National Research University Higher School of Economics (HSE)

APPROVED
25.07.2023
Vice Rector
ROSHCHIN S.Y.

Signed with EDS

Basic Curriculum

Field of study 03.04.02 Physics
Educational Programme "Physics"
Trajectories: "Condensed Matter Physics", "Hydrogen Energy", "Low Temperature Physics", "Nanoelectronics and Photonics", "Quantum Optics and Nanophotonics", "Quantum Technologies", "Space Physics", "Theoretical Physics"
Implementing unit: Faculty of Physics, HSE - Moscow

Years of Study: 2023/2024 - 2024/2025
Length of Programme: 2 years
Mode of Study: Full Time
Degree: Master's degree / MBA

Block Code	Course	Subject type	Credits	Credits by Years		Planned Educational Programme Development Results
				1	2	
	Degree Programme		120,00	60,00	60,00	
	Hydrogen Energy (Research track)		120,00	60,00	60,00	
	Key Seminars		21,00	18,00	3,00	
1	Mentor's Seminar	C	9,00	6,00	3,00	GPC-4, PC-2, PC-8, UC-1, UC-2
2	Research Seminar "Modern Technologies for Creating PEMFC and SOFC"	C	6,00	6,00		GPC-1, PC-1, UC-1, UC-2, UC-3
3	Research Seminar "Computer Modeling of Fuel Cells. Digital Doubles of PEMFC and SOFC"	C	6,00	6,00		GPC-3, PC-1, UC-1, UC-2, UC-3
	Internship		57,00	6,00	51,00	
	Research Internship		57,00	6,00	51,00	
1	Project	C	6,00	6,00		GPC-1, GPC-2, PC-3, PC-4, PC-5, PC-6, PC-7, UC-4, UC-5, UC-6
2	Research project	C	48,00		48,00	GPC-1, GPC-3, PC-3, PC-4, PC-5, PC-6, PC-7, UC-4, UC-5, UC-6
3	Preparation of the Graduate Thesis	C	3,00		3,00	GPC-1, GPC-2, GPC-3, GPC-4, PC-1, PC-2, PC-3, PC-4, PC-5, PC-6, PC-7, PC-8, UC-1, UC-2, UC-3, UC-4, UC-5, UC-6
	Major		39,00	36,00	3,00	
1	Introduction to Machine Learning	C	3,00		3,00	GPC-4, UC-1, UC-2, UC-3
2	Proton Conductivity of Materials with a Confined State of Water	C	6,00	6,00		GPC-1, GPC-4, PC-1, PC-4, PC-5, UC-1

3	Constructional and Functional Ceramics for Solid Oxide Fuel Cells (SOFC)	C	6,00	6,00		GPC-1, GPC-4, PC-1, PC-4, PC-5, UC-1
4	Electrochemistry of Proton-exchange Membrane Fuel Cell (PEMFC) and Redox Batteries	C	6,00	6,00		GPC-1, GPC-4, PC-1, PC-4, PC-5, UC-1
5	Systems and Methods for Hydrogen Production and Storage	C	6,00	6,00		GPC-1, GPC-4, PC-1, PC-4, PC-5, UC-1
6	Stochastic Processes in Physics and Beyond	C	6,00	6,00		PC-1, PC-7, UC-1, UC-2, UC-3
7	Cosmology	C	6,00	6,00		GPC-4, PC-2, PC-5, UC-1, UC-2, UC-3
	Final State Certification (FSC)		3,00		3,00	
1	Final Qualification Paper	C	3,00		3,00	GPC-1, GPC-2, GPC-3, GPC-4, PC-1, PC-2, PC-3, PC-4, PC-5, PC-6, PC-7, PC-8, UC-1, UC-2, UC-3, UC-4, UC-5, UC-6
	Nanoelectronics and Photonics (Research track)		120,00	60,00	60,00	
	Key Seminars		21,00	18,00	3,00	
1	Mentor's Seminar	C	21,00	18,00	3,00	GPC-4, PC-2, UC-1, UC-2
	Internship		57,00	6,00	51,00	
	Research Internship		57,00	6,00	51,00	
1	Project	C	6,00	6,00		GPC-1, GPC-3, PC-3, PC-4, PC-5, PC-6, PC-7, UC-4, UC-5, UC-6
2	Research project	C	48,00		48,00	GPC-1, GPC-3, PC-3, PC-4, PC-5, PC-6, UC-4, UC-5, UC-6
3	Preparation of the Graduate Thesis	C	3,00		3,00	GPC-1, GPC-2, GPC-3, GPC-4, PC-1, PC-2, PC-3, PC-4, PC-5, PC-6, PC-7, PC-8, UC-1, UC-2, UC-3, UC-4, UC-5, UC-6
	Major		39,00	36,00	3,00	
1	Introduction to Superconducting Electronics	C	6,00	6,00		GPC-1, GPC-4, PC-1, PC-4, PC-5, UC-1
2	Laser Physics and Nonlinear Optics	C	6,00	6,00		GPC-2, PC-2, UC-1, UC-2
3	Methods for Multielectronic System Simulation	C	6,00	6,00		GPC-2, PC-2, UC-1, UC-2
4	Low-dimensional Electron Systems	C	6,00	6,00		GPC-2, PC-1, PC-3, UC-1, UC-2
5	Stochastic Processes in Physics and Beyond	C	6,00	6,00		PC-1, PC-7, UC-1, UC-2, UC-3
6	Cosmology	C	6,00	6,00		GPC-4, PC-2, PC-5, UC-1, UC-2, UC-3
7	Introduction to Machine Learning	C	3,00		3,00	GPC-4, UC-1, UC-2, UC-3
	Final State Certification (FSC)		3,00		3,00	
1	Final Qualification Paper	C	3,00		3,00	GPC-1, GPC-2, GPC-3, GPC-4, PC-1, PC-2, PC-3, PC-4, PC-5, PC-6, PC-7, PC-8, UC-1, UC-2, UC-3, UC-4, UC-5, UC-6
	Low Temperature Physics (Research track)		120,00	60,00	60,00	
	Key Seminars		21,00	18,00	3,00	
1	Mentor's Seminar	C	9,00	6,00	3,00	GPC-4, PC-2, UC-1, UC-2

2	Research Seminar "Low Temperature Physics"	C	6,00	6,00		GPC-1, GPC-3, PC-1, PC-3, UC-1, UC-2, UC-3
3	Research Seminar "Condensed Matter Physics"	C	6,00	6,00		UC-1, UC-2, UC-3
	Internship		57,00	6,00	51,00	
	Research Internship		57,00	6,00	51,00	
1	Project	C	6,00	6,00		GPC-1, GPC-3, PC-3, PC-4, PC-5, PC-6, UC-4, UC-5, UC-6
2	Research Project	C	48,00		48,00	GPC-1, GPC-3, PC-3, PC-4, PC-5, PC-6, PC-7, UC-4, UC-5, UC-6
3	Preparation of the Graduate Thesis	C	3,00		3,00	GPC-1, GPC-2, GPC-3, GPC-4, PC-1, PC-2, PC-3, PC-4, PC-5, PC-6, PC-7, PC-8, UC-1, UC-2, UC-3, UC-4, UC-5, UC-6
	Major		39,00	36,00	3,00	
1	Ultra-low temperatures and low-dimensional systems	C	6,00	6,00		GPC-1, GPC-4, PC-1, PC-4, PC-5, UC-1
2	Methods of Low-Temperature Physics	C	6,00	6,00		GPC-1, GPC-4, PC-1, PC-4, PC-5, UC-1
3	Spectroscopy of Solid Media	C	6,00	6,00		GPC-1, GPC-4, PC-1, PC-4, PC-5, UC-1
4	Stochastic Processes in Physics and Beyond	C	6,00	6,00		GPC-4, PC-2, PC-5, UC-1, UC-2, UC-3
5	Cosmology	C	6,00	6,00		GPC-4, PC-2, PC-5, UC-1, UC-2, UC-3
6	Applied Microwave Electrodynamics	C	6,00	6,00		GPC-1, PC-5, UC-1
7	Introduction to Machine Learning	C	3,00		3,00	GPC-4, UC-1, UC-2, UC-3
	Final State Certification (FSC)		3,00		3,00	
1	Final Qualification Paper	C	3,00		3,00	GPC-1, GPC-2, GPC-3, GPC-4, PC-1, PC-2, PC-3, PC-4, PC-5, PC-6, PC-7, PC-8, UC-1, UC-2, UC-3, UC-4, UC-5, UC-6
	Theoretical Physics (Research track)		120,00	60,00	60,00	
	Key Seminars		21,00	18,00	3,00	
1	Mentor's Seminar	C	9,00	6,00	3,00	GPC-4, PC-3, UC-1, UC-2
2	Research Seminar. Functional Methods in the Theory of Disordered Systems	C	6,00	6,00		GPC-2, PC-2, PC-5, UC-1, UC-2
3	Research Seminar "Methods of Statistical Physics of Highly Non-Equlibrium Systems"	C	6,00	6,00		GPC-2, PC-2, UC-1
	Internship		57,00	6,00	51,00	
	Research Internship		57,00	6,00	51,00	
1	Project	C	6,00	6,00		GPC-1, GPC-3, PC-3, PC-4, PC-5, PC-6, PC-7, UC-4, UC-5, UC-6
2	Research project	C	48,00		48,00	GPC-1, GPC-3, PC-3, PC-4, PC-5, PC-6, PC-7, UC-4, UC-5, UC-6

3	Preparation of the Graduate Thesis	C	3,00		3,00	GPC-1, GPC-2, GPC-3, GPC-4, PC-1, PC-2, PC-3, PC-4, PC-5, PC-6, PC-7, PC-8, UC-1, UC-2, UC-3, UC-4, UC-5, UC-6
	Major		39,00	36,00	3,00	
1	Stochastic Processes in Physics and Beyond	C	6,00	6,00		GPC-4, PC-2, PC-5, UC-1, UC-2, UC-3
2	Introduction to the Physics of Disordered Systems	C	6,00	6,00		GPC-1, PC-1, UC-1, UC-2
3	Quantum Mesoscopics. Integer Quantum Hall Effect	C	6,00	6,00		GPC-2, PC-1, UC-1, UC-2
4	Transport in Mesoscopic Systems	C	6,00	6,00		GPC-2, PC-2, UC-1, UC-2
5	Cosmology	C	6,00	6,00		GPC-4, PC-2, PC-5, UC-1, UC-2, UC-3
6	Nonlinear Wave Processes 2	C	6,00	6,00		GPC-2, PC-2, UC-1
7	Introduction to Machine Learning	C	3,00		3,00	GPC-4, UC-1, UC-2, UC-3
	Final State Certification (FSC)		3,00		3,00	
1	Final Qualification Paper	C	3,00		3,00	GPC-1, GPC-2, GPC-3, GPC-4, PC-1, PC-2, PC-3, PC-4, PC-5, PC-6, PC-7, PC-8, UC-1, UC-2, UC-3, UC-4, UC-5, UC-6
	Space Physics (Research track)		120,00	60,00	60,00	
	Key Seminars		21,00	18,00	3,00	
1	Mentor's Seminar	C	9,00	6,00	3,00	GPC-4, PC-2, UC-1, UC-2
2	Research Seminar "Statistical Analysis of the Space Data"	C	6,00	6,00		GPC-1, GPC-2, GPC-3, GPC-4, PC-6, PC-7, PC-8, UC-1, UC-2, UC-3
3	Research Seminar "Experimental Astrophysics"	C	6,00	6,00		GPC-1, GPC-2, GPC-3, GPC-4, PC-5, PC-6, PC-7, PC-8, UC-1, UC-2, UC-3
	Internship		57,00	6,00	51,00	
	Research Internship		57,00	6,00	51,00	
1	Project	C	6,00	6,00		GPC-1, GPC-3, PC-3, PC-4, PC-5, PC-6, UC-4, UC-5, UC-6
2	Research Project	C	48,00		48,00	GPC-1, GPC-3, PC-3, PC-4, PC-5, PC-6, PC-7, UC-4, UC-5, UC-6
3	Preparation of the Graduate Thesis	C	3,00		3,00	GPC-1, GPC-2, GPC-3, GPC-4, PC-1, PC-2, PC-3, PC-4, PC-5, PC-6, PC-7, PC-8, UC-1, UC-2, UC-3, UC-4, UC-5, UC-6
	Major		39,00	36,00	3,00	
1	Plasma Astrophysics	C	6,00	6,00		GPC-1, GPC-4, PC-1, PC-4, PC-5, UC-1
2	High-Energy Astrophysics	C	6,00	6,00		GPC-1, GPC-4, PC-1, PC-4, PC-5, UC-1
3	Celestial Mechanics	C	6,00	6,00		GPC-1, GPC-4, PC-1, PC-4, PC-5, UC-1
4	Observational Cosmology	C	6,00	6,00		GPC-1, GPC-4, PC-1, PC-4, PC-5, UC-1
5	Stochastic Processes in Physics and Beyond	C	6,00	6,00		GPC-4, PC-1, PC-5, UC-1, UC-2, UC-3
6	Cosmology	C	6,00	6,00		GPC-4, PC-1, PC-5, UC-1, UC-2, UC-3
7	Introduction to Machine Learning	C	3,00		3,00	GPC-4, UC-1, UC-2, UC-3

	Final State Certification (FSC)		3,00		3,00	
1	Final Qualification Paper	C	3,00		3,00	GPC-1, GPC-2, GPC-3, GPC-4, PC-1, PC-2, PC-3, PC-4, PC-5, PC-6, PC-7, PC-8, UC-1, UC-2, UC-3, UC-4, UC-5, UC-6
	Quantum Optics and Nanophotonics (Research track)		120,00	60,00	60,00	
	Key Seminars		21,00	18,00	3,00	
1	Mentor's Seminar	C	9,00	6,00	3,00	GPC-4, PC-2, UC-1, UC-2
2	Research Seminar "Quantum Optics"	C	6,00	6,00		GPC-1, GPC-2, GPC-3, GPC-4, PC-6, PC-7, PC-8, UC-1, UC-2, UC-3
3	Research Seminar «The Physics of Quantum Information»	C	6,00	6,00		GPC-1, GPC-2, GPC-3, GPC-4, PC-6, PC-7, PC-8, UC-1, UC-2, UC-3
	Internship		57,00	6,00	51,00	
	Research Internship		57,00	6,00	51,00	
1	Project	C	6,00	6,00		GPC-1, GPC-3, PC-3, PC-4, PC-5, PC-6, PC-7, UC-4, UC-5, UC-6
2	Research Project	C	48,00		48,00	GPC-1, GPC-3, PC-3, PC-4, PC-5, PC-6, PC-7, UC-4, UC-5, UC-6
3	Preparation of the Graduate Thesis	C	3,00		3,00	GPC-1, GPC-2, GPC-3, GPC-4, PC-1, PC-2, PC-3, PC-4, PC-5, PC-6, PC-7, PC-8, UC-1, UC-2, UC-3, UC-4, UC-5, UC-6
	Major		39,00	36,00	3,00	
1	Fundamentals of Nanophotonics	C	12,00	12,00		GPC-1, GPC-4, PC-1, PC-4, PC-5, UC-1
2	Spectroscopy of condensed matter	C	6,00	6,00		GPC-1, GPC-4, PC-1, PC-4, PC-5, UC-1
3	Laser Spectroscopy	C	6,00	6,00		GPC-1, GPC-4, PC-1, PC-4, PC-5, UC-1
4	Stochastic Processes in Physics and Beyond	C	6,00	6,00		GPC-4, PC-2, PC-5, UC-1, UC-2, UC-3
5	Cosmology	C	6,00	6,00		GPC-4, PC-2, PC-5, UC-1, UC-2, UC-3
6	Introduction to Machine Learning	C	3,00		3,00	GPC-4, UC-1, UC-2, UC-3
	Final State Certification (FSC)		3,00		3,00	
1	Final Qualification Paper	C	3,00		3,00	GPC-1, GPC-2, GPC-3, GPC-4, PC-1, PC-2, PC-3, PC-4, PC-5, PC-6, PC-7, PC-8, UC-1, UC-2, UC-3, UC-4, UC-5, UC-6
	Quantum Technologies (Research track)		120,00	60,00	60,00	
	Key Seminars		21,00	18,00	3,00	
1	Research Seminar "Quantum Information"	C	6,00	6,00		GPC-1, GPC-2, GPC-3, GPC-4, PC-3, PC-4, PC-5, PC-6, PC-7, PC-8, UC-1, UC-2, UC-3
2	Mentor's Seminar	C	9,00	6,00	3,00	GPC-4, PC-2, UC-1, UC-2
3	Research Seminar "Atomic Scale Technologies on Surfaces"	C	6,00	6,00		GPC-1, GPC-2, GPC-3, PC-3, PC-4, PC-5, UC-1, UC-2, UC-3

	Internship		57,00	6,00	51,00	
	Research Internship		57,00	6,00	51,00	
1	Project	C	6,00	6,00		GPC-1, GPC-3, PC-3, PC-4, PC-5, PC-6, PC-7, UC-4, UC-5, UC-6
2	Research Project	C	48,00		48,00	GPC-1, GPC-3, PC-3, PC-4, PC-5, PC-6, PC-7, UC-4, UC-5, UC-6
3	Preparation of the Graduate Thesis	C	3,00		3,00	GPC-1, GPC-2, GPC-3, GPC-4, PC-1, PC-2, PC-3, PC-4, PC-5, PC-6, PC-7, PC-8, UC-1, UC-2, UC-3, UC-4, UC-5, UC-6
	Major		39,00	36,00	3,00	
1	Spin Physics	C	6,00	6,00		GPC-1, GPC-4, PC-1, PC-4, PC-5, UC-1
2	Computer Simulation of Multiatomic Systems	C	6,00	6,00		GPC-1, GPC-4, PC-1, PC-4, PC-5, UC-1
3	Quantum Technologies. Experimental Realizations for Quantum Computations	C	6,00	6,00		GPC-1, GPC-4, PC-1, PC-4, PC-5, UC-1
4	Physical Basis for Quantum Information	C	6,00	6,00		GPC-1, GPC-4, PC-1, PC-4, PC-5, UC-1
5	Stochastic Processes in Physics and Beyond	C	6,00	6,00		GPC-4, PC-2, PC-5, UC-1, UC-2, UC-3
6	Cosmology	C	6,00	6,00		GPC-4, PC-2, PC-5, UC-1, UC-2, UC-3
7	Introduction to Machine Learning	C	3,00		3,00	GPC-4, UC-1, UC-2, UC-3
	Final State Certification (FSC)		3,00		3,00	
1	Final Qualification Paper	C	3,00		3,00	GPC-1, GPC-2, GPC-3, GPC-4, PC-1, PC-2, PC-3, PC-4, PC-5, PC-6, PC-7, PC-8, UC-1, UC-2, UC-3, UC-4, UC-5, UC-6
	Condensed Matter Physics (Research track)		120,00	60,00	60,00	
	Key Seminars		21,00	18,00	3,00	
1	Research Seminar «Structure of Real Crystals»	C	6,00	6,00		UC-1, UC-2, UC-3
2	Mentor's Seminar	C	9,00	6,00	3,00	GPC-4, PC-2, UC-1, UC-2
3	Research Seminar "Spin Physics in Semiconductor Structures"	C	6,00	6,00		GPC-1, GPC-2, GPC-3, GPC-4, PC-3, PC-5, PC-6, PC-7, PC-8, UC-1, UC-2, UC-3
	Internship		57,00	6,00	51,00	
	Research Internship		57,00	6,00	51,00	
1	Project	C	6,00	6,00		GPC-1, UC-1, UC-2, UC-3
2	Research Project	C	48,00		48,00	GPC-1, UC-1, UC-2, UC-3
3	Preparation of the Graduate Thesis	C	3,00		3,00	GPC-1, GPC-2, GPC-3, GPC-4, PC-1, PC-2, PC-3, PC-4, PC-5, UC-1, UC-2, UC-3, UC-4, UC-5, UC-6
	Major		39,00	36,00	3,00	
1	Technology of nanostructures	C	6,00	6,00		GPC-1, GPC-4, PC-1, PC-4, PC-5, UC-1
2	Optics of Condensed Matter	C	6,00	6,00		GPC-1, GPC-4, PC-1, PC-4, PC-5, UC-1
3	Equilibrium and Nonequilibrium Condensed Systems	C	6,00	6,00		GPC-1, GPC-4, PC-1, PC-4, PC-5, UC-1

4	Electrons in Disordered Media	C	6,00	6,00		GPC-1, GPC-4, PC-1, PC-4, PC-5, UC-1
5	Stochastic Processes in Physics and Beyond	C	6,00	6,00		GPC-4, PC-2, PC-5, UC-1, UC-2, UC-3
6	Cosmology	C	6,00	6,00		GPC-4, PC-2, PC-5, UC-1, UC-2, UC-3
7	Introduction to Machine Learning	C	3,00		3,00	GPC-4, UC-1, UC-2, UC-3
	Final State Certification (FSC)		3,00		3,00	
1	Final Qualification Paper	C	3,00		3,00	GPC-1, GPC-2, GPC-3, GPC-4, PC-1, PC-2, PC-3, PC-4, PC-5, PC-6, PC-7, PC-8, UC-1, UC-2, UC-3, UC-4, UC-5, UC-6

Curriculum agreed:

Academic Supervisor	LEBEDEV V.V.	30.06.2023
Dean	TRUNIN M.R.	30.06.2023
Head of Centre for Educational Model Design	LEPESHKIN I.A.	21.07.2023

* Subject type:

Compulsory course C