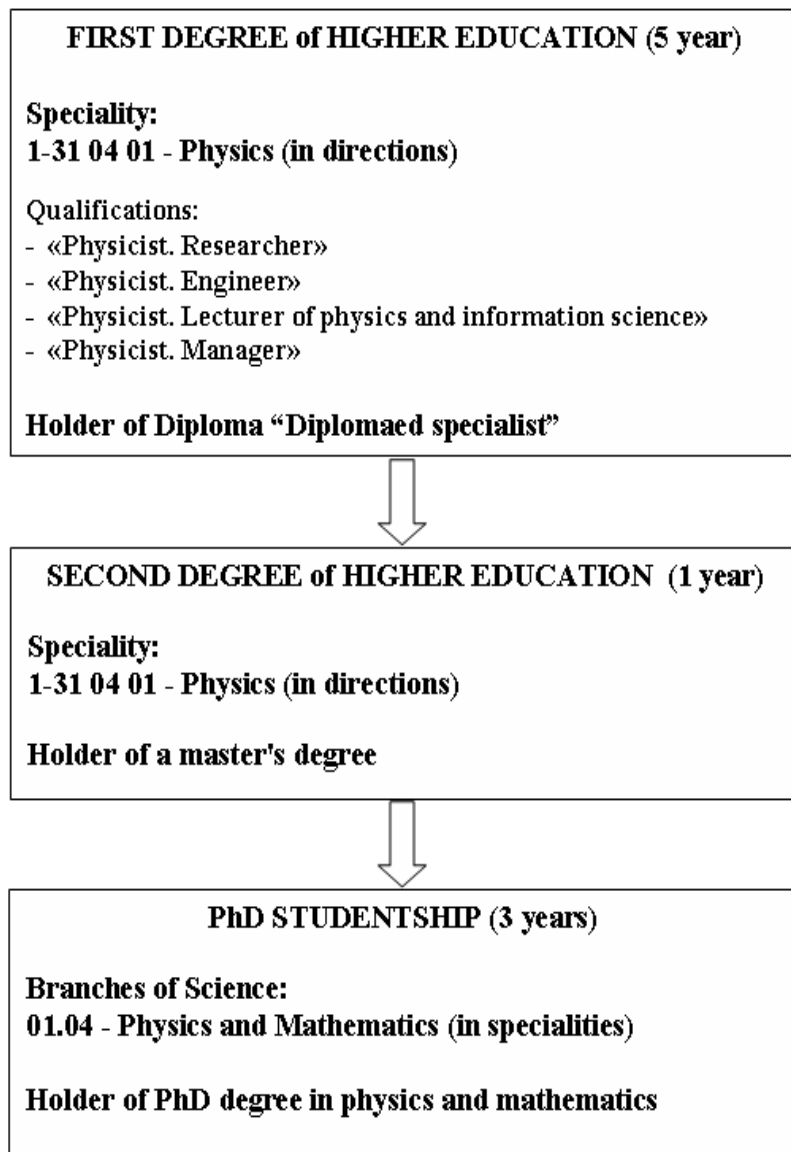
---

**Before 2014, training process for students of BSU, BSTU, GoSU and GrSU was constructed using mainly 3-stage education system “5 + 1 + 3” by all Specialities both in Physical sciences and Engineering.**



**BSU**

**ERASMUS+**



In accordance with "Certified Specialist Academic Education Programme" up to 2013-2014 education year, the training process by speciality "1-31 04 01 - Physics" was divided *on 3 stages*:

1. *General Programme for 1-4 courses (General Physics, Higher Mathematics, Theoretical Physics, etc.)*

2.

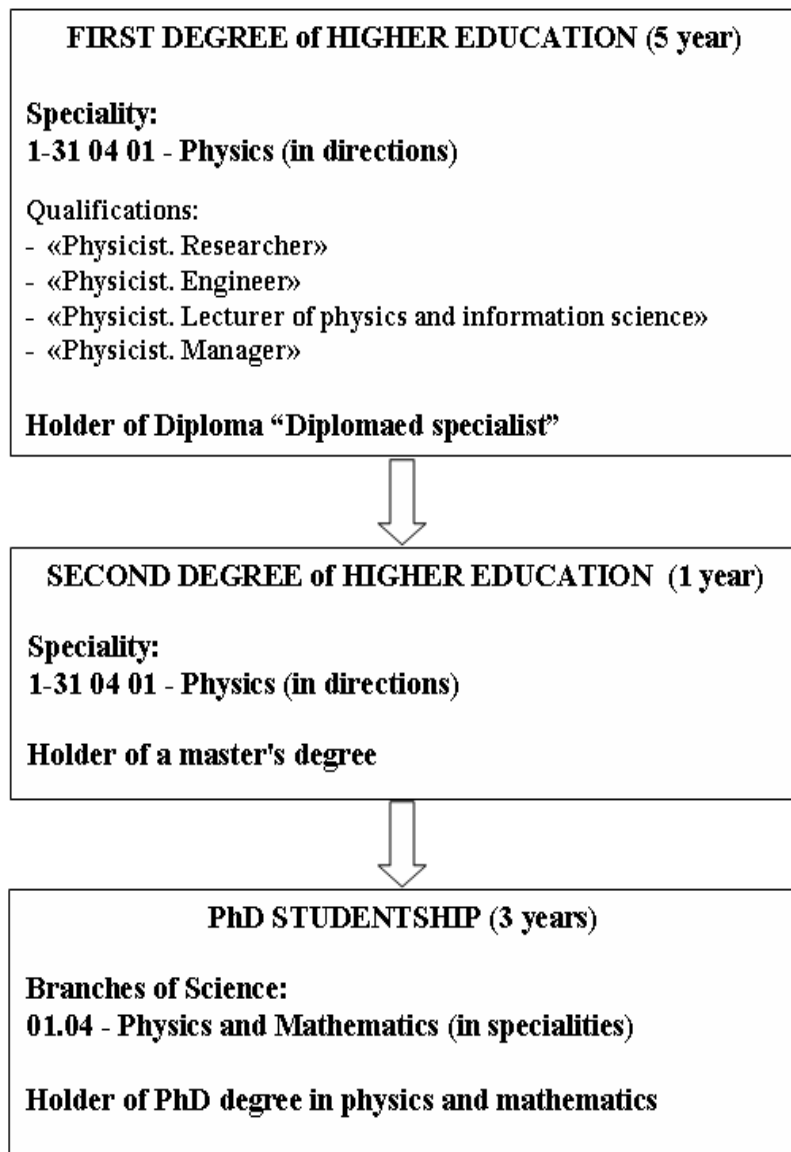
**Fig. 1. The flowchart for speciality 1-31 04 01 - Physics in BSU before 2013-2014 educational year**





**BSU**

**ERASMUS+**



In accordance with "Certified Specialist Academic Education Programme" up to 2013-2014 education year, the training process by speciality "1-31 04 01 - Physics" was divided *on 3 stages*:

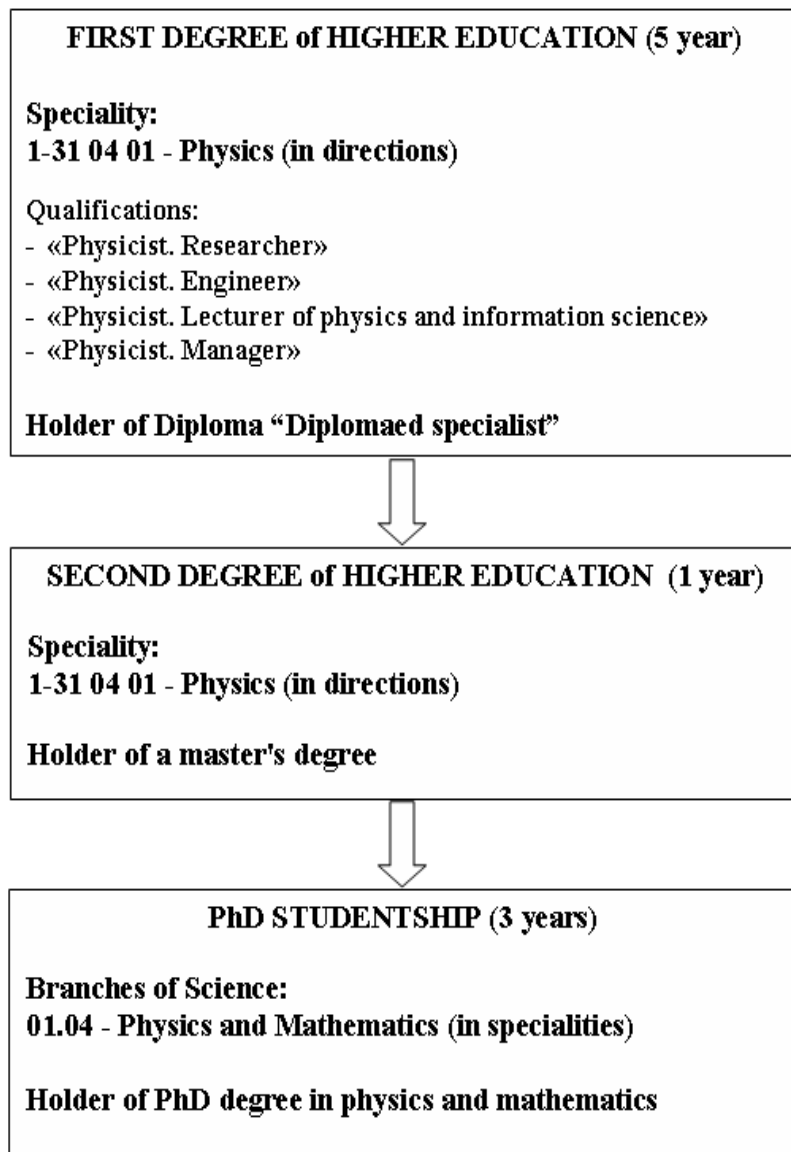
1. *General Programme* for 1-4 courses (General Physics, Higher Mathematics, Theoretical Physics, etc.)
2. *Diploma Programme* for 3-5 courses (for qualifications/skill "research activity", "engineering activity" and "management activity" including 12-18 specializations).

**Fig. 1. The flowchart for speciality 1-31 04 01 - Physics in BSU before 2013-2014 educational year**



**BSU**

**ERASMUS+**



In accordance with “Certified Specialist Academic Education Programme” up to 2013-2014 education year, the training process by speciality "1-31 04 01 - Physics" was divided *on 3 stages*:

1. *General Programme* for 1-4 courses (General Physics, Higher Mathematics, Theoretical Physics, etc.)
2. *Diploma Programme* for 3-5 courses (for qualifications/skill "research activity", "engineering activity" and "management activity" including 12-18 specializations).
3. *Three-year PhD programme* for the branch of science “01.04 - Physics and Mathematics” (by Specialties)

**Fig. 1. The flowchart for speciality 1-31 04 01 - Physics in BSU before 2013-2014 educational year**



**BSU**

**ERASMUS+**



---

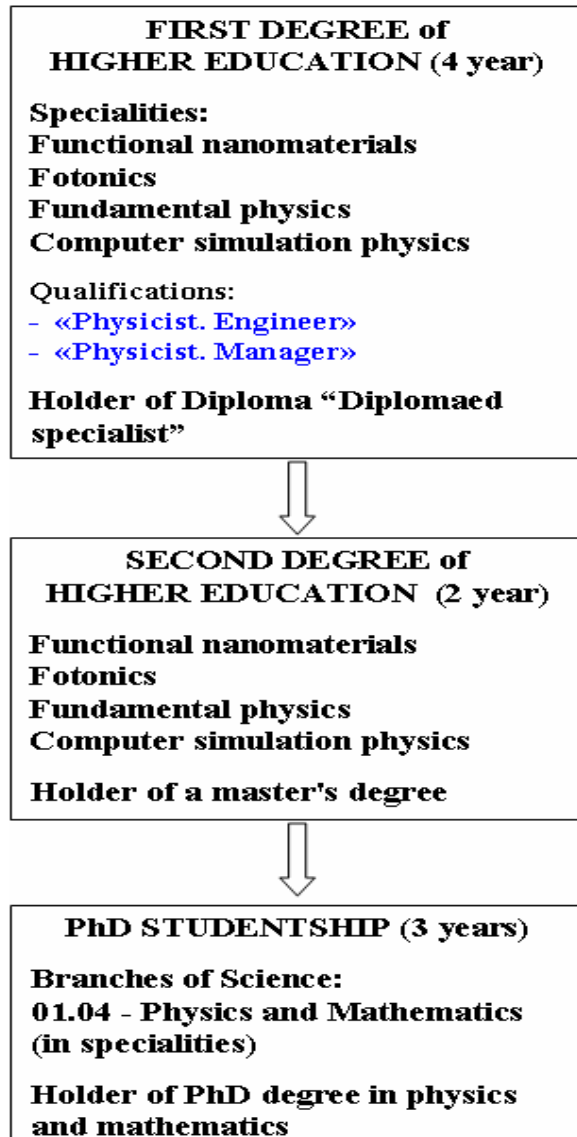
**Striving to reform Belarusian high education system according to the Bologna process, since academic year 2014-2015 Belarusian Ministry of Education set the target *for the most HEIs to reform curricula from the existing system "5 + 1 + 3" to the system "4 + 2 + 3".***

**Fig. 2. The flowchart for some specialities in Physics in BSU since 2013-2014 educational year**



**BSU**

**ERASMUS+**



**Striving to reform Belarusian high education system according to the Bologna process, since academic year 2014-2015 Belarusian Ministry of Education set the target for the most HEIs to reform curricula from the existing system “5 + 1 + 3” to the system “4 + 2 + 3”.**

**Fig. 2. The flowchart for some specialities in Physics in BSU since 2013-2014 educational year**



**BSU**

**ERASMUS+**



## **WP2: “Development and modernizing of curricula“**

**Description of WP2:  
tasks, results and important activities**



**BSU**

**ERASMUS+**



## **Description of WP2: tasks, results and important activities**

<b>Start Date</b>	<b>15.02.2016</b>	<b>End Date</b>	<b>30.10.2018</b>
<b>Leading Organisation</b>	<b>BSU</b>		
<b>Participating Institutions</b>	<b>RTU, KU Leuven, UCY, GrSU, GoSU, BSTU, MERB, BPS, RANI, INP of BSU, LOTIS-TII</b>		



**BSU**

**ERASMUS+**



---

## **Main tasks of WP2:**

- *Development and modernizing of some master-level curricula in 4 Belarusian universities;*



**BSU**

**ERASMUS+**



---

## **Main tasks of WP2:**

- *Development and modernizing of some master-level curricula* in 4 Belarusian universities;
- *Development and accreditation of new master-level programs :*
  - a) *Development and accreditation in the Ministry of Education of RB (MERB) of standard program;*
  - b) *Belarusian universities will also provide internal accreditation* in their universities;
  - c) *Belarusian universities will make re-accreditation of final master-level programs in the MERB after testing beyond the project.*





**BSU**

**ERASMUS+**



---

**Main results of WP2:  
Outputs (tangible) and Outcomes (intangible):**

**2.1. Developed and translated to teaching language  
*master-level study programs and courses for two  
specialities: “Functional nanomaterials” and  
“Photonics”***



**BSU**

**ERASMUS+**



---

## **Main results of WP2: Outputs (tangible) and Outcomes (intangible):**

**2.1. Developed and translated to teaching language *master-level study programs and courses for two specialities: “Functional nanomaterials” and “Photonics”***

**2.2. Master-level *Standard Programs accreditation* in the MERB**



**BSU**

**ERASMUS+**



---

## **Main results of WP2: Outputs (tangible) and Outcomes (intangible):**

**2.1. Developed and translated to teaching language *master-level study programs and courses for two specialities: “Functional nanomaterials” and “Photonics”***

**2.2. Master-level *Standard Programs accreditation* in the MERB**

**2.3. *5 electronic e-Books* by the declared directions (see, below)**



**BSU**

**ERASMUS+**



---

## **Main results of WP2: Outputs (tangible) and Outcomes (intangible):**

**2.1. Developed and translated to teaching language *master-level study programs and courses for two specialities: “Functional nanomaterials” and “Photonics”***

**2.2. Master-level *Standard Programs accreditation* in the MERB**

**2.3. *5 electronic e-Books* by the declared directions (see, below)**

**2.4. *The master-level courses developed on the base of 5 e-Books and tested during two years***



**BSU**

**ERASMUS+**



---

**Main results of WP2:  
Outputs (tangible) and Outcomes (intangible):**

***2.5. Master-level study courses accreditation in  
Belarusian universities***



**BSU**

**ERASMUS+**



---

**Main results of WP2:  
Outputs (tangible) and Outcomes (intangible):**

**2.5. *Master-level study courses accreditation in Belarusian universities***

**2.6. *Documents for master-level curricula accreditation in the MERB***



**BSU**

**ERASMUS+**



---

**Main results of WP2:  
Outputs (tangible) and Outcomes (intangible):**

**2.5. *Master-level study courses accreditation in Belarusian universities***

**2.6. *Documents for master-level curricula accreditation in the MERB***

**2.7. *Academic staff improved professional and practical English skill***



**BSU**

**ERASMUS+**



---

**Main results of WP2:  
Outputs (tangible) and Outcomes (intangible):**

**2.5. *Master-level study courses accreditation in Belarusian universities***

**2.6. *Documents for master-level curricula accreditation in the MERB***

**2.7. *Academic staff improved professional and practical English skill***

**2.8. *Belarusian universities readiness for transition from existing system “5 + 1” to new “4 + 2” system***





**BSU**

**ERASMUS+**



---

## **Main activities of WP2:**

***2.1. Development of lecture synopsises and compatible teaching (didactic) materials in English and translation to teaching languages for Belarusian universities***



**BSU**

**ERASMUS+**



---

## **Main activities of WP2:**

***2.1. Development of lecture synopsises and compatible teaching (didactic) materials in English and translation to teaching languages for Belarusian universities***

***2.2. Academic/teaching/technician staff training on curricula topics, ICT tools and English languages skill***



**BSU**

**ERASMUS+**



---

## **Main activities of WP2:**

***2.1. Development of lecture synopsises and compatible teaching (didactic) materials in English and translation to teaching languages for Belarusian universities***

***2.2. Academic/teaching/technician staff training on curricula topics, ICT tools and English languages skill***

***2.3. Workshops for curricula development: WS2 – WS9***



**BSU**

**ERASMUS+**



---

## **Main activities of WP2:**

***2.1. Development of lecture synopsises and compatible teaching (didactic) materials in English and translation to teaching languages for Belarusian universities***

***2.2. Academic/teaching/technician staff training on curricula topics, ICT tools and English languages skill***

***2.3. Workshops for curricula development: WS2 – WS9***

***2.4. Master-students training***



**BSU**

**ERASMUS+**



---

## **Main activities of WP2:**

***2.5. Master study Standard Programmes  
accreditation in the MERB***



**BSU**

**ERASMUS+**



---

## **Main activities of WP2:**

**2.5. *Master study Standard Programmes accreditation in the MERB***

**2.6. *The 1st year testing of two-year master-level programs***



**BSU**

**ERASMUS+**



---

## **Main activities of WP2:**

***2.5. Master study Standard Programmes accreditation in the MERB***

***2.6. The 1st year testing of two-year master-level programs***

***2.7. Preparation of curricula for accreditation in Belarusian universities during the project implementation and in the MERB beyond the project***



**BSU**

**ERASMUS+**



---

## **Main activities of WP2:**

**2.5. *Master study Standard Programmes accreditation in the MERB***

**2.6. *The 1st year testing of two-year master-level programs***

**2.7. *Preparation of curricula for accreditation in Belarusian universities during the project and in the MERB beyond the project***

**2.8. *Measuring of a feedback***





**BSU**

**ERASMUS+**



## **Short description of Results and Activities in WP2:**

**2.1. Development of lecture synopses, compatible teaching (didactic) materials in English and translation to teaching languages for Belarusian universities**

<b>Description</b>	<b>Developed and translated to teaching language master-level study programs and courses for specialties “Functional nanomaterials” and “Photonics”</b>
<b>Due date</b>	<b>30.08.2018</b>
<b>Languages</b>	<b>English and Russian</b>
<b>Target groups</b>	<b>Teaching staff; Master-students; Trainees</b>



**BSU**

**ERASMUS+**



## **Short description of Results and Activities in WP2:**

**2.2. Academic/teaching/technician staff training on curricula topics, ICT tools and English languages skill**

<b>Description</b>	<b>The set of documents for accreditation in the MERB</b>
<b>Due date</b>	<b>30.10.2017</b>
<b>Languages</b>	<b>Russian</b>
<b>Target groups</b>	<b>Teaching staff; Trainees; Technical staff; Other: MERB, project stakeholders</b>



**BSU**

**ERASMUS+**



## Short description of Results and Activities in WP2:

### 2.3. Five e-Books by the declared directions

<b>Description</b>	<b>Development of e-Books in English by 5 directions: “Applied Physics”, “Functional nanomaterials”, “Photonics”, “Applied Informatics”, “Research towards master thesis”</b>
<b>Due date</b>	<b>28.02.2018</b>
<b>Languages</b>	<b>Russian and English</b>
<b>Target groups</b>	<b>Teaching staff; Master-students; Trainees; Technical staff; Other: MERB, project stakeholders</b>



**BSU**

**ERASMUS+**



## Short description of Results and Activities in WP2:

### 2.4. The master-level courses tested during one year

<b>Description</b>	<b>The master-level courses tested during one year and Testing report</b>
<b>Due date</b>	<b>30.09.2018</b>
<b>Languages</b>	<b>Russian English (Report)</b>
<b>Target groups</b>	<b>Teaching staff; Master-students; Trainees; Technical staff; Other: MERB, project stakeholders</b>



**BSU**

**ERASMUS+**



## **Short description of Results and Activities in WP2:**

### **2.5. Master study courses accreditation in the Ministry of Education**

<b>Description</b>	<b>Curricular materials and set of documents related accreditation in Belarusian universities of Master-level study courses</b>
<b>Due date</b>	<b>30.10.2018</b>
<b>Languages</b>	<b>Russian</b>
<b>Target groups</b>	<b>Teaching staff; Master-students; Trainees; Administrative staff; Technical staff; Other: MERB, project stakeholders</b>



**BSU**

**ERASMUS+**



## **Short description of Results and Activities in WP2:**

### **2.6. Documents for master-level curricula accreditation in the Ministry of Education**

<b>Description</b>	<b>Each Belarusian university prepare final documents for own master-level curricula accreditation in MERB after 2-years testing beyond the project</b>
<b>Due date</b>	<b>30.10.2018</b>
<b>Languages</b>	<b>Russian</b>
<b>Target groups</b>	<b>Teaching staff; Master-students; Trainees; Administrative staff; Technical staff; Other: MERB, project stakeholders</b>



**BSU**

**ERASMUS+**



## Short description of Results and Activities in WP2:

### 2.7. Belarus universities readiness for transition from existing system “5 + 1” to new system “4 + 2”

<b>Description</b>	<b>Transition of Belarusian universities from existing system “5 + 1” to “4 + 2” in the field of applied physics, functional nanomaterials and photonics</b>
<b>Due date</b>	<b>30.10.2018</b>
<b>Languages</b>	<b>Russian</b>
<b>Target groups</b>	<b>Teaching staff; Master-students; Trainees; Administrative staff; Technical staff; Other: MERB, project stakeholders</b>



**BSU**

**ERASMUS+**



On the basis of compatible types of training programs, providing lecture courses, laboratory sessions, etc., *the following e-Books will be developed* in English and translated into Russian:

<b>Course title</b>	<b>Lider</b>	<b>Participants</b>
<b>Applied Physics</b>	<b>KU Leuven (Belgium)</b> <b>Prof. R. De-Craemer</b>	<b>RTU, BSU, BSTU,</b> <b>GrSU, GoSU</b>
<b>Applied Informatics</b>	<b>Riga Technical University (Latvia)</b> <b>Prof. N. Kunicina</b>	<b>RTU, UCY,</b> <b>KU Leuven, BSU</b>
<b>Photonics</b>	<b>Belarusian State University (Belarus)</b> <b>Prof. A. Tolstik</b>	<b>BSU, RTU, GRSU,</b> <b>GoSU,</b>
<b>Functional nanomaterials</b>	<b>Belarusian State University (Belarus)</b> <b>Prof. A. Fedotov</b>	<b>GoSU, GrSU, BSTU,</b> <b>KU Leuven</b>
<b>Research towards master thesis/management of scientific projects</b>	<b>University of Cyprus (Cyprus)</b> <b>Prof. E. Kyriakides</b>	<b>KU Leuven, RTU,</b> <b>BSU, GrSU, GoSU</b>





**BSU**

**ERASMUS+**



---

## **Preliminary contents of e-Books**

### ***1. Applied Physics (curator – KU Leuven)***

**1.1. Electricity and magnetism**

**1.2. Reliability in the (practical) set-up of physical systems**

**1.3. Applied Material Science**

**1.4. Modern measurement technics**

**1.5. Electrical engineering**



**BSU**

**ERASMUS+**



---

## **Preliminary contents of e-Books**

### ***2. Functional nanomaterials (curator – BSU)***

**2.1. Nanostructured materials: synthesis, properties and diagnostics**

**2.2. Physics-chemistry of dispersed systems**

**2.3. Application of nanomaterials**

**2.4. Nanoelectronics**



**BSU**

**ERASMUS+**



---

## **Preliminary contents of e-Books**

### ***3. Photonics (curator – BSU)***

**3.1. Optoelectronics and Nanophotonics**

**3.2. Laser physics and nonlinear optics**

**3.3. Coherent Optics and Holography**



**BSU**

**ERASMUS+**



---

## **Preliminary contents of e-Books**

### **4. Applied Informatics (*curator - RTU*)**

- 4.1. Signal transmitting in heterogeneous environment**
- 4.2. Fibre optics and optical information processing**
- 4.3. Optical waveguides, optical fibers**
- 4.5. Input-output system**
- 4.6. Waveguide modes**
- 4.7. Fibre optical transmission system**
- 4.8. Fibre sensors**
- 4.9. The Fourier transform of the image and spatial filtering**
- 4.10. Optical bistability and selfpulsing of intensity**
- 4.11. Optical networks in industrial systems**



**BSU**

**ERASMUS+**



---

## **Preliminary contents of e-Books**

### **5. Research towards master thesis/scientific project management (*curator - UCY*)**

- 5.1. Master thesis general requirements**
- 5.2. Selection of innovative topics**
- 5.3. Information search**
- 5.4. International intellectual property rights**
- 5.5. Standards and standardisation**
- 5.6. Scientific project management**
- 5.7. Bringing offers to market**
- 5.8. Presentation**
- 5.9. Commercialization / product management**
- 5.10.e-marketing**
- 5.11.Quantify and qualify students' competences to be acquired during master thesis work**
- 5.12.Evaluation methodology for students' master thesis**
- 5.13.Formal requirements in Belarus – special methodical annex**



**BSU**

**ERASMUS+**



---

## **Resume**

**Thus, as a result of the project implementation, we should create an integrated, logically-connected system of complementary educational approaches and tools, allowing**

- to carry out training of the teaching/technical staff of Belarusian universities, and**
- to improve the training of master-students**

**in the physical sciences by practice-oriented master-level programme.**



**BSU**

**ERASMUS+**



---

**Thank you for attention**

**Prof. A.K. Fedotov (BSU)**

[fedotov@bsu.by](mailto:fedotov@bsu.by)