



National Research University Higher School of Economics (HSE)

Basic Curriculum

Field of study 01.03.02 Applied Mathematics and Information Science
Educational Programme "Applied Mathematics and Information Science"

Specializations: "Choice and Decision Theory", "Data Analysis and Intelligent Systems", "Distributed Systems", "Industrial Software Engineering",
"Machine Learning and Applications", "Mathematical and Computational Engineering in Science and Business", "Theoretical Computer Science"

Implementing unit: Faculty of Computer Science, HSE - Moscow

APPROVED
18.05.2022
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		165,00	47,00	44,00	37,00	37,00	
	Core Professional Block (Major)		80,00	47,00	27,00	6,00		
	Mathematical Statistics		5,00		5,00			
1	Mathematical Statistics	E	5,00		5,00			GPC-1, GPC-3, PC-1, UC-1, UC-2
2	Mathematical Statistics (advanced course)	E	5,00		5,00			GPC-1, GPC-3, PC-1, UC-1, UC-2
	Дискретная математика		6,00	6,00				
1	Discrete Mathematics	E	6,00	6,00				GPC-1, GPC-3, PC-1, UC-1, UC-2
2	Discrete Mathematics	E	6,00	6,00				GPC-1, GPC-3, PC-1, UC-1, UC-2
	Линейная алгебра и геометрия		8,00	8,00				
1	Linear Algebra and Geometry	E	8,00	8,00				GPC-1, GPC-3, PC-1, UC-1, UC-2
2	Linear Algebra and Geometry	E	8,00	8,00				GPC-1, GPC-3, PC-1, UC-1, UC-2
	Алгебра		3,00	3,00				
1	Algebra	E	3,00	3,00				GPC-1, GPC-3, PC-1, UC-1, UC-2
2	Algebra	E	3,00	3,00				GPC-1, GPC-3, PC-1, UC-1, UC-2
	Математический анализ		10,00	10,00				
1	Calculus	E	10,00	10,00				GPC-1, GPC-3, PC-1, UC-1, UC-2
2	Calculus	E	10,00	10,00				GPC-1, GPC-3, PC-1, UC-1, UC-2
	-		3,00	3,00				
1	Number Theory	E	3,00	3,00				GPC-1, GPC-3, PC-1, UC-1, UC-2
2	Number Theory (advanced course)	E	3,00	3,00				GPC-1, GPC-3, PC-1, UC-1, UC-2
	Probability Theory		5,00		5,00			
1	Probability Theory	E	5,00		5,00			GPC-1, GPC-3, PC-1, UC-1, UC-2
2	Probability Theory (advanced course)	E	5,00		5,00			GPC-1, GPC-3, PC-1, UC-1, UC-2

	Математический анализ 2		3,00		3,00		
1	Calculus 2	E	3,00		3,00		GPC-1, GPC-3, PC-1, UC-1, UC-2
2	Calculus 2	E	3,00		3,00		GPC-1, GPC-3, PC-1, UC-1, UC-2
	Методы оптимизации		6,00			6,00	
1	Optimization Methods	E	6,00			6,00	GPC-1, GPC-2, GPC-3, PC-1, PC-4, UC-1, UC-2
2	Optimization in Machine Learning	E	6,00			6,00	GPC-1, GPC-2, GPC-3, PC-1, PC-4, UC-1, UC-2
	-		11,00		11,00		
1	Computer Architecture	C	5,00		5,00		GPC-1, GPC-4, PC-3, PC-7, UC-1
2	Operating Systems	C	6,00		6,00		GPC-1, GPC-4, PC-3, PC-7, UC-1
	Programming		20,00	17,00	3,00		
	-		20,00	17,00	3,00		
1	Algorithms and Data Structures 2	E	3,00		3,00		GPC-1, GPC-2, GPC-3, GPC-4, PC-1, PC-2, PC-3, UC-1, UC-2
2	C++ Programming Language	C	4,00	4,00			GPC-4, PC-3, UC-1, UC-2
3	Algorithms and Data Structures	C	13,00	13,00			GPC-1, GPC-2, GPC-3, GPC-4, PC-1, PC-2, PC-3, UC-1, UC-2
	-		20,00	17,00	3,00		
1	Algorithms and Data Structures 2	E	3,00		3,00		GPC-1, GPC-2, GPC-3, GPC-4, PC-1, PC-2, PC-3, UC-1, UC-2
2	C++ Programming Language	C	4,00	4,00			GPC-4, PC-3, UC-1, UC-2
3	Algorithms and Data Structures	C	9,00	9,00			GPC-1, GPC-2, GPC-3, GPC-4, PC-1, PC-2, PC-3, UC-1, UC-2
4	Python Programming Language	C	4,00	4,00			GPC-4, PC-3, UC-1, UC-2
	Elective Professional Block (Major)		85,00		17,00	31,00	37,00
	Обязательная дисциплина по выбору (2 курс 1 семестр)		5,00		5,00		
1	C++ Programming Language	E	5,00		5,00		GPC-1, GPC-2, GPC-3, GPC-4, PC-2, PC-3, UC-1, UC-2
2	Python Programming Language (advanced course)	E	5,00		5,00		GPC-1, GPC-2, GPC-3, GPC-4, PC-2, PC-3, UC-1, UC-2
3	Rust Programming Language	E	5,00		5,00		GPC-1, GPC-2, GPC-3, GPC-4, PC-2, PC-3, UC-1, UC-2
	Обязательная дисциплина по выбору (2 курс 2 семестр)		12,00		12,00		
1	Differential Equations	E	6,00		6,00		GPC-1, GPC-3, PC-1, UC-1, UC-2
2	Fundamentals of Matrix Computations	E	6,00		6,00		GPC-1, GPC-3, PC-1, UC-1, UC-2
3	Functional Analysis	E	6,00		6,00		GPC-1, GPC-3, PC-1, UC-1, UC-2
4	Complex Analysis	E	6,00		6,00		GPC-1, GPC-3, PC-1, UC-1, UC-2
5	Discrete Mathematics 2	E	6,00		6,00		GPC-1, GPC-3, PC-1, UC-1, UC-2
	Обязательная дисциплина на 3 курсе		5,00			5,00	
1	Machine Learning 1	C	5,00			5,00	GPC-1, GPC-2, GPC-3, GPC-4, PC-1, PC-2, PC-3, UC-1, UC-2

	Обязательная дисциплина по выбору (4 курс)		5,00			5,00	
1	DevOps (offered in a foreign language)	E	5,00			5,00	GPC-1, GPC-2, GPC-3, PC-1, UC-1, UC-2
2	How to Win a Data Science Competition: Learn from Top Kagglers (offered in a foreign language)	E	5,00			5,00	GPC-1, GPC-2, GPC-3, PC-1, UC-1, UC-2
3	Introduction to Differential Geometry	E	5,00			5,00	GPC-1, GPC-2, GPC-3, PC-1, UC-1, UC-2
4	Computational Photography Algorithms for Capturing Color Images	E	5,00			5,00	GPC-1, GPC-2, GPC-3, PC-1, UC-1, UC-2
	Специализации		38,00		15,00	23,00	
	Специализация "Машинное обучение и приложения"		38,00		15,00	23,00	
1	Machine Learning 2	E	6,00		6,00		GPC-1, GPC-2, GPC-3, GPC-4, PC-1, PC-2, PC-3, UC-1, UC-2
2	Applied Statistical Data Analysis	E	5,00		5,00		GPC-1, GPC-2, GPC-3, GPC-4, PC-1, UC-1, UC-2
3	Research Seminar "Machine Learning and Applications"	E	4,00		4,00		GPC-1, PC-1, PC-4, PC-5, UC-1, UC-2, UC-3
4	Deep Learning	E	5,00			5,00	GPC-1, GPC-2, GPC-3, GPC-4, PC-1, PC-2, PC-3, UC-1, UC-2
5	Large-Scale Machine Learning	E	4,00			4,00	GPC-1, GPC-2, GPC-3, GPC-4, PC-1, PC-2, PC-3, UC-1, UC-2
6	Research Seminar "Machine Learning and Applications 2"	E	5,00			5,00	GPC-1, PC-1, PC-4, PC-5, UC-1, UC-2, UC-3
7	-	E	5,00			5,00	GPC-1, GPC-2, GPC-3, PC-1, UC-1, UC-2
8	-	E	4,00			4,00	GPC-1, GPC-2, GPC-3, PC-1, UC-1, UC-2
	Специализация "Теоретическая информатика"		38,00		15,00	23,00	
1	Combinatorial Constructions in Theoretical Computer Science	E	6,00		6,00		GPC-1, GPC-2, GPC-3, GPC-4, PC-1, UC-1, UC-2
2	Theory of Computation (offered in a foreign language)	E	5,00		5,00		GPC-1, GPC-2, GPC-3, GPC-4, PC-1, UC-1, UC-2
3	Research Seminar "Theoretical Informatics"	E	4,00		4,00		GPC-1, PC-1, PC-4, PC-5, UC-1, UC-2, UC-3
4	One-Way Functions and Their Applications	E	5,00			5,00	GPC-1, GPC-2, GPC-3, GPC-4, PC-1, UC-1, UC-2
5	A Theorist's Toolkit (offered in a foreign language)	E	4,00			4,00	GPC-1, GPC-2, GPC-3, GPC-4, PC-1, UC-1, UC-2
6	Research Seminar "Theoretical Informatics 2"	E	5,00			5,00	GPC-1, PC-1, PC-4, PC-5, UC-1, UC-2, UC-3
7	-	E	5,00			5,00	GPC-1, GPC-2, GPC-3, PC-1, UC-1, UC-2
8	-	E	4,00			4,00	GPC-1, GPC-2, GPC-3, PC-1, UC-1, UC-2

	Специализация "Распределенные системы"		38,00		15,00	23,00	
1	Theory and Practice of Concurrency	E	6,00		6,00		GPC-1, GPC-2, GPC-3, GPC-4, PC-1, PC-2, PC-3, UC-1, UC-2
2	Distributed Systems	E	5,00		5,00		GPC-1, GPC-2, GPC-3, GPC-4, PC-1, PC-2, PC-3, UC-1, UC-2
3	Research Seminar "Distributed Systems"	E	4,00		4,00		GPC-1, PC-1, PC-4, PC-5, UC-1, UC-2, UC-3
4	Methods and Systems for Processing Big Data	E	5,00			5,00	GPC-1, GPC-2, GPC-3, GPC-4, PC-1, PC-2, PC-3, UC-1, UC-2
5	Theory of Fault-Tolerant Distributed Systems	E	5,00			5,00	GPC-1, GPC-2, GPC-3, GPC-4, PC-1, PC-2, PC-3, UC-1, UC-2
6	Cloud Computing	E	4,00			4,00	GPC-1, GPC-2, GPC-3, GPC-4, PC-1, PC-2, PC-3, UC-1, UC-2
7	Introduction to Blockchain	E	4,00			4,00	GPC-1, GPC-2, GPC-3, GPC-4, PC-1, PC-2, PC-3, UC-1, UC-2
8	Research Seminar "Distributed Systems 2"	E	5,00			5,00	GPC-1, PC-1, PC-4, PC-5, UC-1, UC-2, UC-3
	Специализация "Анализ данных и интеллектуальные системы"		38,00		15,00	23,00	
1	Core Concepts in Data Analysis	E	5,00		5,00		GPC-1, GPC-2, GPC-3, GPC-4, PC-1, UC-1, UC-2
2	Combinatorics, Graphs and Boolean Logic (offered in a foreign language)	E	6,00		6,00		GPC-1, GPC-2, GPC-3, GPC-4, PC-1, UC-1, UC-2
3	Research Seminar "Data Analysis and Artificial Intelligence" (offered in a foreign language)	E	4,00		4,00		GPC-1, PC-1, PC-4, PC-5, UC-1, UC-2, UC-3
4	Automatic Text Processing	E	5,00			5,00	GPC-1, GPC-2, GPC-3, GPC-4, PC-1, UC-1, UC-2
5	Applied Graph Theory (offered in a foreign language)	E	5,00			5,00	GPC-1, GPC-2, GPC-3, GPC-4, PC-1, UC-1, UC-2
6	Semantic Technologies (offered in a foreign language)	E	4,00			4,00	GPC-1, GPC-2, GPC-3, GPC-4, PC-1, UC-1, UC-2
7	Analysis and Visualization of Networks (offered in a foreign language)	E	4,00			4,00	GPC-1, GPC-2, GPC-3, GPC-4, PC-1, UC-1, UC-2
8	Research Seminar "Data Analysis and Artificial Intelligence 2" (offered in a foreign language)	E	5,00			5,00	GPC-1, PC-1, PC-4, PC-5, UC-1, UC-2, UC-3
	Специализация "Анализ и принятие решений"		38,00		15,00	23,00	
1	Choice and Decision Theory (offered in a foreign language)	E	5,00		5,00		GPC-1, GPC-2, GPC-3, GPC-4, PC-1, UC-1, UC-2
2	Operations Research and Game Theory (offered in a foreign language)	E	6,00		6,00		GPC-1, GPC-2, GPC-3, GPC-4, PC-1, UC-1, UC-2
3	Research Seminar "Applied Problems of Decision Making" (offered in a foreign language)	E	4,00		4,00		GPC-1, PC-1, PC-4, PC-5, UC-1, UC-2, UC-3
4	Systems Analysis (offered in a foreign language)	E	5,00			5,00	GPC-1, GPC-2, GPC-3, GPC-4, PC-1, UC-1, UC-2
5	Individual and Social Choice (offered in a foreign language)	E	5,00			5,00	GPC-1, GPC-2, GPC-3, GPC-4, PC-1, UC-1, UC-2

6	Cooperative Games (offered in a foreign language)	E	4,00			4,00	GPC-1, GPC-2, GPC-3, GPC-4, PC-1, UC-1, UC-2
7	Time Series and Stochastic Processes (offered in a foreign language)	E	4,00			4,00	GPC-1, GPC-2, GPC-3, GPC-4, PC-1, UC-1, UC-2
8	Research Seminar "Applied Problems of Decision Making 2" (offered in a foreign language)	E	5,00			5,00	GPC-1, PC-1, PC-4, PC-5, UC-1, UC-2, UC-3
	Специализация "Математическая инженерия в науке и бизнесе"		38,00			15,00	23,00
1	Applied Differential Equations	E	5,00			5,00	GPC-1, GPC-2, GPC-3, GPC-4, PC-1, UC-1, UC-2
2	Mathematical Modeling	E	6,00			6,00	GPC-1, GPC-2, GPC-3, GPC-4, PC-1, UC-1, UC-2
3	Research Seminar "Mathematical and Computational Engineering in Science and Business"	E	4,00			4,00	GPC-1, PC-1, PC-4, PC-5, UC-1, UC-2, UC-3
4	Complex Systems Theory	E	5,00			5,00	GPC-1, GPC-2, GPC-3, GPC-4, PC-1, UC-1, UC-2
5	Stochastic Processes	E	4,00			4,00	GPC-1, GPC-2, GPC-3, GPC-4, PC-1, UC-1, UC-2
6	-	E	5,00			5,00	GPC-1, GPC-2, GPC-3, PC-1, UC-1, UC-2
7	-	E	4,00			4,00	GPC-1, GPC-2, GPC-3, PC-1, UC-1, UC-2
8	Research Seminar "Mathematical and Computational Engineering in Science and Business 2" (offered in a foreign language)	E	5,00			5,00	GPC-1, PC-1, PC-4, PC-5, UC-1, UC-2, UC-3
	-		38,00			15,00	23,00
1	Fault-tolerant System Design	E	5,00			5,00	GPC-1, GPC-2, GPC-3, GPC-4, PC-1, PC-2, PC-3, UC-1, UC-2
2	Fault-tolerant System Design 2	E	6,00			6,00	GPC-1, GPC-2, GPC-3, GPC-4, PC-1, PC-2, PC-3, UC-1, UC-2
3	Project Seminar "Software Engineering"	E	4,00			4,00	GPC-1, PC-1, PC-4, PC-5, UC-1, UC-2, UC-3
4	Systems Reliability Engineering	E	5,00			5,00	GPC-1, GPC-2, GPC-3, GPC-4, PC-1, PC-2, PC-3, UC-1, UC-2
5	Systems Reliability Engineering 2	E	4,00			4,00	GPC-1, GPC-2, GPC-3, GPC-4, PC-1, PC-2, PC-3, UC-1, UC-2
6	-	E	5,00			5,00	GPC-1, GPC-2, GPC-3, PC-1, UC-1, UC-2
7	-	E	4,00			4,00	GPC-1, GPC-2, GPC-3, PC-1, UC-1, UC-2
8	Project Seminar "Software Engineering 2"	E	5,00			5,00	GPC-1, PC-1, PC-4, PC-5, UC-1, UC-2, UC-3
	Дисциплины по выбору (Блок 1)		5,00			5,00	
1	Computer Systems Security	E	5,00			5,00	GPC-1, GPC-2, GPC-3, PC-1, UC-1, UC-2

2	Computer Networks	E	5,00			5,00		GPC-1, GPC-2, GPC-3, PC-1, UC-1, UC-2
3	SQL Language	E	5,00			5,00		GPC-1, GPC-2, GPC-3, PC-1, UC-1, UC-2
	Дисциплины по выбору (Блок 2)		6,00			6,00		
1	Java Programming	E	6,00			6,00		GPC-1, GPC-2, GPC-3, PC-1, UC-1, UC-2
2	Combinatorial Optimization	E	6,00			6,00		GPC-1, GPC-2, GPC-3, PC-1, UC-1, UC-2
3	Chapters in Applied Statistics	E	6,00			6,00		GPC-1, GPC-2, GPC-3, PC-1, UC-1, UC-2
	Дисциплины по выбору (Блок 3)		5,00			5,00		
1	Bayesian Methods for Machine Learning	E	5,00			5,00		GPC-1, GPC-2, GPC-3, PC-1, UC-1, UC-2
2	Statistical Learning Theory (offered in a foreign language)	E	5,00			5,00		GPC-1, GPC-2, GPC-3, PC-1, UC-1, UC-2
3	Unstructured Data Analysis	E	5,00			5,00		GPC-1, GPC-2, GPC-3, PC-1, UC-1, UC-2
	Дисциплины по выбору (Блок 4)		4,00			4,00		
1	Reinforcement Learning	E	4,00			4,00		GPC-1, GPC-2, GPC-3, PC-1, UC-1, UC-2
2	Generative Models in Machine Learning	E	4,00			4,00		GPC-1, GPC-2, GPC-3, PC-1, UC-1, UC-2
3	3D Computer Vision	E	4,00			4,00		GPC-1, GPC-2, GPC-3, PC-1, UC-1, UC-2
	Internship		32,00	4,00	5,00	8,00	15,00	
	Professional Internship		7,00	4,00		3,00		
1	Educational Internship	C	1,00			1,00		PC-1, PC-5, UC-1, UC-2, UC-3, UC-6
2	Educational Internship	C	4,00	4,00				GPC-4, PC-2, PC-3, PC-4, PC-5, PC-7, UC-1, UC-2, UC-3, UC-4, UC-6, UC-8
3	Work Experience Internship	C	2,00			2,00		PC-1, PC-2, PC-3, PC-4, UC-10, UC-11, UC-9
	Project Internship		10,00		5,00	5,00		
1	-	C	5,00		5,00			GPC-4, PC-2, PC-3, PC-4, PC-5, PC-7, UC-1, UC-2, UC-3, UC-4
2	-	C	5,00			5,00		GPC-2, PC-1, UC-4, UC-5, UC-6
	Research Internship		15,00				15,00	
1	Preparation of Graduation Thesis	C	9,00				9,00	PC-1, PC-4, PC-5, UC-1, UC-2, UC-3, UC-4, UC-6
2	Graduation Internship	C	6,00				6,00	PC-1, PC-2, PC-3, PC-4
	General Courses		14,00	9,00	1,00		4,00	
	Core General Courses		2,00	1,00	1,00			
1	Physical Training	C	1,00		1,00			UC-7
2	Safe Living Basics	C	1,00	1,00				UC-8
	Optional General Courses		12,00	8,00			4,00	

1	Economics	C	4,00	4,00				UC-1, UC-2, UC-9
2	Elective General Courses	E	4,00				4,00	UC-1, UC-2, UC-5
3	Legal Literacy	C	4,00	4,00				UC-10, UC-2, UC-3, UC-4
	Minor		20,00		10,00	10,00		
1	Minor	E	20,00		10,00	10,00		UC-1, UC-2, UC-3, UC-5, UC-6
	English		1,00				1,00	
	Examinations		1,00				1,00	
1	Independent English Exam							UC-3, UC-4, UC-5
2	Project Proposal	C	1,00				1,00	PC-5, UC-1, UC-2, UC-4, UC-5, UC-6
3	English Language Integrative Exam (offered in a foreign language)	C						UC-3, UC-4, UC-5
	Optional Courses							
1	Academic English Writing (offered in a foreign language)	O	2,00				2,00	PC-4, PC-5, UC-3, UC-4, UC-5
2	English (offered in a foreign language)	O	14,00	8,00	6,00			UC-3, UC-4, UC-5
	Data Culture		5,00				5,00	
1	Independent Programming Test. Advanced Level	C						GPC-1, GPC-2, GPC-3, GPC-4, GPC-5, PC-2, PC-3, PC-7, UC-1
2	External Examinations on Digital Skills. Entry-level	C						GPC-4
3	External Examinations on Digital Skills. Intermediate Level	C						GPC-4
4	External Examinations on Digital Skills. Final Level	C						GPC-4
5	Service-Oriented Architectures (offered in a foreign language)	E	4,00				4,00	GPC-1, GPC-2, GPC-3, PC-1, UC-1, UC-2
6	Introduction to Deep Learning (offered in a foreign language)	E	4,00				4,00	GPC-1, GPC-2, GPC-3, PC-1, UC-1, UC-2
7	Independent Digital Literacy Test	C						GPC-4, UC-1, UC-6
8	Independent Data Science Test. Advanced Level	C	1,00				1,00	GPC-1, GPC-2, GPC-3, GPC-4, PC-1, UC-1, UC-2
	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-4, PC-1, PC-2, PC-4, PC-5, PC-7, UC-1, UC-2, UC-3
	State Examinations							

Curriculum agreed:

Academic Supervisor	SOKOLOV E.A.	13.05.2022
Dean	ARZHANTSEV I.V.	13.05.2022
Head of Centre for Educational Model Design	LEPESHKIN I.A.	18.05.2022

* Subject type:

Compulsory course

C

Elective course

E

Optional course

O