



National Research University Higher School of Economics (HSE)

Basic Curriculum

Field of study 03.03.02 Physics

Educational Programme "Physics"

Specializations: "Condensed Matter Physics", "Low Temperature Physics", "Nanoelectronics and Photonics", "Quantum Optics and Nanophotonics", "Quantum Technologies", "Space Physics", "The Teaching of Modern Physics", "Theoretical Physics"

Implementing unit: Faculty of Physics, HSE - Moscow

APPROVED

24.05.2022

Vice Rector

ROSHCHIN S.Y.

Signed with EDS

Years of Study: 2022/2023 - 2025/2026

Length of Programme: 4 years

Mode of Study: Full Time

Degree: Bachelor's degree

Block Code	Course	Subject type	Credits	Credits by Years				Planned Educational Programme Development Results
				1	2	3	4	
	Degree Programme		240,00	60,00	60,00	60,00	60,00	
	Major		156,00	47,00	30,00	46,00	33,00	
	Core Professional Block (Major)		104,00	47,00	30,00	21,00	6,00	
1	Chemistry for Physicists	C	4,00		4,00			GPC-3, PC-3, UC-1, UC-2
2	Optics	C	4,00		4,00			GPC-2, PC-3, PC-6, UC-1, UC-3
3	Field Theory	C	3,00		3,00			GPC-3, PC-4, PC-5, UC-1, UC-3
4	Quantum Mechanics	C	6,00		3,00	3,00		GPC-3, PC-2, UC-1, UC-3
5	Probability Theory	C	3,00		3,00			PC-2, UC-1, UC-3
6	Theory of Complex Functions	C	4,00		4,00			UC-1, UC-3
7	Thermodynamics and Molecular Physics	C	3,00		3,00			PC-1, PC-2, UC-1, UC-3
8	Mathematical Physics	C	3,00		3,00			GPC-3, PC-5, UC-1, UC-3
9	Computational mathematics for physicists	C	3,00			3,00		PC-2, UC-1, UC-3
10	Statistical Physics	C	3,00			3,00		PC-3, PC-6, UC-1, UC-3
11	Fundamentals of Modern Physics: Quantum Microphysics	C	3,00			3,00		PC-1, PC-2, UC-1
12	Modern Physics: Introduction to Solid State Physics	C	3,00			3,00		PC-1, PC-2, UC-1, UC-3
13	Basics of Modern Physics: Introduction to Molecular Biology	C	3,00			3,00		PC-1, PC-2, UC-1, UC-3
14	Modern Physics: Introduction to Astrophysics	C	3,00			3,00		PC-1, PC-2, UC-1, UC-3
15	Electrodynamics of Condensed Matter (offered in a foreign language)	C	3,00				3,00	PC-2, PC-6, UC-1, UC-3
16	Mechanics of Continuous Media	C	3,00				3,00	PC-1, PC-2, UC-1, UC-3
17	Computer Science	C	3,00	3,00				GPC-3, UC-1, UC-3
18	Introduction into Python	C	3,00	3,00				PC-1, PC-6, UC-1, UC-3

19	Analytical Approximation Methods	C	4,00	4,00				GPC-3, PC-4, PC-6, UC-1, UC-3
20	Differential Equations	C	4,00	4,00				GPC-2, PC-1, UC-1, UC-3
21	Linear Algebra	C	4,00	4,00				PC-1, PC-5, UC-1, UC-3
22	Elements of Mathematical Methods of Physics	C	4,00	4,00				GPC-1, PC-1, PC-4, UC-1, UC-3
23	Mechanics	C	5,00	5,00				GPC-1, PC-2, UC-1, UC-3
24	Electricity and Magnetism	C	5,00	5,00				GPC-2, PC-3, PC-6, UC-1, UC-3
25	Analytical Mechanics	C	5,00	5,00				PC-4, UC-1, UC-3
26	Calculus	C	13,00	10,00	3,00			GPC-2, PC-2, UC-1, UC-2
	Elective Professional Block (Major)		52,00			25,00	27,00	
	Research seminar		9,00			9,00		
	Specialization "Teaching of modern physics"		5,00			5,00		
1	Project Seminar "Pedagogical Workshop"	C	5,00			5,00		GPC-1, GPC-2, PC-1, PC-2, UC-1, UC-3, UC-4, UC-8
	Research seminar "Condensed matter physics"		9,00			9,00		
1	Research Seminar: High Vacuum Equipment and Thin Film Deposition Technologies	C	3,00			3,00		GPC-2, PC-1, PC-4, PC-6, UC-5, UC-6, UC-8, UC-9
2	Research Seminar: X-Ray and Electron-Microscopic Workshops	C	3,00			3,00		GPC-2, PC-1, PC-4, PC-6, UC-5, UC-6, UC-8, UC-9
3	Research Seminar: Techniques for Physics Experiments	C	3,00			3,00		GPC-2, PC-1, PC-4, PC-6, UC-5, UC-6, UC-8, UC-9
	Research seminar "Theoretical physics"		9,00			9,00		
1	Research Seminar: Langevin Dynamics and Kinetic of Equilibrium and Non-Equilibrium Systems	C	4,00			4,00		GPC-2, PC-1, PC-4, PC-6, UC-5, UC-6, UC-8, UC-9
2	Research Seminar: Nonlinear Wave Processes	C	5,00			5,00		GPC-2, PC-1, PC-4, UC-5, UC-6, UC-8, UC-9
	Research seminar "Quantum technologies"		9,00			9,00		
1	Research Seminar "Electron Spectroscopy and Diffraction"	C	4,00			4,00		GPC-2, PC-1, PC-4, PC-6, UC-5, UC-6, UC-8, UC-9
2	Research Seminar "Fiber Optics"	C	5,00			5,00		GPC-2, PC-1, PC-4, PC-6, UC-5, UC-6, UC-8, UC-9
	Research seminar "Nanoelectronics and photonics"		9,00			9,00		
1	Research Seminar "Modern Methods of Electrophysical Measurements"	C	4,00			4,00		GPC-2, PC-1, PC-4, PC-6, UC-5, UC-6, UC-8, UC-9
2	Research Seminar "Spin-photonics"	C	5,00			5,00		GPC-2, PC-1, PC-4, PC-6, UC-5, UC-6, UC-8, UC-9
	Research seminar "Space physics"		9,00			9,00		
1	Research Seminar "Seminar on scientific literature"	C	9,00			9,00		GPC-2, PC-1, PC-4, UC-5, UC-6, UC-8, UC-9
	Research seminar "Low-temperature physics"		9,00			9,00		
1	Research Seminar: Test and Measurements	C	3,00			3,00		GPC-2, PC-2, UC-2
2	Research Seminar: Basics of Low Temperature Physics	C	3,00			3,00		GPC-2, PC-1, PC-4, PC-6, UC-5, UC-6, UC-8, UC-9
3	Research Seminar: Practical Training on Low Temperature Physics	C	3,00			3,00		GPC-2, PC-1, PC-4, UC-5, UC-6, UC-8, UC-9

	Research seminar "Quantum optics and nanophotonics"		9,00			9,00	
1	Research Seminar: Laboratory Works. Part 2	C	4,00			4,00	GPC-2, PC-1, PC-4, PC-6, UC-5, UC-6, UC-8, UC-9
2	Research Seminar: Laboratory Works. Part 1	C	5,00			5,00	GPC-2, PC-1, PC-4, PC-6, UC-5, UC-6, UC-8, UC-9
	Вариативная часть, в т.ч. дисциплины по выбору студента		13,00			13,00	
	Optional specialized part "Quantum optics and nanophotonics"		13,00			13,00	
1	Quantum Optics and Photonics. Part 1	C	3,00			3,00	GPC-3, PC-6, UC-2
2	Quantum Optics and Photonics. Part 2	C	4,00			4,00	GPC-3, PC-6, UC-2
3	Experimental Methods of Modern Quantum Optics	C	3,00			3,00	GPC-2, PC-2, UC-1, UC-2
4	Experimental Methods of Classical Spectroscopy	C	3,00			3,00	GPC-2, PC-2, UC-1
	Optional specialized part "Quantum technologies"		13,00			13,00	
1	Introduction to the classical theory of information	C	3,00			3,00	GPC-3, PC-5, PC-6, UC-2
2	Symmetry and Group Theory in Physics	C	3,00			3,00	GPC-3, PC-5, UC-2
3	Advanced solid state physics	C	4,00			4,00	GPC-3, PC-2, UC-5, UC-6
4	Introduction to the quantum theory of information	C	3,00			3,00	GPC-3, PC-5, PC-6, UC-2
	Optional specialized part "Nanoelectronics and photonics"		13,00			13,00	
1	Advanced solid state physics	C	4,00			4,00	GPC-3, PC-5, PC-6, UC-2
2	Nanomagnetism and Spintronics	C	3,00			3,00	GPC-3, PC-5, PC-6, UC-2
3	Basics of Magnetism	C	3,00			3,00	GPC-3, PC-5, PC-6, UC-2
4	Symmetry and Group Theory in Physics	C	3,00			3,00	GPC-3, PC-5, PC-6, UC-2
	Optional specialized part "Theoretical physics"		13,00			13,00	
1	Advanced Topics in Mathematical Physics	C	3,00			3,00	GPC-3, PC-5, PC-6, UC-2
2	Functional Integration in the Theory of Classical Chaotic Systems	C	4,00			4,00	GPC-3, PC-5, PC-6, UC-2
3	Low Temperature Magnetism	C	3,00			3,00	GPC-3, PC-2, PC-4, PC-5, UC-2
4	Stochastic processes and modeling in physics	C	3,00			3,00	GPC-3, PC-2, PC-4, PC-5, UC-2
	Optional specialized part "condensed matter physics"		13,00			13,00	
1	Introduction to Surface Physics	C	3,00			3,00	PC-4, UC-1, UC-2, UC-3
2	Diffraction Methods for Studying the Real Structure of Crystals	C	4,00			4,00	PC-6, UC-1, UC-2, UC-3
3	Electronic Dispersion Laws in Solids	C	3,00			3,00	PC-4, UC-1, UC-2, UC-3
4	Low Temperature Magnetism	C	3,00			3,00	GPC-3, PC-2, PC-4, PC-5, UC-2
	Optional specialized part "Space physics"		13,00			13,00	
1	Solar System and Planets of Other Stars	C	3,00			3,00	GPC-2, PC-4, UC-1, UC-2, UC-3
2	Introduction in Plasma Physics	C	4,00			4,00	GPC-2, PC-4, UC-1, UC-2, UC-3
3	Fundamentals of the Kinetic Theory of Gases	C	3,00			3,00	GPC-2, PC-4, UC-1, UC-2
4	Fundamentals of Space Gas Dynamics	C	3,00			3,00	GPC-2, PC-4, UC-1, UC-2, UC-3
	Optional specialized part "Low-temperature physics"		13,00			13,00	

1	Selected Topics of Thermodynamics and Statistical Physics. Part 1	C	5,00			5,00		GPC-2, PC-4, UC-1, UC-2, UC-3
2	Selected Topics of Thermodynamics and Statistical Physics. Part 2	C	5,00			5,00		GPC-2, PC-4, UC-1, UC-2, UC-3
3	Low Temperature Magnetism	C	3,00			3,00		GPC-3, PC-2, PC-4, UC-2
	Specialization "Teaching of modern physics"		13,00			13,00		
1	Modern Methods of Teaching Physics at School	C	4,00			4,00		GPC-1, PC-6, UC-1, UC-11, UC-3, UC-4
2	Fundamentals of Instructional Design	C	3,00			3,00		GPC-3, PC-6, UC-11, UC-8
3	Human Development and Education	C	6,00			6,00		GPC-1, PC-4, UC-11, UC-2, UC-3
	Вариативная часть, в т.ч. дисциплины по выбору студента		27,00				27,00	
	Optional specialized part "Quantum optics and nanophotonics"		27,00				27,00	
1	Fundamentals of Modern Optics	C	7,00				7,00	GPC-1, PC-2, PC-3, PC-6, UC-2
2	Atomic and Molecular Spectroscopy	C	6,00				6,00	GPC-1, PC-2, PC-3, PC-6, UC-2
3	Laser Physics	C	7,00				7,00	GPC-1, PC-2, PC-3, PC-6, UC-2
4	Introduction to Nonlinear Physics and Solid-state Spectroscopy	C	7,00				7,00	GPC-1, PC-2, PC-3, PC-6, UC-2
	Optional specialized part "Quantum technologies"		27,00				27,00	
1	Quantum Cryptography	C	5,00				5,00	GPC-1, PC-2, PC-3, PC-6, UC-2
2	Quantum optics	C	3,00				3,00	GPC-1, PC-2, PC-3, PC-6, UC-2
3	Quantum Materials	C	6,00				6,00	GPC-1, PC-2, PC-3, PC-6, UC-2
4	Computer Simulation of Multiatomic Systems	C	3,00				3,00	GPC-1, PC-3, PC-6, UC-2
5	Fundamentals of Quantum Computing	C	4,00				4,00	GPC-1, PC-2, PC-3, PC-6, UC-2
6	Physical Basis for Quantum Information	C	6,00				6,00	GPC-1, PC-2, UC-1
	Optional specialized part "Nanoelectronics and photonics"		27,00				27,00	
1	Methods for Multielectronic System Simulation	C	4,00				4,00	GPC-1, PC-2, PC-3, PC-6, UC-2
2	Basis of Surface Science	C	3,00				3,00	GPC-1, PC-2, PC-3, PC-6, UC-2
3	Applied Photonics and Fiber Optics	C	6,00				6,00	GPC-1, PC-2, PC-3, PC-6, UC-2
4	Physics of Metals and Electronic Phenomena	C	9,00				9,00	GPC-1, PC-2, PC-3, PC-6, UC-2
5	Many Electron System Simulation Methods	C	5,00				5,00	GPC-1, PC-2, PC-3, PC-6, UC-2
	Optional specialized part "condensed matter physics"		27,00				27,00	
1	Introduction to Materials Science	C	5,00				5,00	GPC-1, PC-2, PC-3, PC-6, UC-2
2	Structure of Real Crystals	C	5,00				5,00	GPC-1, PC-2, PC-3, PC-6, UC-2
3	Phase Diagrams of Multicomponent Systems	C	6,00				6,00	GPC-1, PC-2, PC-3, PC-6, UC-2
4	Physics of partially ordered media	C	5,00				5,00	GPC-1, PC-2, PC-3, PC-6, UC-2
5	Electronic Properties of Solids	C	3,00				3,00	GPC-1, PC-2, PC-3, PC-6, UC-2
6	Electronic Transport in Hybrid Nanostructures	C	3,00				3,00	GPC-1, PC-2, PC-3, PC-6, UC-2
	Optional specialized part "Space physics"		27,00				27,00	
1	Statistical Analysis of Space Experiment Data	C	8,00				8,00	GPC-1, PC-1, PC-3, PC-6, UC-2
2	Introduction to High-energy Astrophysics	C	10,00				10,00	GPC-1, PC-2, PC-3, PC-6, UC-2
3	Fundamentals of Gas Dynamics and Numerical Modeling in Gas Dynamics	C	9,00				9,00	GPC-1, PC-2, PC-3, PC-6, UC-2

	Optional specialized part "Low-temperature physics"		27,00				27,00	
1	Low Temperature Physics	C	10,00				10,00	GPC-1, PC-2, PC-3, PC-6, UC-2
2	Superconductivity	C	8,00				8,00	GPC-1, PC-2, PC-3, PC-6, UC-2
3	Physics of Metals and Electronic Phenomena	C	9,00				9,00	GPC-1, PC-2, PC-3, PC-6, UC-2
	Вариативная часть. Блок 1		3,00			3,00		
1	Actual problems of modern physics (offered in a foreign language)	C	3,00			3,00		GPC-2, PC-2, PC-3, UC-1, UC-2, UC-9
	Internship		42,00	8,00	11,00	4,00	19,00	
	Professional Internship		5,00				5,00	
1	Teaching Internship	E	4,00			4,00		PC-1, PC-6, UC-2
2	Science and Research Internship	C	5,00				5,00	GPC-2, GPC-3, PC-4, PC-5, UC-1, UC-2
	Project Internship		4,00			4,00		
1	Electronic Methods in Physics	E	4,00			4,00		GPC-3, PC-2, UC-2
2	Laboratory Work on Modern Physics	E	4,00			4,00		GPC-1, GPC-2, PC-1, PC-2, UC-1, UC-3, UC-4, UC-8
	Research Internship		33,00	8,00	11,00		14,00	
1	Preparation of Graduation Thesis	C	8,00				8,00	GPC-1, GPC-2, GPC-3, PC-1, PC-10, PC-2, PC-3, PC-4, PC-5, PC-6, PC-7, PC-8, PC-9, UC-1, UC-10, UC-11, UC-2, UC-3, UC-4, UC-5, UC-6, UC-7, UC-8, UC-9
2	Laboratory Work on Mechanics	C	4,00	4,00				GPC-1, GPC-2, PC-1, PC-2, PC-3, UC-4, UC-7
3	Laboratory Work on Electricity and Magnetism	C	4,00	4,00				GPC-2, GPC-3, PC-1, PC-2, PC-3, UC-4, UC-7
4	Laboratory Work in Optics	C	4,00		4,00			GPC-1, GPC-2, PC-1, PC-2, PC-3, UC-4, UC-7
5	Laboratory Work on Thermodynamics and Molecular Physics	C	4,00		4,00			GPC-1, GPC-2, GPC-3, PC-1, PC-2, UC-4, UC-7
6	Educational Internship	C	3,00		3,00			GPC-1, GPC-2, PC-4, PC-5
7	Research project	C	6,00				6,00	GPC-1, GPC-3, PC-1, PC-6
	General Courses		14,00	5,00	5,00		4,00	
	Core General Courses		2,00	1,00	1,00			
1	Safe Living Basics	C	1,00	1,00				GPC-3, UC-1
2	Physical Training	C	1,00		1,00			UC-7, UC-8
	Optional General Courses		12,00	4,00	4,00		4,00	
1	Legal Literacy	C	4,00		4,00			GPC-3, PC-1, UC-1, UC-2
2	Economics	C	4,00				4,00	GPC-3, PC-8, PC-9
3	Elective General Courses	E	4,00	4,00				GPC-3, UC-1, UC-2
	Minor		20,00		10,00	10,00		
1	Minor	C	20,00		10,00	10,00		GPC-3, PC-1, UC-1
	English		1,00				1,00	
	Examinations		1,00				1,00	

1	Independent English Exam (offered in a foreign language)	C						UC-4, UC-5
2	Project Proposal (offered in a foreign language)	C	1,00				1,00	GPC-1, GPC-2, UC-1, UC-4
3	English Language Integrative Exam (offered in a foreign language)	C						UC-1, UC-4
	Optional Courses							
1	Academic Writing (English) (offered in a foreign language)	O	2,00				2,00	GPC-3, PC-3
2	English Language (offered in a foreign language)	O	14,00	8,00	6,00			GPC-3, UC-4
	Data Culture		4,00		4,00			
1	Processing and Data Analysis in Physics	C	3,00		3,00			GPC-3, PC-4, UC-1, UC-3
2	Independent Data Science Test. Intermediate	C	1,00		1,00			GPC-2, GPC-3, UC-1
3	Independent Programming Test. Intermediate	C						GPC-3, UC-1
4	External Examinations on Digital Skills. Entry-level	C						GPC-3
5	External Examinations on Digital Skills. Intermediate Level	C						GPC-3
6	External Examinations on Digital Skills. Final Level	C						GPC-3
7	Independent Digital Literacy Test	C						GPC-2, GPC-3, UC-1
	Final State Certification (FSC)		3,00				3,00	
	Thesis Work		3,00				3,00	
1	Presenting of Graduation Thesis	C	3,00				3,00	GPC-1, GPC-2, GPC-3, PC-1, PC-10, PC-2, PC-3, PC-4, PC-5, PC-6, PC-7, PC-8, PC-9, UC-1, UC-10, UC-11, UC-2, UC-3, UC-4, UC-5, UC-6, UC-7, UC-8, UC-9

Curriculum agreed:

Academic Supervisor	Кунцевич А.Ю.	19.05.2022
Dean	TRUNIN M.R.	19.05.2022
Head of Centre for Educational Model Design	LEPESHKIN I.A.	20.05.2022

* Subject type:

Compulsory course	C
Elective course	E
Optional course	O