



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
07.07.2021
Vice Rector
ROSHCHIN S.Y.
Signed with EDS

Years of Study: 2021/2022 - 2024/2025

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		162,00	47,00	33,00	46,00	36,00	
	Core Professional Block (Major)		110,00	47,00	33,00	21,00	9,00	
	Subject Areas		110,00	47,00	33,00	21,00	9,00	
	General Physics		40,00	10,00	9,00	12,00	9,00	
1	Basics of Modern Physics: Introduction to Molecular Biology	C	3,00			3,00		PC-1, PC-2, UC-1, UC-3
2	Fundamentals of Modern Physics: Quantum Microphysics	C	3,00			3,00		PC-1, PC-2, UC-1, UC-3
3	Introduction to Physics of Continuous Media	C	5,00				5,00	PC-1, PC-2, UC-1, UC-3
4	Electrodynamics of Condensed Matter (offered in a foreign language)	C	4,00				4,00	PC-2, PC-6, UC-1, UC-3
5	Chemistry for Physicists	C	3,00		3,00			GPC-3, PC-3, UC-1, UC-2
6	Modern Physics: Introduction to Astrophysics	C	3,00			3,00		PC-1, PC-2, UC-1, UC-3
7	Modern Physics: Introduction to Solid State Physics	C	3,00			3,00		PC-1, PC-2, UC-1, UC-3
8	Mechanics	C	5,00	5,00				GPC-1, PC-2, UC-1, UC-3
9	Thermodynamics and Molecular Physics	C	3,00		3,00			GPC-1, PC-2, UC-1, UC-3
10	Optics	C	3,00		3,00			GPC-2, PC-3, PC-6, UC-1, UC-3
11	Electricity and Magnetism	C	5,00	5,00				GPC-2, PC-3, PC-6, UC-1, UC-3
	Theoretical Physics		17,00	5,00	6,00	6,00		
1	Statistical Physics	C	3,00			3,00		PC-3, PC-6, UC-1, UC-3
2	Field Theory	C	3,00		3,00			GPC-3, PC-4, PC-5, UC-1, UC-3
3	Quantum Mechanics	C	6,00		3,00	3,00		GPC-3, PC-2, UC-1, UC-3

4	Analytical Mechanics	C	5,00	5,00				PC-4, UC-1, UC-3
	Mathematics		41,00	26,00	15,00			
1	Probability Theory	C	3,00		3,00			PC-2, UC-1, UC-3
2	Calculus	C	14,00	10,00	4,00			GPC-2, PC-3, UC-1, UC-3
3	Linear Algebra	C	4,00	4,00				GPC-2, PC-2, UC-1, UC-3
4	Mathematical Physics	C	5,00		5,00			GPC-3, PC-5, UC-1, UC-3
5	Theory of Complex Functions	C	3,00		3,00			UC-1, UC-3
6	Analytical Approximation Methods	C	4,00	4,00				GPC-3, PC-4, UC-1, UC-3
7	Elements of Mathematical Methods of Physics	C	4,00	4,00				PC-1, PC-4, UC-1, UC-3
8	Differential Equations	C	4,00	4,00				GPC-2, PC-3, UC-1, UC-3
	Computational Physics		12,00	6,00	3,00	3,00		
1	Computational mathematics for physicists	C	3,00			3,00		PC-2, UC-1, UC-3
2	Computational Physics	C	3,00		3,00			GPC-4, GPC-6, PC-2, UC-1, UC-3
3	Computer Science	C	3,00	3,00				PC-3, UC-1, UC-3
4	Introduction into Python	C	3,00	3,00				UC-1, UC-2
	Elective Professional Block (Major)		52,00			25,00	27,00	
	Research seminar		9,00			9,00		
	Научно-исследовательские семинары		9,00			9,00		
	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
	Research seminar "Quantum technologies"		9,00			9,00		
1	Research Seminar "Local Probe Microscopy"	C	4,00			4,00		GPC-2, PC-1, PC-4, PC-6, UC-5, UC-6, UC-8, UC-9
2	Research Seminar: Introduction to Laser Spectroscopy	C	5,00			5,00		GPC-1, PC-2, UC-1, UC-2
	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, UC-5, UC-6, UC-8, UC-9
	Research seminar "Condensed matter physics"		9,00			9,00		
1	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
2	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
3	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
	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, PC-6, UC-5, UC-6, UC-8, UC-9
	Seminar		5,00		5,00		
1	Project Seminar "Pedagogical Workshop"	C	5,00		5,00		GPC-6, GPC-8, PC-1, UC-1, UC-4
	Научно-исследовательский семинар для специализации "Физика космоса"		9,00		9,00		
1	Research Seminar "Seminar on scientific literature"	C	9,00		9,00		GPC-1, PC-2, UC-1, UC-2
	Научно-исследовательский семинар для специализации "Физика низких температур"		9,00		9,00		
1	Research Seminar: Basics of Low Temperature Physics	C	3,00		3,00		GPC-2, PC-1, PC-4, UC-5, UC-6, UC-8, UC-9
2	Research Seminar: Test and Measurements	C	3,00		3,00		GPC-7, PC-4, PC-5, UC-8
3	Research Seminar: Practical Training on Low Temperature Physics	C	3,00		3,00		GPC-1, PC-1, UC-8
	Elective Components (Courses)		43,00		16,00	27,00	
	Вариативная часть, в т.ч. дисциплины по выбору студента		13,00		13,00		
	Вариативная профильная часть "Физика космоса"		13,00		13,00		
1	Fundamentals of the Kinetic Theory of Gases	C	3,00		3,00		PC-4, UC-1, UC-2, UC-3
2	Fundamentals of Space Gas Dynamics	C	3,00		3,00		GPC-1, PC-4, UC-1, UC-2, UC-3
3	Introduction in Plasma Physics	C	4,00		4,00		GPC-1, PC-4, UC-1, UC-2, UC-3
4	Solar System and Planets of Other Stars	C	3,00		3,00		GPC-1, GPC-2, GPC-3, PC-1, PC-2, PC-3, UC-1, UC-2
	Вариативная профильная часть "Физика низких температур"		13,00		13,00		
1	Low Temperature Magnetism	C	3,00		3,00		GPC-1, PC-1, UC-1
2	Selected Topics of Thermodynamics and Statistical Physics. Part 1	C	5,00		5,00		GPC-3, PC-2, PC-4, PC-6, UC-2
3	Selected Topics of Thermodynamics and Statistical Physics. Part 2	C	5,00		5,00		GPC-3, PC-2, PC-4, PC-5, UC-2
	Вариативная профильная часть "Теоретическая физика"		13,00		13,00		
1	Low Temperature Magnetism	C	3,00		3,00		GPC-1, PC-1, UC-1
2	Advanced Topics in Mathematical Physics	C	3,00		3,00		GPC-1, GPC-3, PC-1, PC-2, PC-3, UC-1, UC-2
3	Functional Integration in the Theory of Classical Chaotic Systems	C	4,00		4,00		GPC-1, GPC-3, PC-1, PC-2, PC-3, UC-1, UC-2
4	Stochastic processes and modeling in physics	C	3,00		3,00		GPC-1, GPC-3, PC-1, PC-2, PC-3, UC-1, UC-2

	Вариативная профильная часть "Физика конденсированных сред"		13,00			13,00	
1	Diffraction Methods for Studying the Real Structure of Crystals	C	4,00			4,00	GPC-1, PC-2, PC-3, PC-6, UC-2
2	Electronic Dispersion Laws in Solids	C	3,00			3,00	GPC-1, PC-2, PC-3, PC-6, UC-2
3	Introduction to Surface Physics	C	3,00			3,00	GPC-1, PC-2, PC-3, PC-6, UC-2
4	Low Temperature Magnetism	C	3,00			3,00	GPC-1, PC-1, UC-1
	Вариативная профильная часть "Квантовая оптика и нанофотоника"		13,00			13,00	
1	Quantum Optics and Photonics. Part 1	C	3,00			3,00	GPC-1, PC-2, PC-3, PC-6, UC-2
2	Quantum Optics and Photonics. Part 2	C	4,00			4,00	GPC-1, PC-2, PC-3, PC-6, UC-2
3	Experimental Methods of Modern Quantum Optics	C	3,00			3,00	GPC-3, PC-6, UC-2
4	Experimental Methods of Classical Spectroscopy	C	3,00			3,00	GPC-3, PC-6, UC-2
	Вариативная профильная часть "Квантовые технологии"		13,00			13,00	
1	Symmetry and Group Theory in Physics	C	3,00			3,00	GPC-1, GPC-3, PC-1, PC-2, PC-3, UC-1, UC-2
2	Advanced solid state physics	C	4,00			4,00	GPC-1, GPC-2, PC-1, UC-1, UC-2
3	Introduction to the classical theory of information	C	3,00			3,00	GPC-1, GPC-3, PC-1, PC-2, PC-3, UC-1, UC-2
4	Introduction to the quantum theory of information	C	3,00			3,00	GPC-1, GPC-3, PC-1, PC-2, PC-3, UC-1, UC-2
	Вариативная профильная часть "Нанoeлектроника и фотоника"		13,00			13,00	
1	Advanced solid state physics	C	4,00			4,00	GPC-1, PC-1, PC-2, UC-1, UC-2
2	Symmetry and Group Theory in Physics	C	3,00			3,00	GPC-1, GPC-3, PC-1, PC-2, PC-3, UC-1, UC-2
3	Basics of Magnetism	C	3,00			3,00	GPC-1, GPC-3, PC-1, PC-2, PC-3, UC-1, UC-2
4	Nanomagnetism and Spintronics	C	3,00			3,00	GPC-1, GPC-3, PC-1, PC-2, PC-3, UC-1, UC-2
	Специализация "Преподавание современной физики"		13,00			13,00	
1	Fundamentals of Instructional Design	C	3,00			3,00	GPC-1, GPC-3, PC-1, PC-2, PC-3, UC-1, UC-2
2	Human Development and Education	C	6,00			6,00	GPC-8, PC-1, UC-1, UC-11, UC-6
3	Modern Methods of Teaching Physics at School	C	4,00			4,00	GPC-1, GPC-3, PC-1, PC-2, PC-3, UC-1, UC-2
	Вариативная часть, в т.ч. дисциплины по выбору студента		27,00			27,00	
	Вариативная профильная часть "Физика низких температур"		27,00			27,00	
1	Physics of Metals and Electronic Phenomena	C	9,00			9,00	PC-2, PC-3, PC-6, UC-2

2	Low Temperature Physics	C	10,00			10,00	PC-2, PC-3, PC-6, UC-2
3	Superconductivity	C	8,00			8,00	PC-2, PC-3, PC-6, UC-2
	Вариативная профильная часть "Теоретическая физика"		27,00			27,00	
1	Diagrammatic Technique for Many-Body Systems	C	10,00			10,00	PC-2, PC-3, PC-6, UC-2
2	Introduction to Statistical Hydrodynamics	C	9,00			9,00	PC-2, PC-3, PC-6, UC-2
3	Seminar on Scientific Literature	C	8,00			8,00	PC-2, PC-3, PC-6, UC-2
	Вариативная профильная часть "Физика конденсированных сред"		27,00			27,00	
1	Electronic Properties of Solids	C	3,00			3,00	PC-2, PC-3, PC-6, UC-2
2	Electronic Transport in Hybrid Nanostructures	C	3,00			3,00	PC-2, PC-3, PC-6, UC-2
3	Phase Diagrams of Multicomponent Systems	C	6,00			6,00	PC-2, PC-3, PC-6, UC-2
4	Introduction to Materials Science	C	5,00			5,00	PC-2, PC-3, PC-6, UC-2
5	Physics of partially ordered media	C	5,00			5,00	PC-2, PC-3, PC-6, UC-2
6	Structure of Real Crystals	C	5,00			5,00	PC-2, PC-3, PC-6, UC-2
	Вариативная профильная часть "Квантовая оптика и нанофотоника"		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	Laser Physics	C	7,00			7,00	GPC-1, PC-2, PC-3, PC-6, UC-2
3	Introduction to Nonlinear Physics and Solid-state Spectroscopy	C	7,00			7,00	GPC-2, PC-2, PC-3, PC-6, UC-2
4	Atomic and Molecular Spectroscopy	C	6,00			6,00	GPC-2, PC-2, PC-3, PC-6, UC-2
	Вариативная профильная часть "Нанoeлектроника и фотоника"		27,00			27,00	
1	Basis of Surface Science	C	3,00			3,00	PC-1, PC-2, PC-3, UC-4
2	Applied Photonics and Fiber Optics	C	6,00			6,00	PC-1, PC-2, PC-3, UC-4
3	Physics of Metals and Electronic Phenomena	C	9,00			9,00	PC-1, PC-2, PC-3, UC-4
4	Many Electron System Simulation Methods	C	5,00			5,00	PC-4, UC-1, UC-2, UC-3
5	Methods for Multielectronic System Simulation	C	4,00			4,00	PC-1, PC-2, PC-3, UC-4
	Вариативная профильная часть "Физика космоса"		27,00			27,00	
1	Fundamentals of Gas Dynamics and Numerical Modeling in Gas Dynamics	C	9,00			9,00	PC-4, UC-1, UC-2, UC-3
2	Statistical Analysis of Space Experiment Data	C	8,00			8,00	PC-4, UC-1, UC-2, UC-3
3	Introduction to High-energy Astrophysics	C	10,00			10,00	PC-4, UC-1, UC-2, UC-3
	Вариативная профильная часть "Квантовые технологии"		27,00			27,00	
1	Quantum Cryptography	C	5,00			5,00	PC-4, UC-1, UC-2, UC-3
2	Fundamentals of Quantum Computing	C	4,00			4,00	PC-4, UC-1, UC-2, UC-3
3	Computer Simulation of Multiatomic Systems	C	3,00			3,00	GPC-1, GPC-3, PC-1, PC-2, PC-3, UC-1, UC-2
4	Quantum optics	C	3,00			3,00	GPC-1, GPC-3, PC-1, PC-2, PC-3, UC-1, UC-3

5	Physical Basis for Quantum Information	C	6,00				6,00	GPC-1, GPC-3, PC-1, PC-2, PC-3, UC-1, UC-4
6	Quantum Materials	C	6,00				6,00	GPC-1, GPC-3, PC-1, PC-2, PC-3, UC-1, UC-5
	Специализация "Преподавание современной физики"		27,00				27,00	
1	Practical Astronomy and Astrophysics	C	7,00				7,00	PC-2, PC-6, UC-1, UC-4
2	Assessment and feedback	C	6,00				6,00	GPC-8, PC-6, UC-1, UC-11, UC-8
3	Key Competences and New Literacy	C	6,00				6,00	GPC-8, PC-3, UC-1, UC-10, UC-4, UC-6
4	Olympiad Physical Practicum	C	8,00				8,00	PC-1, PC-4, UC-1, UC-4, UC-5
	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-7, UC-1, UC-2
	Internship		36,00	8,00	8,00	4,00	16,00	
	Professional Internship		3,00				3,00	
1	Teaching Internship	E	4,00			4,00		GPC-2, PC-6, UC-1, UC-2
2	Educational Internship	C	3,00				3,00	GPC-1, GPC-2, GPC-6, GPC-8, PC-4, PC-5, UC-1
	Research Internship		33,00	8,00	8,00	4,00	13,00	
	Mandatory projects		22,00	8,00	8,00		6,00	
1	Исследовательский проект	C	6,00				6,00	GPC-1, GPC-4, GPC-5, GPC-6, GPC-8, PC-1
2	Практикум по механике	C	4,00	4,00				GPC-1, GPC-2, GPC-3, GPC-8, PC-1, PC-2, UC-4, UC-7
3	Практикум по электричеству и магнетизму	C	4,00	4,00				GPC-1, GPC-2, GPC-3, PC-1, PC-2, UC-4, UC-7
4	Практикум по оптике	C	4,00		4,00			GPC-1, GPC-2, GPC-3, GPC-8, PC-1, PC-2, UC-4, UC-7
5	Практикум по термодинамике и молекулярной физике	C	4,00		4,00			GPC-1, GPC-2, GPC-3, GPC-8, PC-1, PC-2, UC-4, UC-7
	Elective Projects		4,00			4,00		
1	Electronic Methods in Physics	E	4,00			4,00		GPC-1, GPC-2, GPC-3, GPC-8, PC-1, PC-2, PC-3, UC-4, UC-7
2	Практикум по современной физике	E	4,00			4,00		GPC-1, GPC-2, GPC-3, GPC-8, PC-1, PC-2, PC-3, UC-4, UC-7
	Preparation of the final qualifying work		7,00				7,00	
1	Preparation of Graduation Thesis	C	7,00				7,00	GPC-1, GPC-3, PC-2, PC-4, UC-1, UC-2, UC-4
	General Courses		14,00	5,00	5,00		4,00	
	Core General Courses		2,00	1,00	1,00			
1	Physical Training	C	1,00		1,00			GPC-7, GPC-9
2	Safe Living Basics	C	1,00	1,00				PC-4, PC-6
	Optional General Courses		12,00	4,00	4,00		4,00	
1	Economics	C	4,00				4,00	GPC-6, UC-2

