Improvement of master-level education in the field of physical sciences in Belarusian universities

WP2 Development and modernizing of curricula

Belarusian State University
Grodno State University
Gomel State University
Belarusian State Technological University

Goal of presentation:

- **Remembering of the WP2 objectives and tasks**
- **Current state of WP2**
- **Problems**
- **Next steps**

WP2 objectives

- to upgrade curricula in physical sciences in four universities of Belarus according to Bologna practices,

- to enhance the quality and relevance of education by modernising study programs, through the enhanced use of ICT and networking activities to the labour market needs.

WP2 tasks
in the 1-st year of the project

- ***Development/modernizing of new master-level curricula*** in 4 Belarusian universities;
- ***Accreditation of new master-level curricula*** in the Ministry of Education of RB (MERB)/internal accreditation in Belarusian universities;
- **5 e-Books preparation;**

WP2 tasks
in the 1-st and 2-nd years of the project

- **Development of study programs and lecture courses;**
- **Development of laboratory practices and didactic materials for them;**
- **One-year testing.**

FIRST DEGREE of HIGHER EDUCATION (4 year)

Specialities:
Functional nanomaterials
Fotonics
Fundamental physics
Computer simulation physics

Qualifications:
- «Physicist. Engineer»
- «Physicist. Manager»

Holder of Diploma "Diplomaed specialist"

⇩

SECOND DEGREE of HIGHER EDUCATION (2 year)

Functional nanomaterials
Fotonics
Fundamental physics
Computer simulation physics

Holder of a master's degree

⇩

PhD STUDENTSHIP (3 years)

Branches of Science:
01.04 - Physics and Mathematics (in specialities)

Holder of PhD degree in physics and mathematics

Since academic year 2013-2014 *the most Universities have reformed curricula* (educational plans) ***from the system***

"5 + 1 + 3"

to the system

"4 + 2 + 3".

The flowchart for some specialities in Physics in BSU since 2013-2014 educational year

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⇩

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01.04 - Physics and Mathematics (in specialities)

Holder of PhD degree in physics and mathematics

As to the master-level education, according to system

"4 + 2 + 3"

in BSU, GrSU, GSU and BSTU we shall work by the following curricula:

1. **Functional nanomaterials**
2. **Photonics**
3. **Production and processing of polymers and composites**

The flowchart for some specialities in Physics in BSU since 2013-2014 educational year

Structure of curricula "Functional Nanomaterials" (BSU, GrSU, GomSU, BSTU)

List of courses for the two-year master-level education by all **SPECIALTIES**

State component

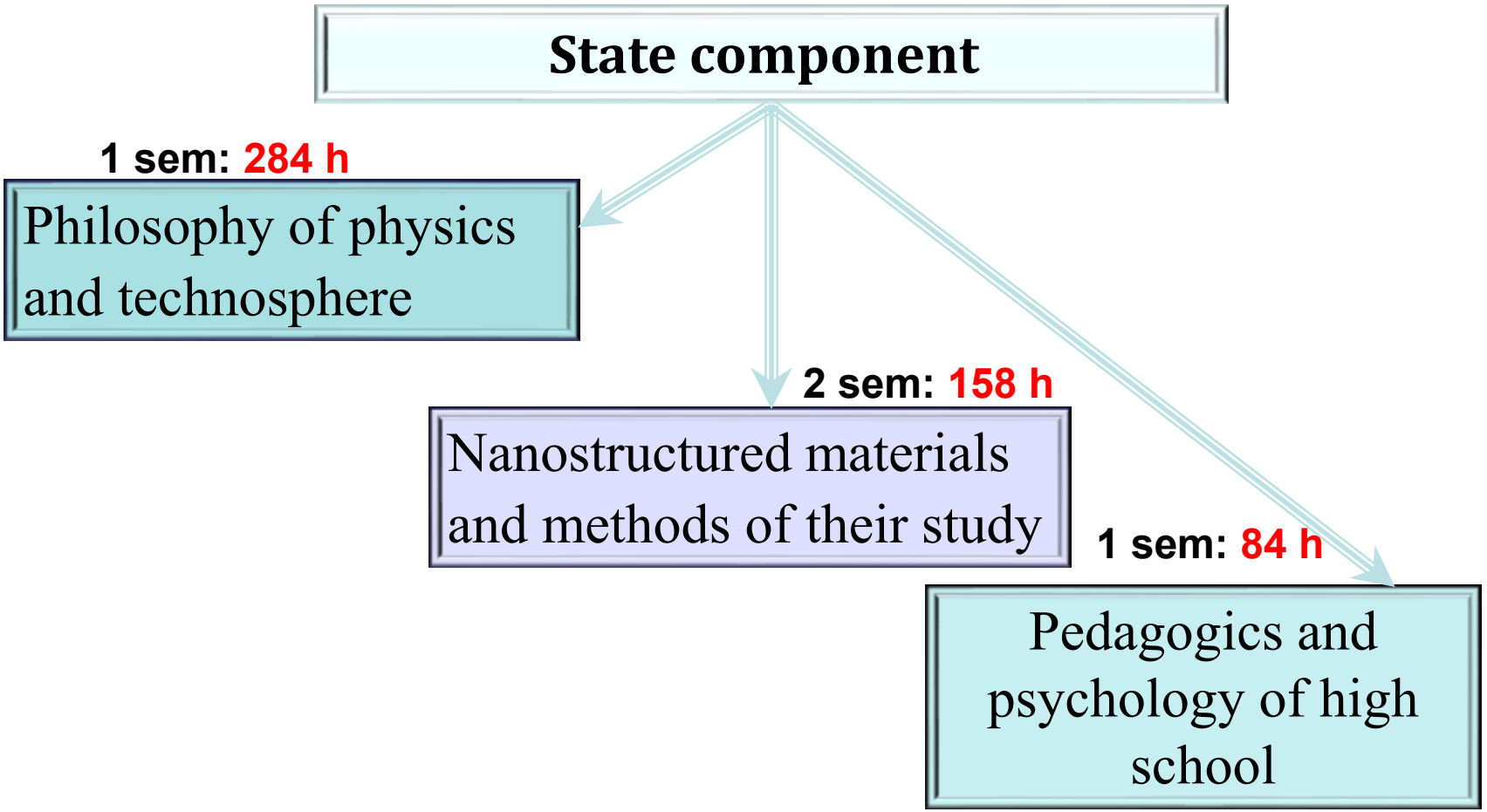
University component

Elective courses/ Courses on choice

4 semesters

4536 hours = 1098 (aud.) + 3438 (independent work)

Structure of curricula "Functional Nanomaterials" (BSU, GrSU, GomSU)

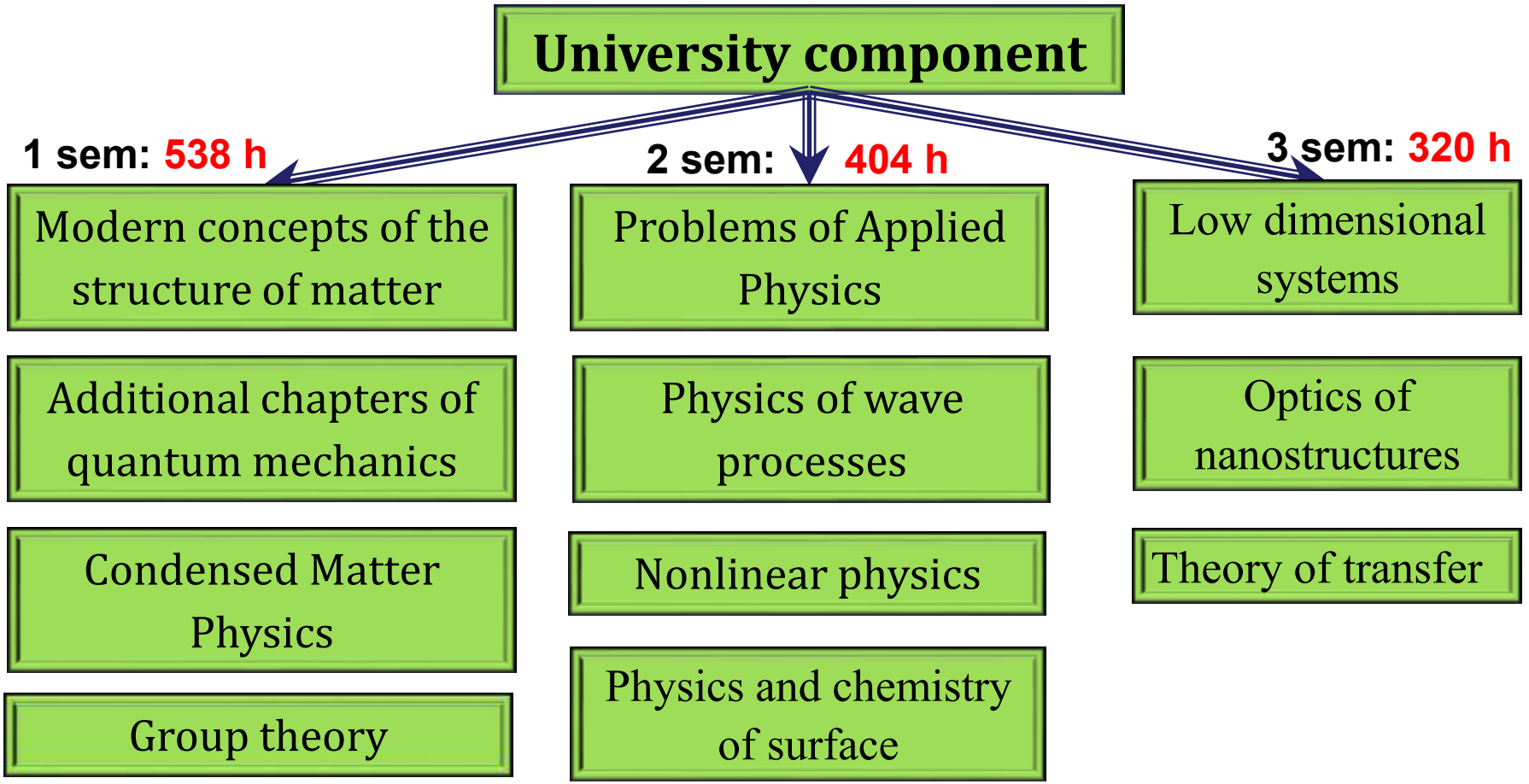


Curricula

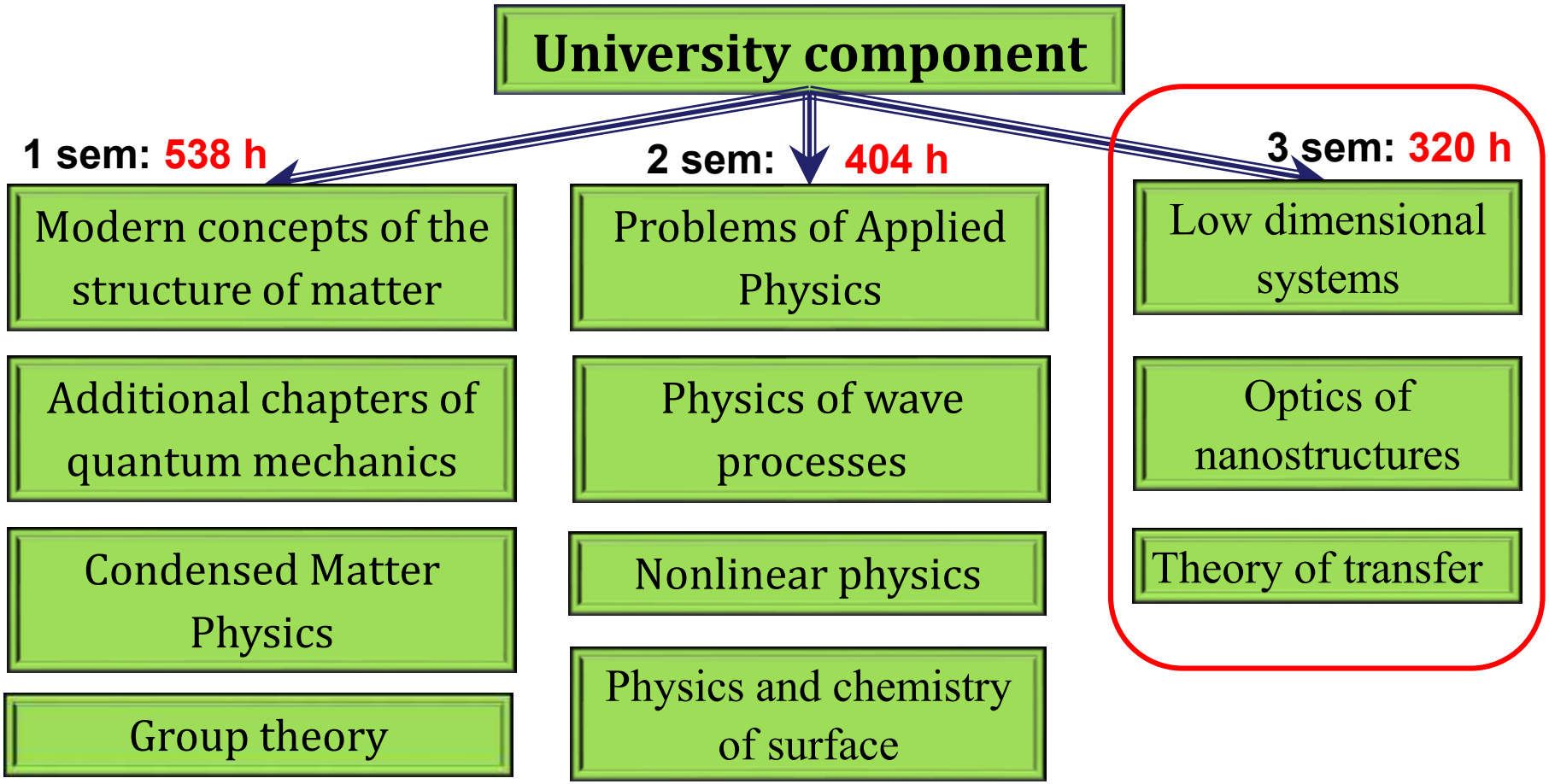
"FUNCTIONAL NANOMATERIALS"

in BSU, GrSU and GSU

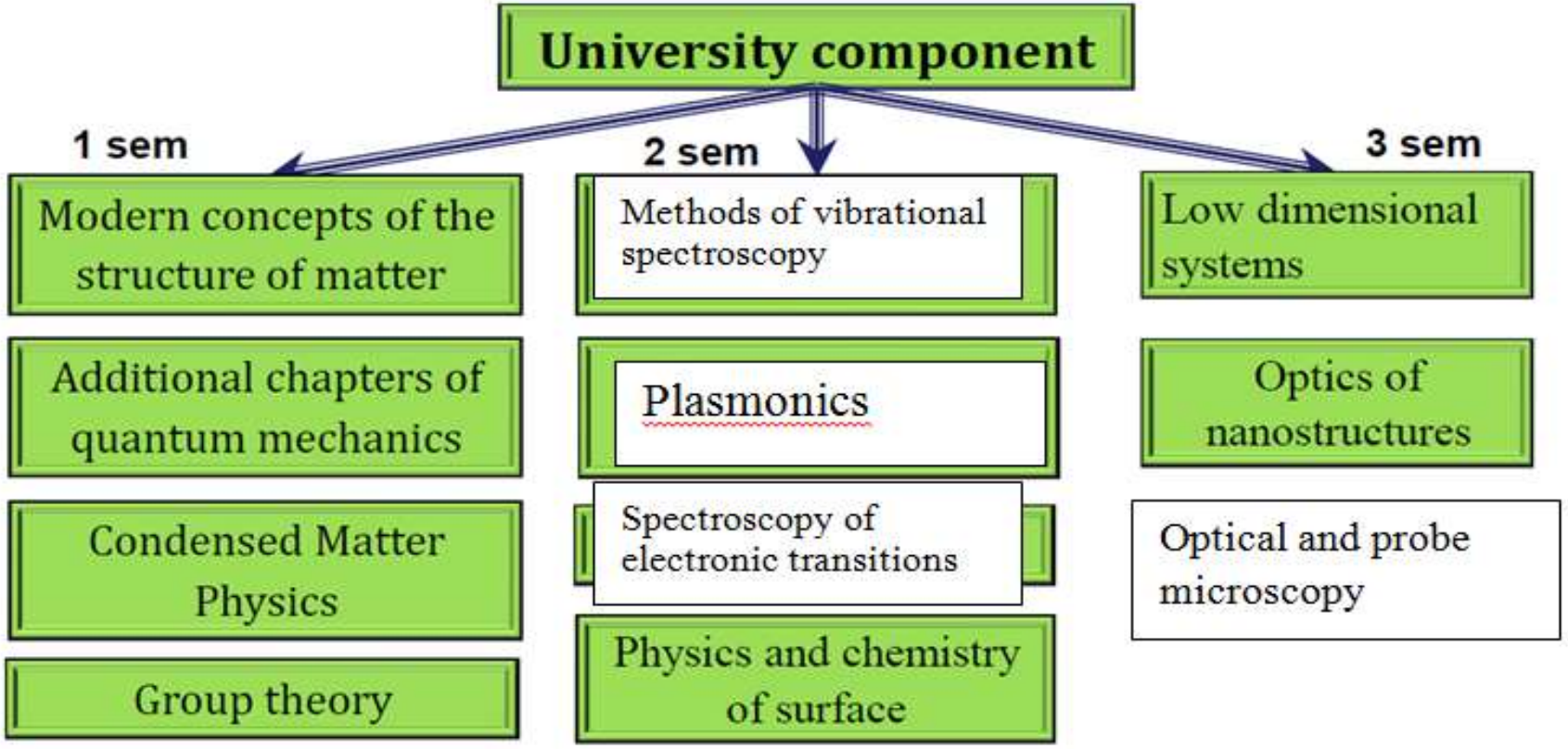
Structure of curricula "Functional Nanomaterials" (BSU)



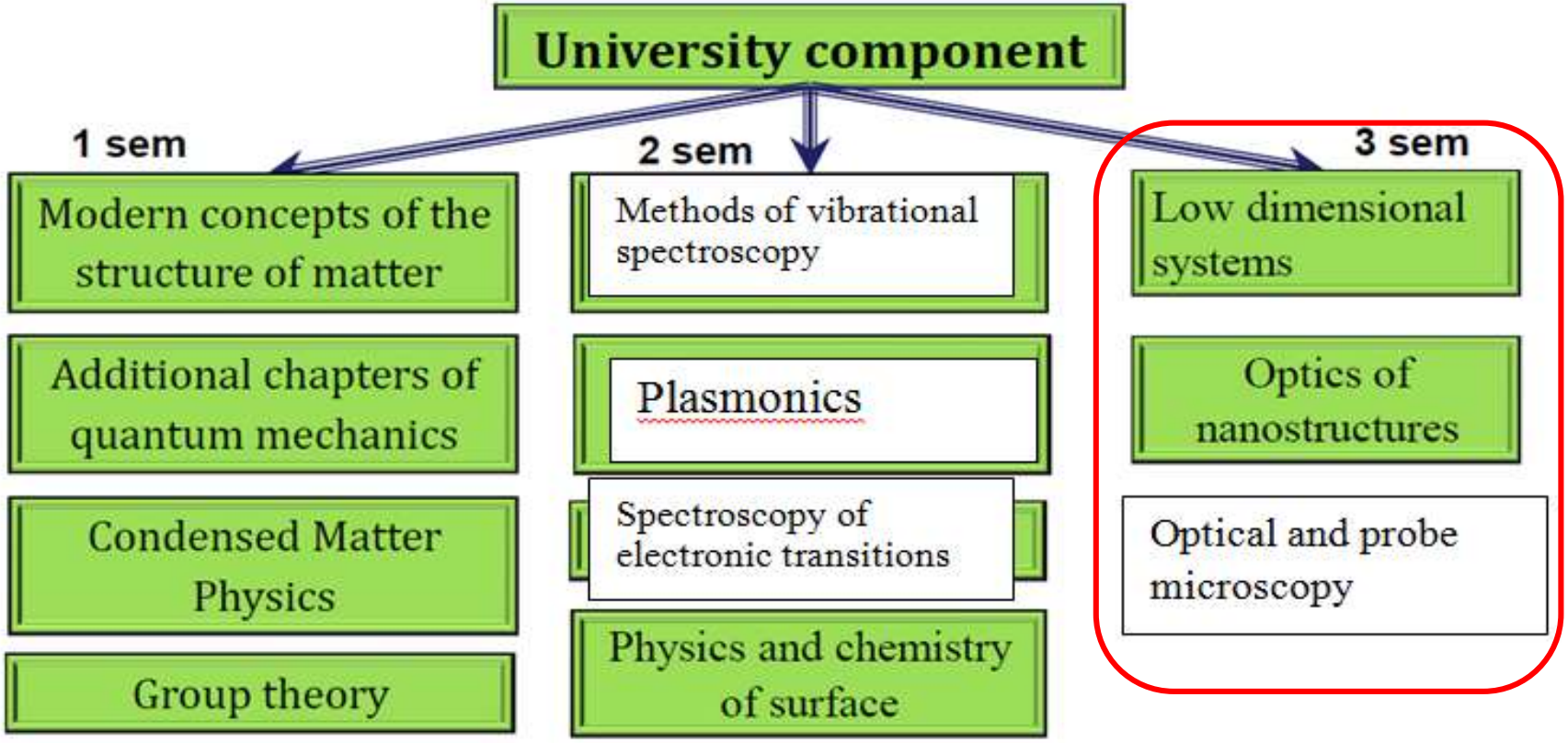
Structure of curricula "Functional Nanomaterials" (BSU)



Structure of curricula "Functional Nanomaterials" (GrSU)



Structure of curricula "Functional Nanomaterials" (GrSU)



Structure of curricula "Functional nanomaterials" (BSU)

684 h = 252 (aud.)+ 432 (independent work)

Elective courses /Courses on choice

1 sem

- Synthesis of nanomaterials/Nanotech-nology in electronics
- Low Dimensial Systems (Special chapters)

2 sem

- Spectra and structure of molecules/Technique of microcontroller systems
- Bionanomaterials/ Physics of liquid crystals processing
- Laser physics/ Polymer physics

3 sem

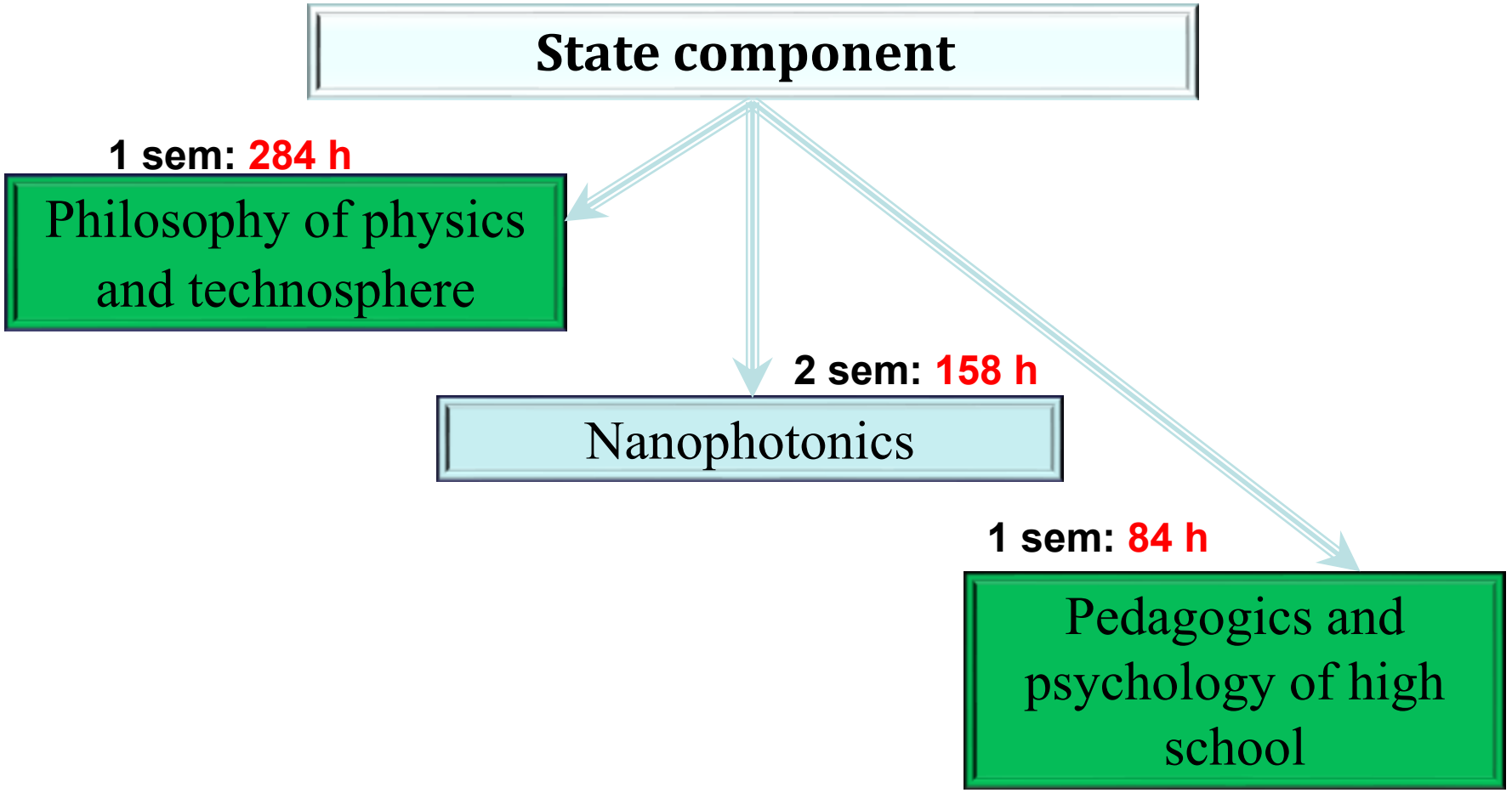
- Laboratory practices (Energy effective materials/Materials in electronics)

Curricula

"PHOTONICS"

in BSU, GrSU, GomSU

Structure of curricula "Photonics" (BSU)



Structure of curricula "Photonics" (BSU)

University component

1 sem: 538 h

- Modern concepts of the structure of matter
- Additional chapters of quantum mechanics
- Condensed Matter Physics
- Group theory

2 sem: 404 h

- Problems of Applied Physics
- Physics of wave processes
- Nonlinear physics
- Laser Physics

3 sem: 320 h

- Nonlinear optics
- Lasers and laser systems
- Quantum optics

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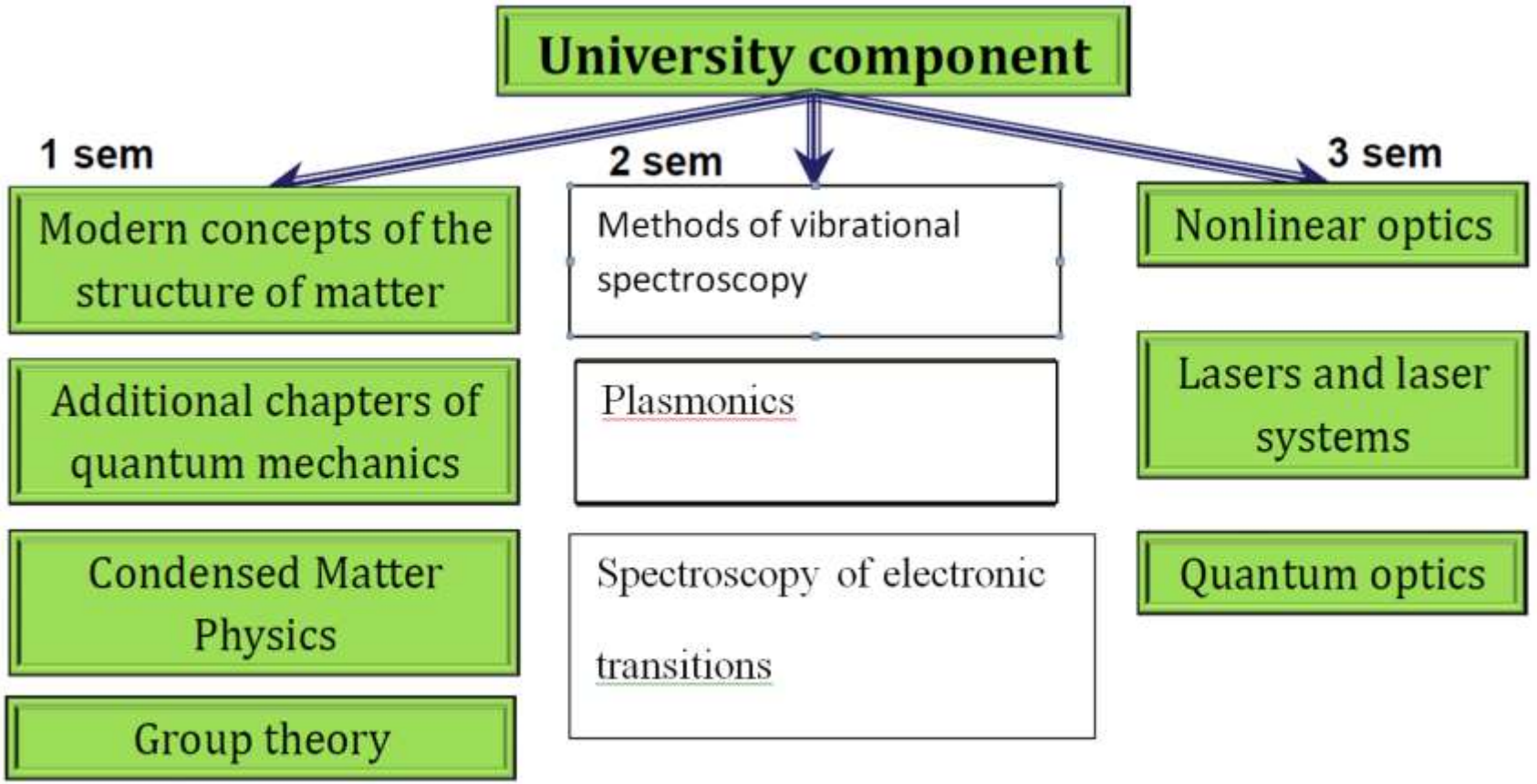
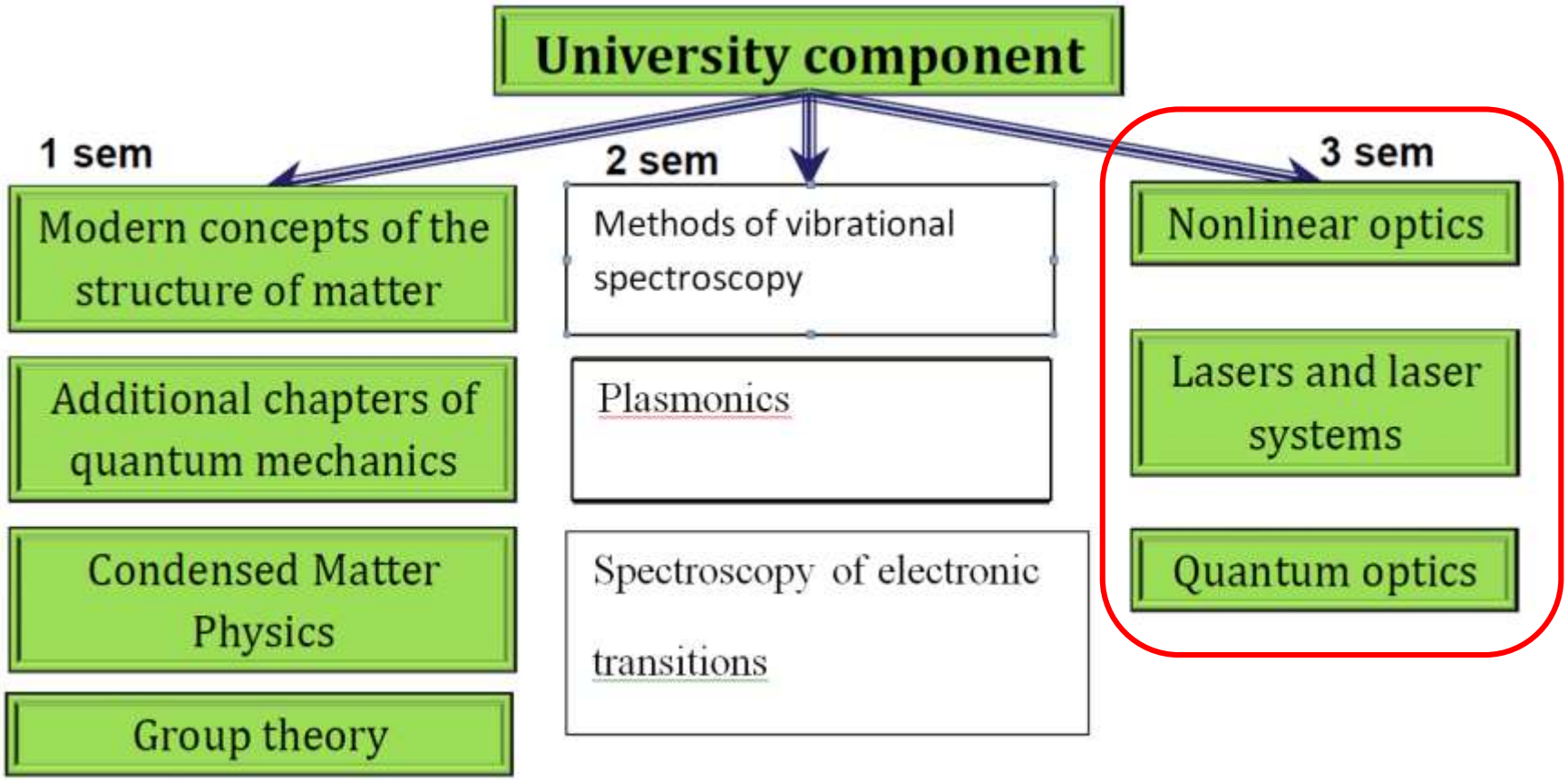
Structure of curricula "Photonics" (GrSU)



Structure of curricula "Photonics" (GrSU)



Structure of curricula "Photonics" (BSU)

684 h = 252 (aud.)+ 432 (independent work)

Elective courses /Courses on choice

2 sem

- Nanophotonics / Laser technology
- Laser spectroscopy / Optics of Anisotropic Media

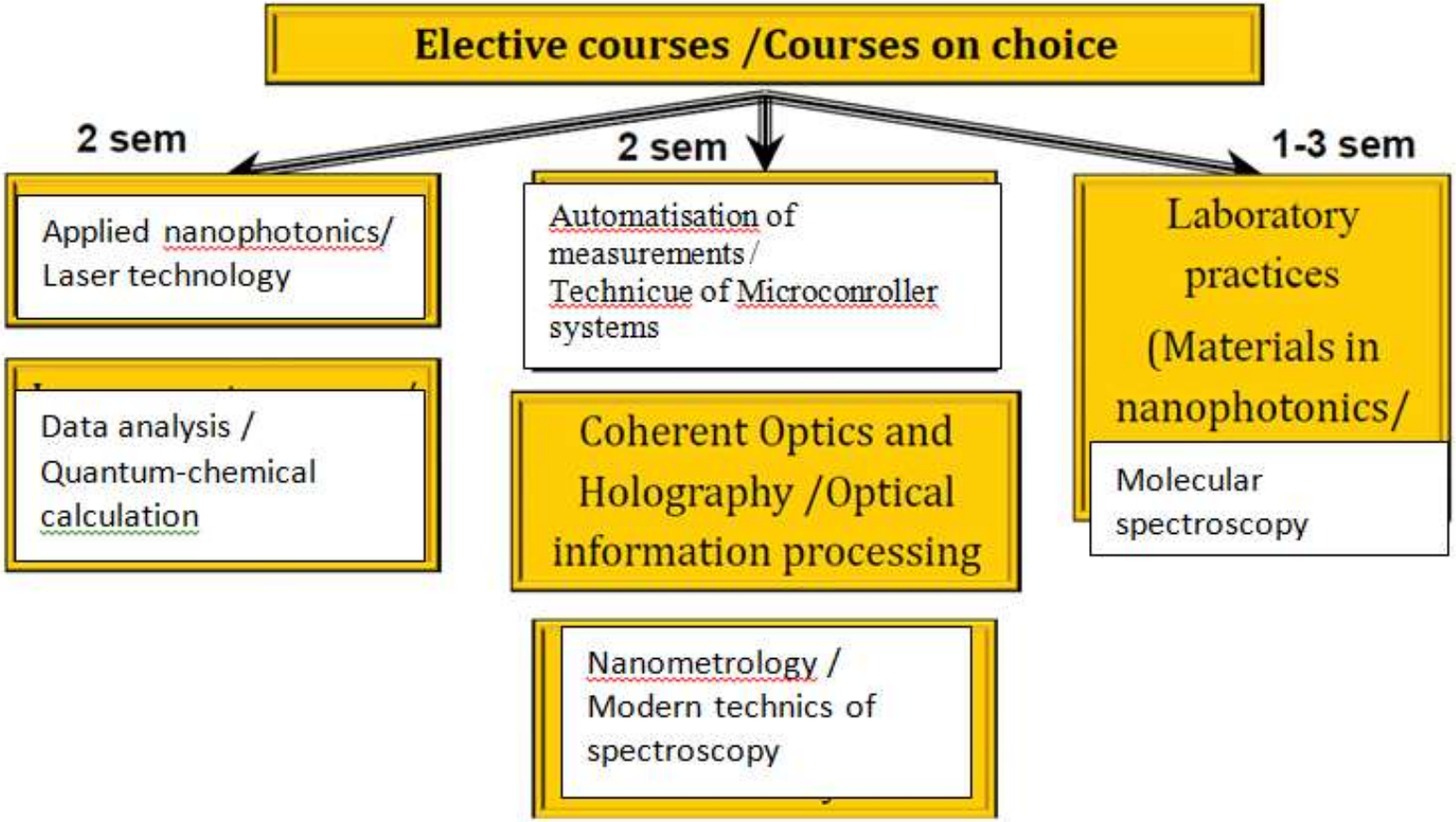
2 sem

- Lasers in Medicine and Laser Technology/ Waveguide optics
- Coherent Optics and Holography /Optical information processing
- Optics of liquid crystal and polymers / Photonic crystals

1-3 sem

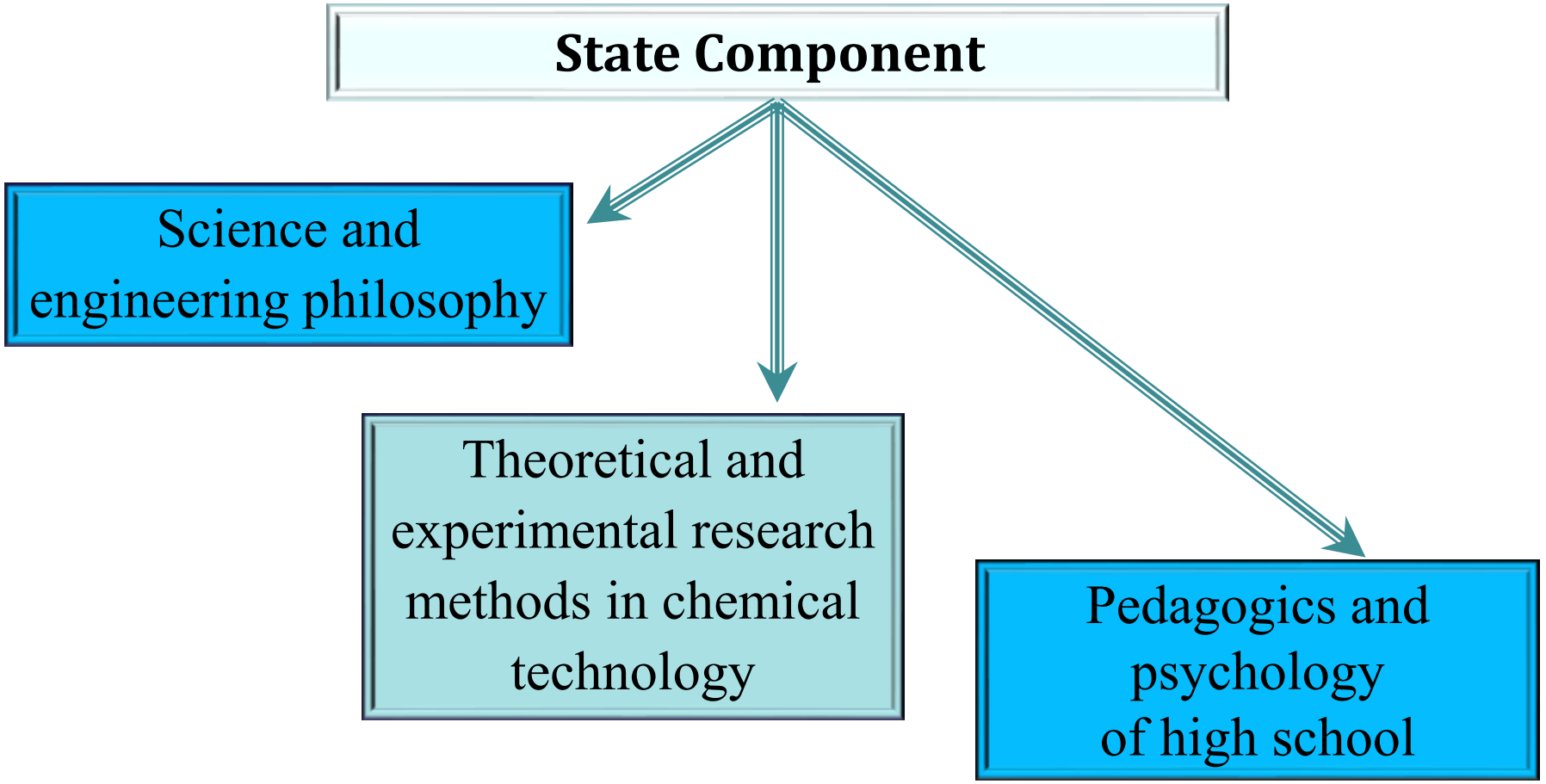
- Laboratory practices (Materials in nanophotonics/ Laser technologies

Structure of curricula "Photonics" (GrSU)

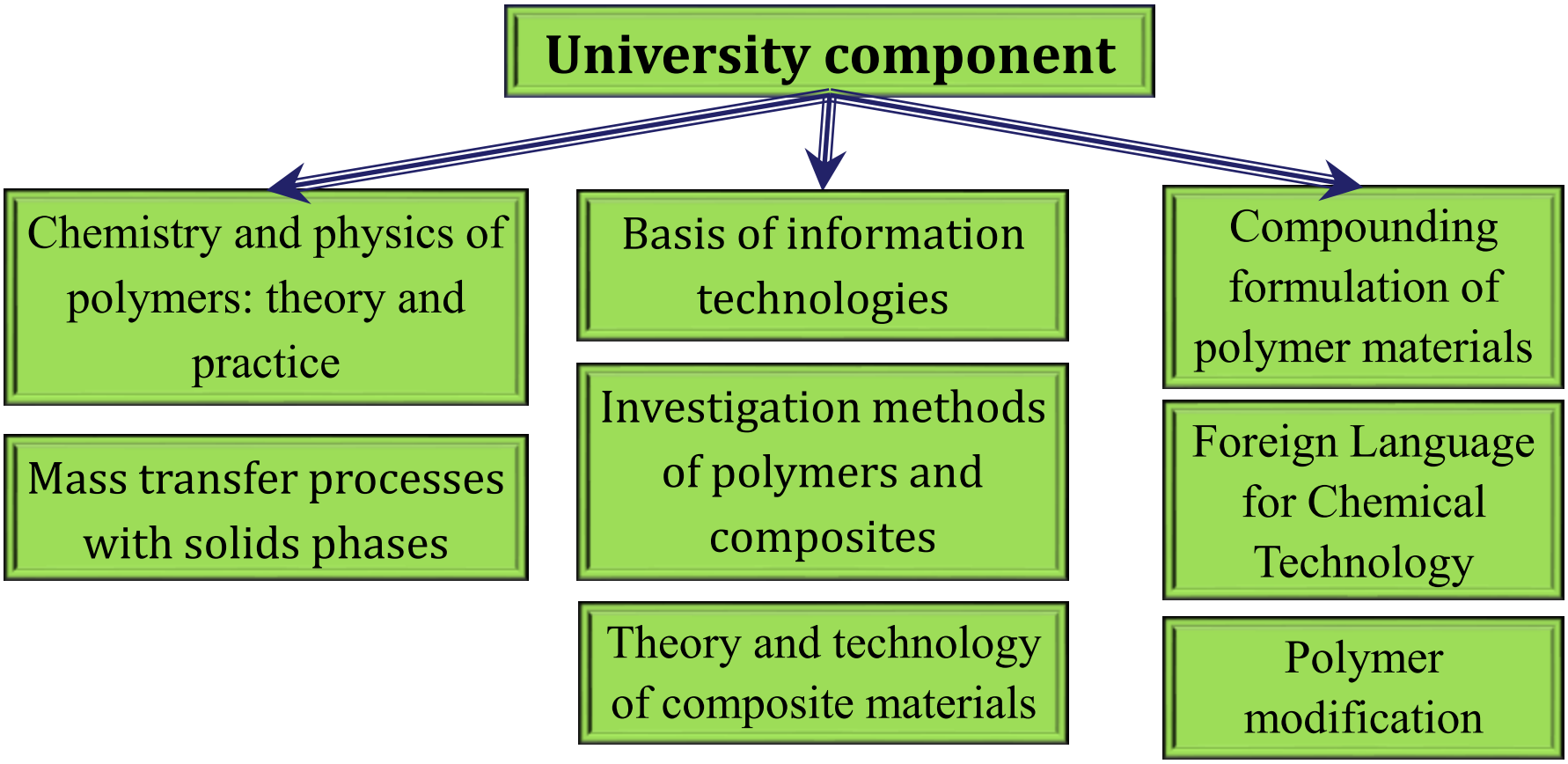


Curricula in BSTU

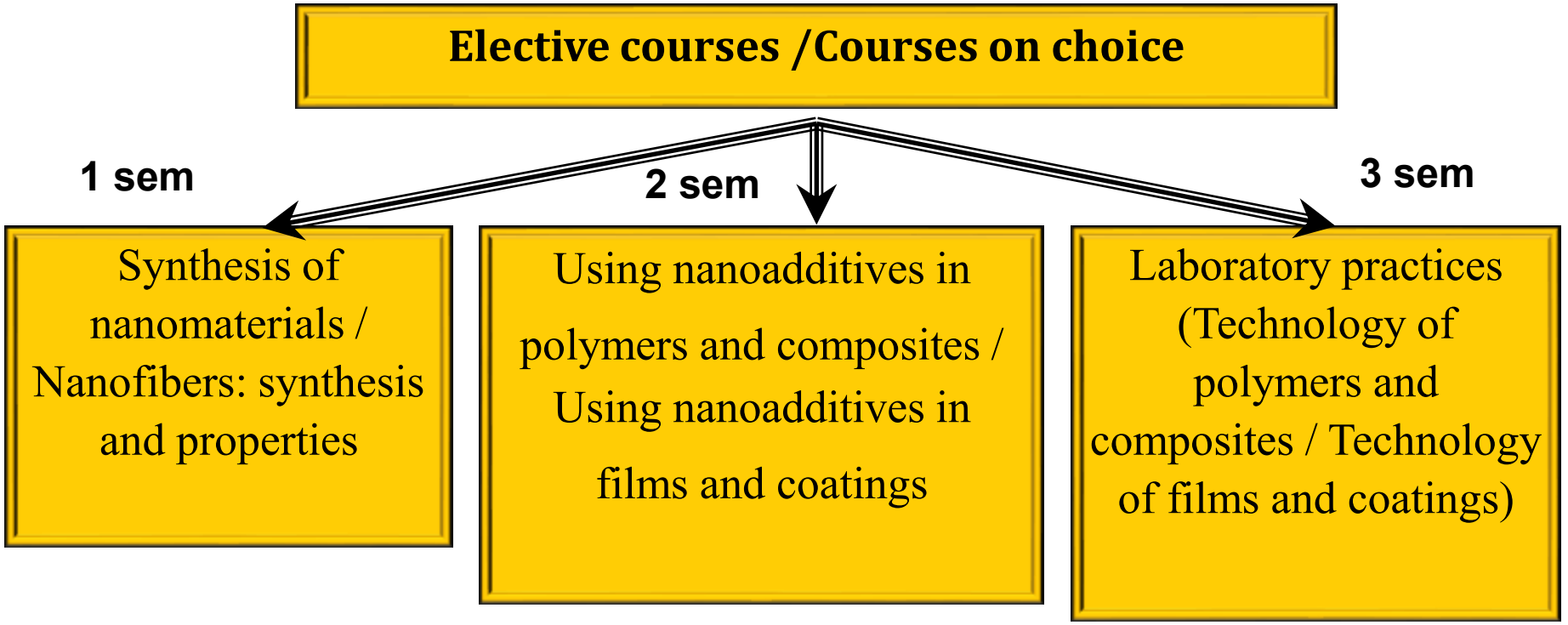
Structure of curricula "Production and processing of polymers and composites" (BSTU)



Structure of curricula "Production and processing of polymers and composites" (BSTU)



Structure of curricula "Production and processing of polymers and composites" (BSTU)



The current state of curricula preparation:

- we are waiting the approval of Educational Standards,

after this approval:

- Ministry of Education/Universities validate curricula
- Universities validate study programs of courses
- Course Lectures and Laboratory Practices with appropriate Guides will be developed

To provide lecture courses and laboratory sessions in the framework of the modernized curricula, ***the following 5 e-Books are developed*** in English/Russian languages to provide

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

Progress of e-Book "Functional nanomaterials"

Version: 24.01.2017
The course leader: Alexander FEDOTOV – BSU
http://dl.bsu.by/course/view.php?id=849

Chapters/Papers	University	Contributors	Current state
Executive summary	BSU	A. Fedotov, V. Odzhaev	In progress
Introduction	BSU	A. Fedotov, V. Odzhaev	In progress
Chapter 1: Concepts of Low-Dimensional Effects	BSU	A. Fedotov	In progress
Chapter 2: Introduction to Physics of Surface/Interface	BSU	A. Fedotov	Uploaded, Chapter 2-rus
Chapter 3: Thermal Properties of Nanomaterials	BSU	M. Tivanov	In progress
Chapter 4: Chemistry of Nanomaterials	BSU	A. Mazanik	Abstract-rus, Abstract-eng, In progress
Chapter 5: Physics of Carbon Low-dimensional Systems and Device Structures	BSU	N. Poklonski	Uploaded, Chapter 5-eng

Progress of e-Book "Functional nanomaterials"

Version: 23.10.2016
The course leader: Alexander FEDOTOV – BSU
http://dl.bsu.by/course/view.php?id=849

Chapters/Papers	University	Contributors	Current state
Chapter 6: Arrays of carbon nanostructures: fabrication, properties and applications	BSU	V. Ksenevich	Abstract-rus, Abstract-eng, In progress
Chapter 7: Conductive Polymers	BSU	V. Odzhaev	Uploaded, Chapter 7-rus
Chapter 8: Electrically conductive nano-composites	BSU	N. Gorbachuk, A. Fedotov	Abstract-rus, Abstract-eng, In progress
Chapter 9: Magnetotransport and Magnetism in Nanocomposite and Multilayered Materials	BSU	J. Fedotova, J. Kasiuk	Abstract-rus, Abstract-eng, In progress
Chapter 10: Nanoscale Materials and Structures for Spintronics	BSU	M.Lukashevich	Uploaded, Chapter 10-eng
Chapter 11: Nanomaterials for Power Engineering	BSU	A. Mazanik	Abstract-rus, Abstract-eng, In progress
Chapter 13: Fluorescent quantum dots for bioimaging	GrSU	N. Strekal	Uploaded, Chapter 13-eng

Progress of e-Book "Functional nanomaterials"

Version: 23.10.2016
The course leader: Alexander FEDOTOV – BSU
http://dl.bsu.by/course/view.php?id=849

Chapters/Papers	University	Contributors	Current state
Chapter 14: Plasmonic nanomaterials for photonics, biochemistry and quantum technology	GrSU	N. Strekal	Uploaded, Chapter 14-eng
Chapter 15: Nanofibers: synthesis, properties and applications	BSTU	N.R. Prokopchuk, Zh.S. Shashok	Uploaded, Chapter 15-rus, eng
Chapter 16: Elastomeric compositions with carbon nanomaterials	BSTU	K.V. Vishnevskii, Zh.S. Shashok	Uploaded, Chapter 16-rus, eng
Chapter 17: Paints and coatings, modified carbon nanomaterials	BSTU	N.R. Prokopchuk, A.L. Shutova	Uploaded, Chapter 17-rus, eng
Chapter 18: Plasma-chemical synthesis of nanocomposite polymer coatings	GSU	A.V. Rogachev, A.A. Rogachev, M. Yarmolenko	Abstract-rus, Abstract-eng, In progress
Chapter 19: Carbon coatings doped with metals	GSU	A.V. Rogachev, D.Pilipcov, N. Fedosenko	Uploaded, Chapter 19-rus, eng

Progress of e-Book "Functional nanomaterials"

Version: 23.10.2016
The course leader: Alexander FEDOTOV – BSU
http://dl.bsu.by/course/view.php?id=849

Chapters/Papers	University	Contributors	Current state
Chapter 20: Sol-gel synthesis of functional materials	GSU	D. Kovalenko V. Gaishun A. Semchenko	Uploaded, Chapter 20-rus
Chapter 21: Micro- and nanosensors	KU Leuven	Joan Peuteman	Uploaded, Chapter 21-eng
References	BSU		In progress

Progress of e-Book "Photonics"

Version: 23.10.2016
The course leader: Alexey TOLSTIK – BSU
http://dl.bsu.by/course/view.php?id=850

Chapters/Papers	University	Contributors	Current state
Executive summary	BSU	A.Tolstik	In progress
Introduction	BSU	A.Tolstik	In progress
Chapter 1: Laser physics	BSU	A.Tolstik	Uploaded, Chapter 1-eng
Chapter 2: Laser physics and nonlinear optics	BSU	A.Tolstik	Uploaded draft In progress
Chapter 3: Coherent Optics and Holography	BSU	A. Melnikova	Uploaded, Chapter 1-eng

Progress of e-Book "Photonics"

Version: 23.10.2016
The course leader: Alexey TOLSTIK - BSU

Chapters/Papers	University	Contributors	Current state
Chapter 4: Optoelectronics	**BSU**	**A.Tolstik**	
4.1. Physics of Condensed Matter	BSU	A. Fedotov	**Uploaded, Chapter 4.2-rus, eng**
4.2. Semiconductor optical detectors	KU Loven	J. Peuteman	**Uploaded, Chapter 4.2-eng**
4.3. Solar cells	BSU	M. Tivanov	**Abstract-rus, In progress**
4.4. Applications of photovoltaic systems	KU Loven	J. Peuteman	**Uploaded, Chapter 4.4-eng**
Chapter 5: Optical waveguides	**BSU**	**D. Gorbach**	**Uploaded Chapter 5-rus,**

Progress of e-Book "Photonics"

Version: 23.10.2016
The course leader: Alexey TOLSTIK - BSU

Chapters/Papers	University	Contributors	Current state
Chapter 6: Nanophotonics	**GrSU**	**N. Strekal**	
6.1. Quantun and classical confainment effect	GrSU	N. Strekal	**Uploaded, Chapter 6.1-eng**
6.2. Density of states and modified density of states in system of low dimensionality	GrSU	N. Strekal	**Uploaded, Chapter 6.2-eng**
6.3. Breaking through the difraction limit and near-field optics	GrSU	N. Strekal	**Uploaded, Chapter 6.3-eng**
6.4. Quantum dots and basic ideas of nanophotnic devices	GrSU	N. Strekal	**Uploaded, Chapter 6.4-eng**
6.5. Molecular electronics and photonics devices	GrSU	G. Vasilyuk	**Uploaded, Chapter 6.5-rus, eng**
6.6 Metamaterials	GSU	I. Semchenko	**Uploaded, Chapter 6.6-rus**
References	**GrSU**	**N. Strekal**	**In progress**

Problems

1. Delay of the tender procedure due to late approval of the Project by Government (October 27, 2016) and validation of the list of equipment purchasing by Ministry of Economics (December 30, 2016).

2. We had problems with the paying of visits for the team of Ministry of Education

3. **We have uncertain situation with the changes in master-level education system in close future**

Problems

SPECIALTIES FOR PREVIOS TWO-STAGE EDUCATIONAL SYSTEM "5 + 1" (since 2008)

1st stage (5 year)		2nd year (1 year)
1-31 04 01-01 Physics (scientific-research activity)		1-31 80 05 Physics
1-31 04 01-02 Physics (engineering activity)	Exams	1-31 81 01 Physics of condensed state
1-31 04 01-03 Physics (teaching activity)		1-31 81 02 Photonics
1-31 04 01-04 Physics (management activity)		1-31 81 03 Functional nanomaterials
1-31 04 01-05 Physics (nuclear physics and technologies)		1-31 81 04 Contem-porary methods and devices for physical measurements
1-31 04 01-06 Physics (physics of nanomaterials and nanotechnologies)		

Problems

SPECIALTIES FOR 2-STAGE EDUCATIONAL SYSTEM with differentiated terms of study" "5 + 1" and "4 + 2" (since 2013)

1st stage (4 years)		2nd stage (2 years)
1-31 04 01-01 Physics (scientific-research activity)	Exams	1-31 80 05 Physics
1-31 04 01-03 Physics (teaching activity)		1-31 81 01 Physics of condensed state
1-31 04 01-04 Physics (management activity)		1-31 81 02 Photonics
		1-31 81 03 Functional nanomaterials
		1-31 81 04 Contemporary methods and devices for physical measurements

1st stage (5 or 5,5 years)		2nd stage (1 year)
1-31 04 01-01 Physics (scientific-research activity)	Exams	1-31 80 05 Physics
1-31 04 01-05 Physics (nuclear physics and technologies)		1-31 81 01 Physics of condensed state
1-31 04 01-06 Physics (physics of nanomaterials and nanotechnologies)		1-31 81 02 Photonics
1-31 04 08 Computer physics		1-31 81 03 Functional nanomaterials
		1-31 81 04 Contemporary methods and devices for physical measurements

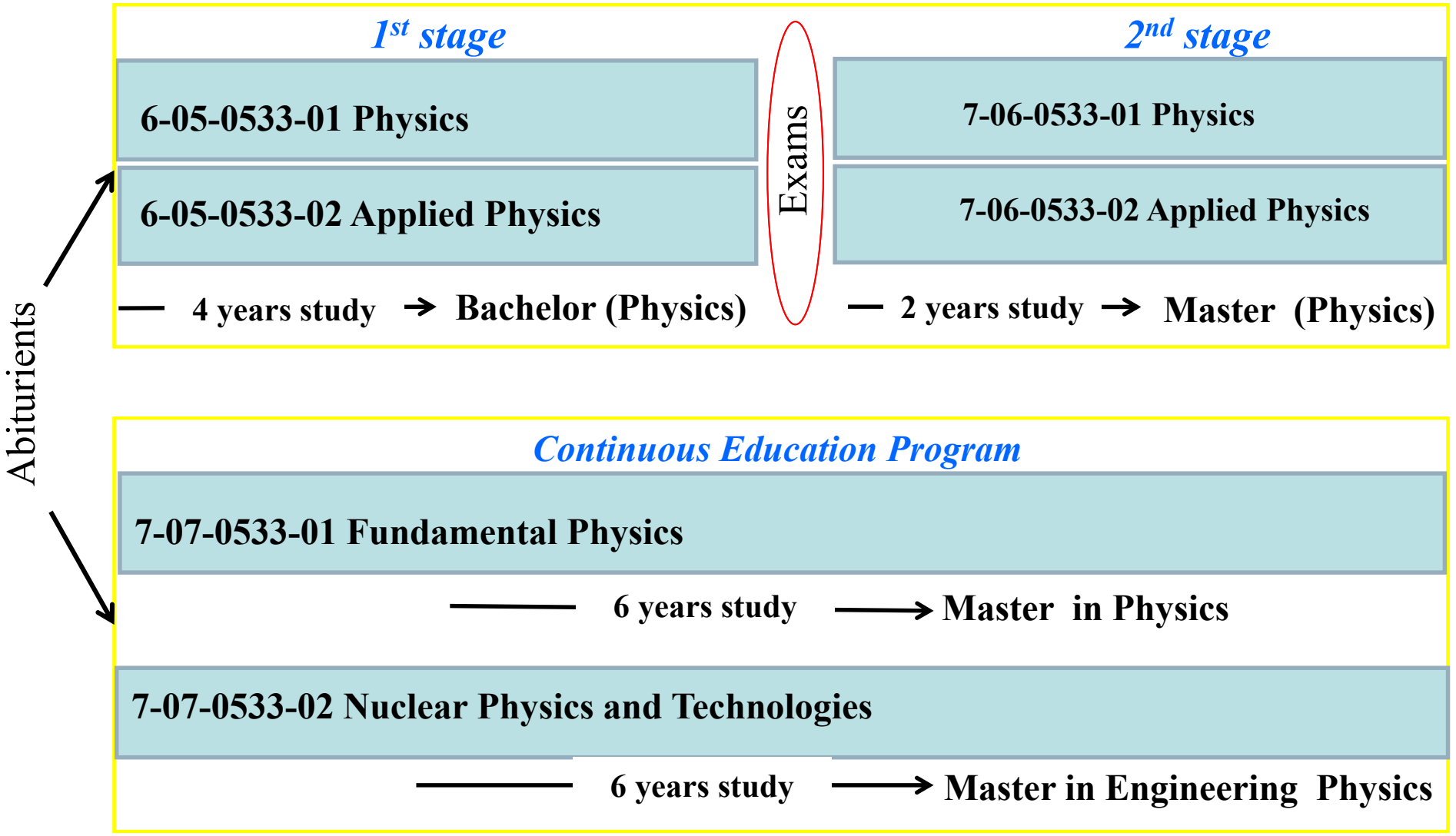
We are waiting the validation of

EDUCATIONAL ACT (STATUT)

by Belarusian Parliament

Problems

SPECIALTIES FOR 2-STAGE EDUCATIONAL SYSTEM with differentiated terms of study: “6” and “4 + 2” (since 2018)



The last type of curricula will be based on 3 principles:

- **Dependence on education profile**
- **Modular structure**
- **Principle of single competence for every Module**

Education profiles for specialty “PHYSICS”:

- Bio-physics and bio-engineering
- Photonics
- Computer physics
- Physics of condensed state

Education profiles for specialty

“APPLIED PHYSICS”:

- Energy effective technologies and materials
- Physics of nanomaterials and nanotechnologies
- Laser physics

Demands to the curricula:

1.The maximum amount of classroom time - not more than 32 hours a week

2.The maximum amount of teaching load - no more than 54 hours of work per week

3.The amount of independent work in each academic discipline - at least 50 % of study time

Demands to the curricula:

4. The educational process is built on a modular principle.

5. The complexity of each discipline/module should be at least 3/6 credits.

6. The module is studied for 1 semester (in the extreme case – 2 semesters)

7. The curriculum provides courses on choice in the amount of not less than 15 % of the total volume of theoretical (lecture) training.

This reconstruction of educational process results in the following:

- **More long continuation of transition state of our Educational Systems**
- **We shall be forced to tune our testing procedures in close future**

Next steps

1. Reviewing of curricula by non-governmetal and associated Partners (BPS, RANI, RI for NP, Lotis)

2. Development of study programs by curricula disciplines (courses) – template of programs was developed and sent to the teams

3. Reviewing of study programs by non-govrenmetal and associated Partners (BPS, RANI, RI for NP, Lotis)

Template of study programs

Belarusian State University — Faculty of Physics

BSU Master Course "Physics and Chemistry of Surface"

Faculty of Physics

General data

Code	
Course title	Physics and Chemistry of Surface
Course status in the programme	Compulsory
Course level	Master Studies
Course type	Academic
Field of study	Specialty "Functional Nanomaterials"
Responsible instructor	Alexander K. Fedotov
Academic staff	Alexander Mazanik Alexander S. Fedotov
Volume of the course: parts and hours	1 part, 42 academic hours
Language of instruction	RU
Possibility of distance learning	Planned
Abstract	This course describes atomic and electronic structure of surfaces/interfaces; thermodynamics of surfaces/interfaces; physical/chemical processes at real surfaces/interfaces; influence of surfaces/interfaces on the formation of properties of solid materials and multilayered devices; methods of clean surfaces preparation; methods for surfaces/interfaces characterization.
Goals and objectives of the course in terms of competences and skills	To demonstrate to master-students the fundamental ideas and physical/chemical principles of description and forming clean surfaces/interfaces in crystalline solids; to give knowledge of their atomic and electronic structure; to learn the main physical/chemical processes that determine real structure of surfaces/interfaces in crystalline solids and electronic devices on their base; to describe a role of surfaces/interfaces in the formation of properties of functional nanomaterials and low-dimensional solid-state devices; to get main competences and skills in the preparation and experimental study of surfaces/interfaces in functional nanomaterials and devices on their base.
Structure and tasks of independent studies	At home must be prepared 15 tests and written 1 essay from 8 main parts of the course within the framework of Controlled Independent Work (CIW) of students
Recommended literature	A.K. Fedotov. Physical Material Science. Part 1. Solid State Physics. Minsk, Hizh Education School, 2010, 400 pp.; The e-books "Functional nanomaterials", Chapter 2, 2016; Fistul V.I. Physics and Chemistry of Solids. Parts 1 at 2. Moscow, Metallurgy, 1995, 543 pp.
Course prerequisites	Fundamentals of general physics and mathematics, quantum mechanics, thermal dynamics, statistical physics, electrodynamics, electric engineering, electronic devices
Courses acquired before	Basics of material sciences and solid-state devices

Course outline

Theme	Hours
Lectures	
1. Introduction to the subject. The external and internal surfaces in solids. Ideal and non-ideal surfaces in solids. The role of the surface in a variety of physical and chemical processes. The phenomena of wetting and spreading. Inhomogeneous surfaces: physical, chemical and induced inhomogeneities. A role of external and internal surfaces in the physics and chemistry of nanosystems.	2
2. Atomically clean surfaces. Thermodynamics of atomically clean surfaces. Surface tension and surface stresses. The anisotropy of the surface tension. Surface melting.	2
The ideal crystal surface. The surface in the macroscopic and microscopic sense. Atomic structure of the ideal crystal surface. The nature of chemical bonds at the surface of solids. Relaxed and reconstructed surfaces. The symmetry properties of the relaxed and reconstructed surfaces. Crystallographic methods to describe the relaxed and reconstructed surfaces. Structural defects at the atomically clean surfaces. Experimental data on the atomic structure of the surface in semiconducting and metallic materials.	2
3. Dynamics of atoms at atomically clean crystalline surfaces The vibrations of atoms near the surface. Analysis of the vibrational spectrum of the atoms in the atomically-clean surface. Experimental data on the vibrations of surface atoms. The thermal expansion of the surface lattices. Effect of atomic vibrations at the surface on the properties of solids.	2
4. Band model of the atomically clean surfaces in crystals. The electronic structure of the surface in solids. "Jelly" model. The one-dimensional band theory. Three-dimensional band theory. Electron emission and surface ionization. Electronic structure of semiconductor surfaces. Surface levels and band bending in semiconductors. A phenomenological description of the surface in semiconductors. Zone diagrammns. The main characteristics of the space charge region (SCR) in thermodynamically equilibrium and non-equilibrium conditions. SCR charge. An excess of free charge carriers in the SCR.	2
Tamm and Shockley surface states in semiconductors. Fluctuations in the surface potential. Admittance of surface states. Electrophysical characteristics of the SCR at the surface. Surface photo-emf. Electrophysical dimensional effects in SCR. Processes of eelectron transfer in SCR. The effective electron mobility in the SCR. The main mechanisms of influence of surface on electron phenomena in semiconductors. Electron transfer processes in thin films. Influence of surface scattering on charge carriers transport phenomena. The diffuse and specular scattering. Surface scattering mechanisms.	2

Belarusian State University — Faculty of Physics

5. The actual surface. Physical adsorption. The thermodynamic approach. The forces acting upon adsorption. The simplest of the adsorption isotherms. Langmuir adsorption isotherm. Isoterm polymolecular adsorption. Adsorption from the liquid phase. The changes in the properties of solids due to adsorption. A role of adsorbed atoms in the formation of surface structures. Electronic structure of surfaces with adsorbates. Vibrations of adsorbed atoms. Experimental methods for the study of adsorption.	2
Chemisorption on metals and semiconductors. The structure of the surface at the crystal due to chemisorption. Phase transitions. The impact of external influences on phase transitions at the surface. The electronic structure of the surface in metals and semiconductors due to chemisorption. Schottky barrier and band shifts.	2
Surface diffusion. The reactions at the surfaces. The influence of external impacts on the surface phase transitions.	2
6. The internal boundaries (interface). The atomic structure of interfaces: the grain boundaries in polycrystals and bicrystals, interphase boundaries. Electronic structure of interfaces in the structures metal-semiconductor, metal-insulator, semiconductor-dielectric, superlattices and others. Transport of charge carriers in the vicinity of the interface. Energy diagrams of Schottky barriers and MIS structures. The electrical neutrality equation. The capacity and the current-voltage characteristics. The potential fluctuations. Admittance of the states at the interface.	2
7. Methods for the preparation of atomically-clean surfaces. Experimental methods for the creation of clean surfaces. Methods for preliminary surface cleaning. Methods with vacuum cleaning: thermal desorption, ion etching, catalytic reactions, sputtering, cleavage.	2
8. Methods of studying the structure of the surface and interface. Methods of studying the chemical composition, atomic structure and atomic dynamics at the surface. Auger electron spectroscopy. X-ray photoelectron spectroscopy. Mass spectroscopy of secondary ions. Rutherford back-scattering. IR spectroscopy. Raman spectroscopy. Thermic-stimulated desorption. Ellipsometry. Electron microscopy. Difraction of slow electrons. Scanning tunneling microscopy. Atomic force microscopy. Electronic spectroscopy of characteristic losses.	2
Electrophysical methods for the study of surface states in semiconductors. Measurement of surface conductivity. Electroreflection. The field effect. Measurement of surface photo-emf. Measurement of the double layer capacitance. The work function measurement: a diode, a capacitor, photoemission. Field methods.	2

Learning outcomes and assessment

Learning outcomes	Assessment methods
To understand the basic ideas and approaches to manufacturing and characterization of atomically-clean surfaces	Ability to solve corresponding problems
To understand main physical and chemical processes, proceeding at real surfaces/interfaces and controlling their properties	Ability to solve corresponding problems
To understand the mechanisms of surface/interface influences on functional properties of nanomaterials and device structures	Ability to solve corresponding problems
To be able to execute 15 short tests by 15 lectures (consisting of 5 questions every)	To give the right answers on 4 of 5 questions
To be able to execute 8 written tests (consisting of 3 questions every)	To give the right answers on 2 of 3 questions
At home must be done 1 essay	Successfully written home essay

Study subject structure

Part	Semester		Hours per semester			Tests				CIW
	Autumn	Spring	Lectures	Practical	Lab.	Short test	Written test	Essay	Exam	
1	+	-	34	-	-	+	+	-	+	8

Next steps

4. Development of lectures, their synopsises and presentations to provide the testing procedure

5. Signing of the partner`s agreements with EU and Belarusian universities

6. Claim of tender for purchasing of equipment and hardware/software

7. Development of laboratory practices on the base of purchased equipment

8. Development guides for laboratory sessions to provide the testing procedure

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.

Thank you for attention

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