



Handbook of modules for the study course Applied Mathematics, B.Sc.

October 2025

valid for all students enrolled from
WS 2023/24 onwards

The most important details

Duration:	8 semesters
Location:	100174, Tashkent city, Almazor district, University street, 4th house
Qualification:	Bachelor of Applied Mathematics
Course start:	Annually in the autumn term
Language:	Uzbek
Preparatory internship:	Students undertake a 2-week (60 hours, 2 credits) qualifying internship after the 2nd, 4th, and 6th semesters. In the 8th semester, they complete a 450-hour (15 credits) qualifying internship. The Final State Certification is conducted in the 8th semester with a workload of 450 hours (15 credits).
Internship/ study abroad:	-
Bachelor thesis:	During the 7th and 8th semesters, final-year students of the applied mathematics program work on their bachelor thesis under academic supervision. The thesis is prepared in accordance with the academic standards of the program and is defended at the end of the 8th semester.
Calculation of workload:	1 CP equals 30 hours per semester
Examinations:	The assessment of students' knowledge is carried out in accordance with the Order of the Minister of Higher and Secondary Specialized Education of the Republic of Uzbekistan "On the Approval of the Regulation on the System of Monitoring and Assessing Students' Knowledge in Higher Educational Institutions", developed under the credit-modular system.
Literature:	Literature mentioned in the module descriptions are first recommendations and do not replace the syllabus of the module. The module coordinators assume as a rule that the titles specified always refer to the most current version.
Attendance:	Attendance of all seminars, exercises and lab courses is mandatory.

This programme is
accredited by



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Curriculum BD-60540200 – Applied Mathematics

Semester 1											
Serial number in the curriculum	Subject qualification code	Names of academic subjects and types of activities	Student academic workload (in hours)							Weekly in-class workload (hours)	Credits (ECTS)
			Total workload	In-class sessions (hours)					Independent study		
				Total	Lectures	Problem-solving sessions	Laboratory work	Seminars			
1.01	UYTB104	Contemporary History of Uzbekistan	120	60	30			30	60	4	4
1.04	XJTB104	Foreign Language	120	60		60			60	4	4
1.08	AAGB110	Linear Algebra and Analytic Geometry 1	150	60	30	30			90	4	5
1.09	DMM110	Discrete Mathematics and Mathematical Logic 1	150	60	30	30			90	4	5
1.10	MANB117	Mathematical Analysis	180	90	44	46			90	6	6
1.11	ATDB120	Algorithmic Languages and Programming	180	60	30	30			120	4	6
Total per semester			900	390	164	196		30	510	26	30
Semester 2											
Serial number in the curriculum	Subject qualification code	Names of academic subjects and types of activities	Student academic workload (in hours)							Weekly in-class workload (hours)	Credits (ECTS)
			Total workload	In-class sessions (hours)					Independent study		
				Total	Lectures	Problem-solving sessions	Laboratory work	Seminars			
1.03	URTB104	Uzbek (Russian) Language	120	60		60			60	4	4

1.07	UFZB104	General Physics	120	60	30		30		60	4	4
1.08	AAGB110	Linear Algebra and Analytic Geometry	150	60	30	30			90	4	5
1.09	DMM110	Discrete Mathematics and Mathematical Logic	150	60	30	30			90	4	5
1.10	MANB117	Mathematical Analysis	180	90	46	44			90	6	6
1.11	ATDB120	Algorithmic Languages and Programming	120	60	30	30			60	4	4
	AMAB1211	Qualification Internship 1	60						60		2
Total per semester			900	390	150	150	60	30	510	26	30
Total Academic Load per Year			1800	780	300	300	120	60	1020	52	60

Semester 3											
Serial number in the curriculum	Subject qualification code	Names of academic subjects and types of activities	Student academic workload (in hours)							Weekly in-class workload (hours)	Credits (ECTS)
			Total workload	In-class sessions (hours)					Independent study		
				Total	Lectures	Problem-solving sessions	Laboratory work	Seminars			
1.02	FALB204	Philosophy	120	60	30			30	60	4	4
1.10	MANB117	Mathematical Analysis 3	150	60	30	30			90	4	5
1.11	ATDB120	Algorithmic Languages and Programming 3	150	60	30	30			90	4	5
1.12	DFTB206	Differential Equations	180	90	30	60			90	6	6
1.13	ABSB206	Algorithms and Data Structures	180	60	30	30			120	4	6
1.14	ENMB209	Probability Theory and Mathematical Statistics 1	120	60	30	30			60	4	4
Total per semester			900	390	180	90	90	30	510	26	30

Semester 4											
Serial number in the curriculum	Subject qualification code	Names of academic subjects and types of activities	Student academic workload (in hours)							Weekly in-class workload (hours)	Credits (ECTS)
			Total workload	In-class sessions (hours)					Independent study		
				Total	Lectures	Problem-solving sessions	Laboratory work	Seminars			
1.05	DINB204	Religious Studies	120	60	30			30	60	4	4
1.11	ATDB120	Algorithmic Languages and Programming 4	120	60		60			60	4	4
1.11	ATDB120	Algorithmic Languages and Programming (Course Project)	30	0					30	cp	1
1.14	ENMB209	Probability Theory and Mathematical Statistics 2	150	60	30	30			90	4	5
1.15	FANB204	Functional Analysis	120	60	30	30			60	4	4
1.16	NZMB206	Theoretical Mechanics	180	90	30	60			90	6	6
2.00		Elective Courses	120	60	30	30			60	4	4
2.03		<i>Elective Course 3</i>	120	60	30	30			60	4	4
	SITB204	Artificial Intelligence Technologies									
	MO'B204	Machine Learning									
	CO'B04	Deep Learning									
	AMAB1212	Qualification Internship 2	60	0					60		2
		Total per semester	900	390	180	120	60	30	510	26	30

Total Academic Load per Year			1800	780	360	210	150	60	1020		60
Semester 5											
Serial number in the curriculum	Subject qualification code	Names of academic subjects and types of activities	Student academic workload (in hours)							Weekly in-class workload (hours)	Credits (ECTS)
			Total workload	In-class sessions (hours)					Independent study		
				Total	Lectures	Problem-solving sessions	Laboratory work	Seminars			
1.06	UPPB308	General Pedagogy. Psychology 1	120	60	30			30	60	4	4
1.17	MIMB306	Methodology of Teaching Mathematics and Informatics	180	60	30			30	120	4	6
1.18	MFTB305	Equations of Mathematical Physics	150	60	30	30			90	4	5
1.19	MMLB310	Mathematical Modelling 1	150	60	30	30			90	4	5
2.00		Elective Courses	300	150	60	90			150	10	10
2.04		<i>Elective Course 2</i>	150	90	30	60			60	6	5
	AHUB305	Methods of Information Protection									
	AXAB305	Fundamentals of Information Security									
	KUB305	Cryptographic Methods									
2.03		<i>Elective Course 3</i>	150	90	30	60			60	6	5
	NTMB305	Incorrect and Inverse Problems									
	MFTB305	Selected Chapters of Mathematical Physics									
	SKMB305	Conditionally Well-posed Problems									
Total per semester			900	390	150	90	120	30	510	26	30

Semester 6											
Serial number in the curriculum	Subject qualification code	Names of academic subjects and types of activities	Student academic workload (in hours)						Weekly in-class workload (hours)	Credits (ECTS)	
			Total workload	In-class sessions (hours)							Independent study
				Total	Lectures	Problem-solving sessions	Laboratory work	Seminars			
1.06	UPPB308	General Pedagogy. Psychology 2	120	60	30			30	60	4	4
1.19	MMLB310	Mathematical Modelling 2	120	60	30	30			60	4	4
1.19	MMLB310	Mathematical Modelling (Course Project)	30	0					30	cp	1
1.20	JTOB305	Operations Research and Optimal Control	150	60	30	30			90	4	5
1.21	KMTB306	Computer-based Mathematical Systems	180	90	30	60			90	6	6
2.00		Elective Courses	240	120	60	60			120	8	8
2.04		<i>Elective Course 4</i>	120	60	30	30			60	4	4
	PTDB304	Python Programming Language									
	PKB304	Python Libraries									
	PLB304	Project Development in Python									
2.05		<i>Elective Course 5</i>	120	60	30	30			60	4	4
	YTKB304	Constitution of the Republic of Uzbekistan (New Edition)									
	HFXB304	Life Safety									
	YFGB304	Age Physiology and Hygiene									
	AMAB1212	Qualification Internship 3	60						60		2
		Total per semester	900	390	180	180		30	510	26	30
		Total Academic Load per Year	1800	780	360	330		90	1020		60

Semester 7											
Serial number in the curriculum	Subject qualification code	Names of academic subjects and types of activities	Student academic workload (in hours)							Weekly in-class workload (hours)	Credits (ECTS)
			Total workload	In-class sessions (hours)					Independent study		
				Total	Lectures	Problem-solving sessions	Laboratory work	Seminars			
1.22	SUSB406	Numerical Methods	150	90	30	60			60	6	5
1.22	SUSB406	Numerical Methods (Course Project)	30						30	cp	1
1.23	KUFB406	Theory of Functions of a Complex Variable	180	60	30	30			120	4	6
2.00		Elective Courses	480	240	120	120			240	16	16
2.06		<i>Elective Course 6</i>	120	60	30	30			60	4	4
	MIYB405	Mobile Application Development									
	MILB405	Mobile Application Design									
	TMIB405	Using Mobile Applications in Education									
2.07		<i>Elective Course 7</i>	120	60	30	30			60	4	4
	KGB405	Computer Graphics									
	KGEB405	Computer Geometry									
	FGB405	Vector Graphics									
2.08		<i>Elective Course 8</i>	120	60	30	30			60	4	4
	BTB404	Cloud Technologies									
	TMBB404	Computer Network Administration									
	LBB404	Project Management									
2.09		<i>Elective Course 9</i>	120	60	30	30			60	4	4
	CMYB404	Modern Methods for Solving Boundary Problems									
	FIB404	Function Interpolation									

	HMZB404	Modern Methods of Computational Mathematics									
Total per semester			900	390	194	136	30	30	510	26	30
Semester 8											
Serial number in the curriculum	Subject qualification code	Names of academic subjects and types of activities	Student academic workload (in hours)						Weekly in-class workload (hours)	Credits (ECTS)	
			Total workload	In-class sessions (hours)							
				Total	Lectures	Problem-solving sessions	Laboratory work	Seminars			Independent study
	AMAB1214	Qualification Internship 4	450						450		15
	YDAB415	Final State Certification	450						450		15
		Total per semester	900						900		30
Total Academic Load per Year			1800	390	194	136	30	30	1410		60
Total			7200	2730	1168	812	480	270	4470		240

Curriculum Applied Mathematics, B.Sc

Module No./ Modul-Nr.	Subjects / Module	CS*	L	Type					Ex		CP								
				Pr	S	Lab	SS	CW	Module Exam	Final exam		1 sem	2 sem	3 sem	4 sem	5 sem	6 sem	7 sem	8 sem
UYTB104	The latest history of Uzbekistan	2	1		1		2		P		4	4							
FALB204	Philosophy	2	1		1		2		P		4			4					
URTB104	Uzbek (Russian) language	2		2			2		P		4		4						
XJTB104	Foreign language	2		2			2		P		4	4							
DINB204	Religious studies	2	1		1		2		P		4				4				
UPPB308	General pedagogy. Psychology	4	2		2		4		P		8					4	4		
UFZB104	General Physics	2	1			1	2		P		4		4						
AAGB110	Linear algebra and analytical geometry	4	2	2			6		P		10	5	5						
DMM110	Discrete mathematics and mathematical logic	4	2	2			6		P		10	5	5						
MANB117	Mathematical analysis	8	4	4			9		P	E	17	6	6	5					
ATDB120	Algorithmic languages and programming	8	3	5			12	cw	P	E	20	6	4	5	5				
DFTB206	Differential equations	3	1	2			3		P		6			6					
ABSB206	Algorithms and data structures	2	1	1			4		P		6			6					
ENMB209	Probability theory and mathematical statistics	4	2	2			5		P		9			4	5				
FANB204	Functional analysis	2	1	1			2		P		4				4				
NZMB206	Theoretical mechanics	3	1	2			3		P		6				6				
MIMB306	Methods of teaching mathematics and computer science	2	1		1		4		P		6					6			
MFTB305	Equations of Mathematical Physics	2	1	1			3		P		5					5			
MMLB310	Mathematical modeling	4	2	2			6	cw	P	E	10					5	5		
JTOB305	Operations Research and Optimal Control	2	1	1			3		P		5						5		
KMTB306	Computer mathematical systems	3	1	2			3		P		6						6		
SUSB406	Numerical methods	3	1	2			3	cw	P	E	6							6	
KUFB406	Theory of functions of a complex variable	2	1	1			4		P		6							6	
	Elective Subjects	19	8	11			21				40				4	10	8	18	

	Total	91	39	45	6	1	113				204	30	28	30	28	30	28	30	0	
AMAB121	Qualification practice										21		2		2		2		15	
YDAB415	Final state certification										15								15	
	Total										36									
	ALL										240									
											240									
											Credit Points									240

Abbreviations:

CS= Classroom sessions, in ECTS

Ex= type of examination

CP = credit points (= ECTS-points)

L = Lecture

S= Seminar

SS = Self study

Lab= lab course

Pr= Praktikum

CW = Course work

T = certificate

P = examination (graded)

	total	1.Sem	2.Sem	3.Sem	4.Sem	5.Sem	6.Sem	7.Sem	8.Sem
CS	204	30	28	30	28	30	28	30	
CP	240	30	30	30	30	30	30	30	30

Elective modules 1		SWS	Ex	CP
SITB204	Artificial intelligence technologies	4	P	4
MO'B204	Machine learning	4	P	4
CO'B204	Deep learning	4	P	4
2 elective modules amount to		4		4

Elective modules 3		SWS	Ex	CP
NTMB305	Incorrect and inverse problems	5	P	4
MFTB305	Selected Chapters of Mathematical Physics	5	P	4
SKMB305	Conditionally well-posed problems	5	P	4
2 elective modules amount to		5		4

Elective modules 5		SWS	Ex	CP
HFXB304	Life safety	6	P	4
YFGB304	Age physiology and hygiene	6	P	4
YTKB304	The Constitution of the Republic of Uzbekistan in a new analysis	6	P	4
1-2 elective modules amount to		6		4

Elective modules 7		SWS	Ex	CP
KGB405	Computer graphics	7	P	4
KGEB405	Computer geometry	7	P	4
FGB405	Vector graphics	7	P	4
1-2 elective modules amount to		7		4

Elective modules 9		SWS	Ex	CP
CMYB404	Modern Methods for Solving Boundary Problems	7	P	4
FIB404	Function interpolation	7	P	4
HMZB404	Modern methods of computational mathematics	7	P	4
1-2 elective modules amount to		7		4

Elective modules 2		SWS	Ex	CP
AHUB305	Methods of Information Protection	5	P	5
AXA305	Fundamentals of Information Security	5	P	5
KUB305	Cryptographic methods	5	P	5
2 elective modules amount to		5		5

Elective modules 4		SWS	Ex	CP
PDTB304	Python programming language	6	P	4
PKB304	Python libraries	6	P	4
PLB304	Project development in Python	6	P	4
1-2 elective modules amount to		6		4

Elective modules 6		SWS	Ex	CP
MIYB405	Mobile Application Development	7	P	4
MILB405	Mobile applications design	7	P	4
TMIB405	Using mobile applications in education	7	P	4
1-2 elective modules amount to		7		4

Elective modules 8		SWS	Ex	CP
BTB404	Cloud technologies	7	P	4
TMBB404	Computer Network Administration	7	P	4
LBB404	Project management	7	P	4
1-2 elective modules amount to		7		4

Study Semester: 1 (full time)**ECTS:** 4**Workload**

Contact Time		Self-study	
Lectures	30 h	Preparation for Contact Time	30 h
Exercises	30 h	Literature review	30 h
Sum	60 h	Sum	60 h

Total Workload: 120 h**Lecturers**

R. Khomitov – Professor at the Department of “Modern History of Uzbekistan”,
 A. Ermetov – Professor at the Department of “Modern History of Uzbekistan”,
 K. Saipova – Professor at the Department of “Modern History of Uzbekistan”,
 H. Olimjonov – Senior Lecturer at the Department of “Modern History of Uzbekistan”.

Teaching Contents

Introduction. Subject, goals, and objectives of the educational course "Modern History of Uzbekistan," its theoretical and methodological foundations. Stages of formation and development of Uzbek statehood. Socio-political processes in Uzbekistan on the eve of independence. Historical significance of the formation of the independent Republic of Uzbekistan. Uzbekistan's unique path to sovereignty and development. Formation of the foundations of a democratic, civil society in Uzbekistan and the political reforms implemented. Socio-economic changes in Uzbekistan during the years of independence. Spiritual and cultural development of Uzbekistan during the years of independence. The Republic of Karakalpakstan during the years of independence. Uzbekistan and the global community. Reforms being implemented in the new Uzbekistan.

Learning Outcomes:

To successfully complete this discipline, students:

- know the recent history of Uzbekistan; to understand the processes of Uzbekistan's integration into the global community under modern conditions, ensuring security, interethnic harmony, and religious tolerance; to comprehend the role of historical science in the development of society and human worldview, as well as to possess skills in recognizing the connection between contemporary events and significant historical facts¹;
- be able to apply the idea of national independence in studying the problems of the modern history of Uzbekistan and forming a worldview; understand the importance of increasing the international rating and authority of the Republic of Uzbekistan from a historical and objective point of view²;
- To be able to scientifically justify and express one's views on spiritual, national, and universal issues; to possess the competencies of an active life philosophy based on the ideas of national independence³.

¹Knowledge; ²Skill; ³Competence.

Teaching and learning methods:

Lectures; problem-solving sessions; group discussions; individual assignments; formative assessment and feedback; interactive case studies; practical sessions (logical reasoning, rapid Q&A); group work; giving presentations.

Entrance requirements:

Mandatory: None

Recommended: History of Uzbekistan, World History

Reading list

1. R.H. Murtazayeva O‘zbekistonda millatlararo munosabatlar va tolerantlik. Darslik. - Toshkent: Mumtoz so‘z, 2019.
2. Mustaqil O‘zbekiston tarixi. Mas’ul muharrir A.Sabirov. – Toshkent: Akademiya, 2013.
3. Новейшая история Узбекистана. Руководитель проекта и редактор. М.А.Рахимов. – Тошкент: Адабиёт учкунлари, 2018.
4. Rasulova N. O‘zbekistonning eng yangi tarixi. 1-qism. – Toshkent, 2021. – 186 bet.
5. O‘zbekistonning eng yangi tarixi. R.H.Murtazayeva, A.A.Ermetov, A.A.Odilov. – Toshkent, 2023.

Examination:

Assessment of students’ knowledge is carried out in accordance with the Regulation on the system for monitoring and assessing students’ knowledge in higher education institutions developed based on the credit-module system

Type of assessment	Midterm	Final
Type of assessment	Midterm	Final
Time of assessment	Week 8	Weeks 16-17
Form of assessment	Written work	Written and oral

Intermediate assessment: This evaluation is conducted after covering sections related to lectures and seminars, amounting to half of the total course material. The covered content will be distributed across different versions, each containing 1 complex question and 2 simple ones. Responses will be accepted in both written and oral formats. Students submit their written answers and then respond to the questions orally, with the opportunity to earn a maximum of 5 points for each response. Students will receive up to 5 points for each correct answer.

Teaching materials and media

Projector; white/black board; hand-outs; flipchart; visualisation aids for presentation; demonstration materials.

Study Semester: 3 (full time)**ECTS:** 4**Workload**

Contact Time		Self-study	
Lectures	30 h	Preparation for Contact Time	30 h
Exercises	30 h	Literature review	30 h
Sum	60 h	Sum	60 h

Total Workload: 120 h**Lecturers**

O. Mukhamadieva – Professor at the Department of “Philosophy”,
 A. Tulaev – Associate Professor at the Department of “Philosophy”,
 G. Shodimetova – Associate Professor at the Department of “Philosophy”.

Teaching Contents

Philosophy and its role in society. Stages in the development of philosophical thought: Eastern philosophy. Stages in the development of philosophical thought: Western philosophy. Philosophy of being (ontology) and philosophy of development. Philosophy of knowledge (epistemology). Logic. Forms of thinking: concept, judgment, and reasoning. Social philosophy. Philosophy of human nature (philosophical anthropology). Philosophy of values (axiology). Philosophy of morality (ethics). Philosophy of beauty (aesthetics). Philosophy of globalization and sustainable development. Global experience in combating corruption. Uzbekistan's anti-corruption policy.

Learning Outcomes:

To successfully complete this discipline, students:

- know the key stages in the development of philosophical thought: Ancient Eastern, Ancient Greek and Roman, Medieval, Modern, and Contemporary philosophy; understand the fundamental categories and concepts of philosophy: being, matter, consciousness, cognition, truth, values, personality, society; comprehend the role of philosophy in shaping the scientific worldview and methodology of physics; be familiar with contemporary philosophical concepts related to ontology, epistemology, and axiology; understand the interrelation between philosophy and physics, especially in aspects of scientific method, limits of knowledge, and ethics of scientific research; recognize the significance of philosophy in the context of globalization, digitalization, and the ecological and technological challenges of our time¹;
- to be able to use philosophical categories and methods for analyzing problems in physics and scientific cognition; to apply principles of logic and critical thinking in argumentation, constructing proofs, and scientific reasoning; to utilize philosophical ideas when discussing scientific, ethical, and social aspects of a physicist's professional activities; to analyze philosophical texts and extract from them the main arguments, propositions, and worldview perspectives²;
- to be capable of forming one's own position on fundamental questions of existence, cognition, science, and ethics; to critically evaluate social and cultural phenomena from the perspective of philosophy and science; to synthesize philosophical and scientific knowledge in order to develop a responsible approach to scientific issues; to engage in dialogue about the philosophical foundations of science, free will, the responsibility of scientists, and the values and goals of scientific progress³.

¹Knowledge; ²Skill; ³Competence.

Teaching and learning methods:

Lectures; problem-solving sessions; group discussions; individual assignments; formative assessment and feedback; interactive case studies; practical sessions (logical reasoning, rapid Q&A); group work; giving presentations.

Entrance requirements:

Mandatory: None

Recommended: History of Uzbekistan, World History

Reading list

1. Davronov Z., Shermuhamedova N, Qahharova M, Nurmatova M, Husanov B, Sulstonova A. Falsafa. – Toshkent: TMU, 2019
2. Madaeva Sh. Shermuhamedova N. va boshqalar. Falsafa – o‘quv qo‘llanmasi. – Toshkent: 2019
3. Muhammadjonova L.A. L.A. Abdulla Sher, Shodimetova G. Axloq falsafasi. – Toshkent: Vneshinvestprom, 2023
4. Saifnazarov I. Muxtorov A., Sultanov T., Usmonov F. Falsafa. Darslik. –T.: Innovatsion rivojlanish nashriyot – matbaa uyi, 2021.-424 b.

5. Саифназаров И.С., Абдуллаханова Г.С., Эрназаров Д.З. Философия (Логика, Этика, Эстетика). Учебное пособие для высших учебных заведений. LAMBERT Akademik Publishing RU. 2019. -134 стр.
6. Shermuhamedova N. Falsafa. – Toshkent: Idris Abdurauf Nashr, 2021. 667-b

Examination:

Assessment of students' knowledge is carried out in accordance with the Regulation on the system for monitoring and assessing students' knowledge in higher education institutions developed based on the credit-module system, Article 15

Type of assessment	Midterm	Final
Time of assessment	Weeks 29-30	Weeks 36-37
Form of assessment	Written work	Written and oral

Intermediate assessment: This evaluation is conducted after covering sections related to lectures and seminars, amounting to half of the total course material. The covered content will be distributed across different versions, each containing 1 complex question and 2 simple ones. Responses will be accepted in both written and oral formats. Students submit their written answers and then respond to the questions orally, with the opportunity to earn a maximum of 5 points for each response. Students will receive up to 5 points for each correct answer. Final Assessment: is conducted based on the prepared variants for all covered topics. In this case, the covered material will be distributed among the variants, which will contain 1 difficult and 2 simple questions. Answers are accepted in writing. The overall score is derived based on the arithmetic mean.

Teaching materials and media

Projector; white/black board; hand-outs; flipchart; visualisation aids for presentation; demonstration materials.

Study Semester: 2 (full time)

ECTS: 4

Workload

Contact Time		Self-study	
Exercises	60 h	Preparation for Contact Time	30 h
		Literature review	30 h
Sum	60 h	Sum	60 h

Total Workload: 120 h

Lecturers

Z.Takhirov – Professor Lecturer at the Department of “Computational Linguistics and Applied Linguistics” (Uzbek language),

D. Fattakhova – Senior Lecturer at the Department of “Computational Linguistics and Applied Linguistics” (Uzbek language),

Z. Qodirova – Assistant Lecturer at the Department of “Computational Linguistics and Applied Linguistics” (Uzbek language),

M. Jurakulova – Assistant Lecturer at the Department of “Computational Linguistics and Applied Linguistics” (Uzbek language),

K. Ibodullayeva – Assistant Lecturer at the Department of “Computational Linguistics and Applied Linguistics” (Uzbek language).

Teaching Contents

Uzbek language: Uzbekistan is the only Homeland. Rules of orthoepy: Uzbek as the state language. Orthographic rules of the Uzbek language. National values are the pride of the nation. Word formation in the Uzbek language. History and our time. Lexical layers of language. Education in the modern world. Language and terminology. Museums: a bridge between past and future. Industry-specific terms and their usage. Reading books. Free and fixed word combinations. Types of idioms. Literature: a source of spiritual elevation. Speech styles. Artistic style. Mass media. Internet culture. Journalistic style and its features. Innovations in the 21st century. Scientific style and its methodological characteristics. Global problems of our time. Articles and their types. Nature and humankind. Rules for conducting interviews. Report preparation procedure. Legal culture. Formal administrative style and its features. From the life of our scientific community. Conversational style and its features. Dialect-specific words. Life in My Imagination. Text and Its Manifestations. Types of Dialogic Texts Based on Semantic Relations. The Mentor’s School. Monologic Text. The Sequence of Content and Tone in a Monologic Text. The Story of My Profession. Specialized Dictionaries: Issuance of Terms and Combinations. A Seasoned Specialist. Text Analysis and Editing. The Path to Science. Annotation and Review Texts, Features of Expressive Material. Professional Ethics. Speech Etiquette. The Concept of Norm. Art and Spirituality. Artistic Terms Adopted into the Common Lexicon. The Work I Love. Tools of Artistic Representation. Economy and Life. Economic Terms Adopted into the Common Lexicon. Language and Style of Conducting a Meeting.

Russian language: Introduction. Phonetic and orthoepic norms of the Russian language. Parts of speech (noun, adjective, numeral, pronoun, verb). Predicate-case system: nominative case, prepositional case, accusative case, genitive case, instrumental case. Verbs, their forms, and governance (past, present, and future tenses). Verbs of motion; type (perfect, imperfect). Common vocabulary. Expression of object-explanatory relations in simple and complex sentences. Expression of temporal relations in simple and complex sentences. Expressing connection (addition), comparison, juxtaposition, and contrast. The expression of attributive relations in simple and complex sentences. Expressing spatial relationships in simple and complex sentences. The expression of cause-and-effect relationships in simple and complex sentences. Expressing conditional and concessive relations in simple and complex sentences. Expressing purposeful relationships in simple and complex sentences. Speech styles: functional speech styles. Scientific style of speech and its features. Essay. Structure of the abstract. Abstract. Linguistic and syntactic means of scientific speech. Expression of subject-predicative relations. The expression of object relations in sentences. Expression of object-explanatory relations. The expression of attributive relations in sentences. Expressing connection (addition), comparison, juxtaposition, and contrast. Expression of spatial relations in sentences. Review. Review structure.

Learning Outcomes:

To successfully complete this discipline, students:

- to possess linguistic and communicative competence in the modern Uzbek (Russian) language within the professional domain of one's chosen field; To be able to construct a monologic statement in Russian on professional topics.
- independently search for scientific information as a foundation for professional activity; to express one's thoughts freely in both oral and written forms on professionally relevant topics; work independently when preparing presentations, reports, and papers on professional subjects; be able to conduct a dialogue, participate in a polylogue on a given topic, and produce secondary scientific texts (such as annotations, abstracts, summaries); be able to generalize and interpret scientific information, and to apply key techniques for processing oral and written texts using academic vocabulary and scientific language structures.²
- possess skills in drafting annotations and abstracts, selecting linguistic means appropriate to the communicative intent and context of interaction; be able to use etiquette forms of scientific and professional communication; have the ability to clearly articulate one's point of view on a scientific issue in Uzbek (Russian); translate informational messages (without a dictionary) and specialized texts (with a dictionary) from Uzbek (Russian) into the native language.³

¹Knowledge; ²Skill; ³Competence.

Teaching and learning methods:

Practical classes, Group work.

Entrance requirements:

Mandatory: None

Recommended: To be able to express and understand one's opinion on everyday life topics.

Reading list

1. M.Abdurahmanova, D.Fattoxova, U.Xalmuxamedova, N.Inogamova, N.Egamberdiyeva. O'zbek tili (o'quv qo'llanma). – Toshkent: Mumtoz so'z, 2018. – 276 b.
2. Husanov N., Xo'jaqulova R., Dilmurodova N. O'zbek tili (darslik). – Toshkent: TMI, 2020. – 515 b.
3. Muhiddinova X., Salisheva Z., Po'latova X. O'zbek tili (oliy ta'lim muassasalari rus guruhlar uchun darslik). – Toshkent: O'qituvchi, 2012.– 288 b
4. Yuldasheva Sh., Kabulova D., Sobirova M. O'zbek tili (o'quv qo'llanma). Nukus: Bilim, 2013. – 156 b.
5. Lafasov U. O'zbek tili (o'quv qo'llanma).–Toshkent:ToshDSHI, 2016. –532

Examination:

Assessment of students' knowledge is carried out in accordance with the Regulation on the system for monitoring and assessing students' knowledge in higher education institutions developed based on the credit-module system, Article 15

Type of assessment	Midterm	Final
Type of assessment	Midterm	Final
Time of assessment	Weeks 28-29	Weeks 36-37
Form of assessment	Written work	Written and oral work

Midterm Assessment: is conducted after mastering the sections related to lectures and seminars in a volume equal to half of the total. Answers will be accepted in written and oral form. The student submits the written answer, and then answers the questions orally.

Final Assessment: is conducted based on the prepared variants for all covered topics. Answers will be accepted in written and oral form. The student submits the written answer, and then answers the questions orally.

Teaching materials and media

Projector; white/black board; hand-outs; flipchart; visualisation aids for presentation; demonstration materials.

Study Semester:**1 (full time)****ECTS: 4****Workload**

Contact time		Self-study hours	
Practical course	60 hours	Preparation for contact time	30 hours
		Literature review	30 hours
Total hour	60 hours	Total hour	60 hours

Total workload: 120 hours**Lecturers**

Z.Agzamova – senior teacher of the Interfaculty Department of the “English language”,

D.Olimova – teacher of the Interfaculty Department of the “English language”,

N.Urmanova - professor of the department of the “French philology”.

Teaching Contents

General topics – talking about myself, family, daily routine, favorite activities, free time, everyday life, etc.;

Social topics – everyday issues, personality and professional psychology, ethics, environmental protection, global problems;

Socio-Cultural topics – situations related to science and professional fields, cultural differences, countries where the target language is spoken, their culture, social characteristics, and the importance of foreign languages;

Educational topics – the education system, lifelong learning, leading universities of the world, lectures, scientific articles, writing theses, reading, learning, and presentation strategies;

Topics related to the Internet and Information Technology – scientific and technological news in the world and in our country, achievements, inventions, the use of internet networks, and the latest technologies;

Topics related to the professional field – career, current topics, drafting documents, professional ethics, conducting negotiations, scientific and applied ideas in the professional sphere, innovative ideas and developments, leading scientists in the field and their contributions to science.

In practical classes, communicative competence is developed through the integration of reading, writing, listening, and speaking skills. The topics are selected based on the specifics of the subject and professional orientation and serve as a foundation for language skill development. It is recommended to effectively use various teaching methods and technologies in this process. For example:

Dialogue – conversations on social topics and informal dialogues; formal and informal discussions on professional or other topics; conducting interviews, phone negotiations, etc.

Monologue – preparing and presenting lectures on professional topics, discussion, giving arguments and evidence, expressing one’s opinion; preparing and delivering presentations, writing and analyzing articles;

Reading – skimming, scanning, and intensive reading to develop skills; reading letters, messages, and emails; reading specialized texts containing authentic materials; reading texts with professional and scientific terminology, literature in the field of study, electronic sources, and the press;

Writing – composing various texts, letters and messages, specialized documents (e.g., CVs); writing essays, summaries, abstracts, scientific and graduation qualification papers;

Listening – listening to authentic materials twice to understand the main idea, obtain necessary information, and reproduce it; understanding daily news, reports, film character speech, etc.

Learning Outcomes:

To successfully complete this discipline, students:

- Acquire knowledge – build a lexical and grammatical foundation necessary for communication on every day, academic, and professional topics; comprehend the content of written and oral texts related to professional and scientific activities;
- Develop skills – apply foreign language skills in both oral and written forms to solve communicative tasks in academic, professional, and everyday environments; participate in discussions, interviews, business negotiations, and presentations while adhering to speech norms and cultural differences; analyze the structure and content of scientific and professional texts; interpret key ideas and arguments;
- Master competences – carry out comparative analysis of authentic information sources (scientific articles, reports, interviews, professional dialogues); formulate and express personal opinions on professional and scientific topics orally and in writing, using appropriate terminology; produce written texts (essays, reports, CVs, abstracts, scientific articles) on subjects related to their future

profession; develop strategies for independent foreign language learning, including searching for, selecting, and using authentic materials; demonstrate the ability to critically process information received in a foreign language and apply it in professional practice.

Teaching and learning methods:

Individual, pair and group works, presentations, project works, case-study and different interactive methods and activities.

Entrance requirements:

Mandatory: None

Recommended: Ability to express and understand one's opinion on everyday life topics

Reading list

1. Tim Falla, Paul A. Davis, Solutions Elementary. Student's Book, 3-rd edition. Oxford University press, 2017
2. Tim Falla, Paul A. Davis, Solutions Pre-Intermediate. Student's Book, 3-rd edition. Oxford University press, 2017
3. Tim Falla, Paul A. Davis, Solutions Intermediate Elementary. Student's Book, 3-rd edition. Oxford University press, 2017
4. Shirinova R.X. Fransuz tili // Darslik. - T.: Sano standart, 2015 (ikkinchi nashr, 2017).
5. O'rmonova N.M., Raximova M.A. Le français niveau B1. Toshkent. Yosh avlod matbaa. 2021.
6. Girardet J., Pecheur J. et d'autres. Tendances. Methode de français. CLE International, 2016. P.161.

Examination:

Assessment of students' knowledge is carried out in accordance with the Regulation on the system for monitoring and assessing students' knowledge in higher education institutions developed based on the credit-module system, Article 15

Type of assessment	Midterm	Final
Type of assessment	Midterm	Final
Time of assessment	Weeks 9	Weeks 19-20
Form of assessment	Written work	Written and oral work

Midterm assessment - conducted after completing sections corresponding to the practical sessions, covering approximately half of the overall course content. Answers are accepted in written form.

Final assessment - conducted based on prepared exam variants covering all topics studied throughout the course. Answers are accepted in both written and oral form. The student first submits a written response, and then answers the topic questions orally.

Teaching materials and media

Projector; white/black board; hand-outs; flipchart; visualisation aids for presentation; demonstration materials.

Study Semester: 4 (full time)**ECTS:** 4**Workload**

Contact Time		Self-study	
Lectures	30 h	Preparation for Contact Time	30 h
Seminars	30 h	Literature review	30 h
Sum	60 h	Sum	60 h

Total Workload: 120 h**Lecturers**

N.Tangirov – Associate Professor at Department of “Philosophy”,

A.Tulyaev – Associate Professor at Department of “Philosophy” (Russian).

Teaching Contents

The significance of religion as a phenomenon of social culture. National religions. Zoroastrianism. Buddhism. Christianity. Islam. Dogmatic schools and branches of Islam. The role of the Hanafi madhhab in the history of Central Asia. Religious organizations operating in Uzbekistan. Modern religious movements and sects. The social danger of spreading religious beliefs in cyberspace. The sociopolitical risks of missionary activity and proselytism. History and trends of religious fundamentalism, radicalism, and terrorism. Global experience in combating extremism and terrorism. The importance of achieving unity between empirical knowledge and religious belief.

Learning Outcomes:

To successfully complete this discipline, students:

- Know the basic concepts and terms of religious studies: religion, faith, cult, sect, fanaticism, extremism, tolerance, secularism; understand the historical stages of development of religious teachings and their main characteristics; be familiar with the fundamental teachings of world religions — Buddhism, Christianity, Islam and their branches; understand the interplay between religion, science, and philosophy throughout cultural history; understand the causes of religious fundamentalism, fanaticism, extremism, the essence of religious belief, customs, and traditions and their significance for the individual and society; distinguish between secular and religious knowledge, as well as between authentic religious teachings and their distorted interpretations; understand the influence of religion on worldview, social relations, and intercultural interactions¹;
- Apply knowledge of religious studies to analyze religious phenomena in contemporary society; use religious and philosophical arguments in discussions about the role of religion, morality, and spiritual values; apply acquired knowledge in the prevention of extremism and religious intolerance in everyday and professional activities; analyze similarities and differences in beliefs, rituals, and social functions of world religions; analyze texts and ideas of religious teachings, identifying key points and arguments²;
- Identify links between religious beliefs and social, political, and cultural processes; form a critical attitude toward issues of religious faith, secularism, and interreligious dialogue; evaluate religious, cultural, and political phenomena from the standpoint of tolerance, peace, and humanism; synthesize knowledge of religion, philosophy, and society to form a responsible attitude toward religious culture and spiritual security; engage in dialogue with people of diverse worldviews, respecting religious diversity and recognizing the importance of interfaith interaction³.

¹Knowledge; ²Skill; ³Competence.**Teaching and learning methods:**

Lectures; seminars; independent work; group work.

Entrance requirements:

Mandatory: None

Recommended: History of Uzbekistan, World history.

Reading list

1. Kamilov D. Dinshunoslik. O‘quv qo‘llanma. – T.: Lesson Press, 2021. – 128 b.
2. Muratov D., Alimova M., Karimov J. Dinshunoslik, darslik.– Toshkent, «Navro‘z» nashriyoti, 2019. – 264 b.
3. Raximdjanov D., Ernazarov O. Dinshunoslikka kirish. O‘quv qo‘llanma. – T.: «O‘zbekiston faylasuflari milliy jamiyati» nashriyoti, 2018. – 304 b.
4. Isoqjonov R. Qiyosiy dinshunoslik. O‘quv qo‘llanma. – T.: OOO «Complex print», 2020. – 198 b.
5. Shermuxamedova N.A. Diniy fanatizm fenomeni//Inson falsafasi.– T.: Noshir, 2016. B.314-499.

Examination:

Assessment of students' knowledge is carried out in accordance with the Regulation on the system for monitoring and assessing students' knowledge in higher education institutions developed based on the credit-module system, Article 15

Type of assessment	Midterm	Final
Type of assessment	Midterm	Final
Time of assessment	Weeks 31-32	Weeks 36-37
Form of assessment	Written work	Written and oral work

Midterm Assessment: Conducted after the completion of lecture and seminar sections covering approximately half of the total course. The material is divided into variants with 1 difficult and 2 simple questions. Answers are accepted in both written and oral form. The student submits a written response and then answers the questions orally. A maximum of 5 points can be awarded for each correct answer.

Final Assessment: Covers all course topics. Each exam variant contains 1 difficult and 2 simple questions. Written format. Final grade is calculated as the average score.

Teaching materials and media

Projector; white/black board; hand-outs; flipchart; visualization aids for presentation; demonstration materials.

Study Semester: 5 (full time)**ECTS:** 4**Workload**

Contact Time		Self-study	
Lectures	30 h	Preparation for Contact Time	30 h
Seminars	30 h	Literature review	30 h
Sum	60 h	Sum	60 h

Total Workload: 120 h**Lecturers**

F. Babashev – Associate Professor at Department of “Teacher education”,

U. Sodikov – Associate Professor at Department of “Teacher education”.

Teaching Contents

Methodological foundations of pedagogy. The subject of pedagogical science and research methods. Modernization processes in the education system of the Republic of Uzbekistan. Theory of upbringing. The essence of the educational process. Organizational forms and teaching methods. Innovative methods in education. Theory of upbringing. Upbringing in the pedagogical process. Methods and forms of the educational (upbringing) process. Fundamentals of social pedagogy. Basics of pedagogical activity. Content of the pedagogical profession and its activities. Pedagogical competence and creativity. Management of the education system. Educational administration. The school as an object of management. Contemporary trends in pedagogy. Pedagogical diagnostics. Fundamentals of media education. Fundamentals of inclusive education.

Learning Outcomes:

To successfully complete this discipline, students:

- know the essence and structure of the pedagogical process, the goals and objectives of education, the main methods of teaching and upbringing, and the forms of pedagogical activity; the basics of pedagogical diagnostics, principles of building an educational system, and the characteristics of inclusive and innovative education; understand the integrity of the pedagogical process, the interrelation of teaching and upbringing components, and the importance of pedagogical technologies and resources; the principles of designing curricula and programs, methodological materials, and educational documentation in educational institutions¹;
- be able to apply teaching and upbringing methods in educational practice, manage the educational process using pedagogical and information technologies; organize educational and upbringing activities considering the age and individual characteristics of students, as well as the goals and objectives of personality development; develop and utilize pedagogical resources, maintain educational and methodological documentation, and adapt content and forms of teaching to an inclusive environment².
- be capable of conducting pedagogical diagnostics, interpreting results, and making management decisions based on them; independently developing, analyzing, and implementing innovative teaching methods and forms into the educational process; engaging in pedagogical research, summarizing and disseminating advanced pedagogical experience, and forming one’s own pedagogical strategy; integrating the results of theoretical and practical pedagogical developments into the system of professional education³.

¹Knowledge; ²Skill; ³Competence.**Teaching and learning methods:**

Lecture; Seminars; Self-study; Group work.

Entrance requirements:

Mandatory: None

Recommended: None

Reading list

1. Ахтарова З., Содиков У., Аллаярлова С., Садиқова Ш., Шодмоннов Ш. –Umumiy pedagogika. O‘quv qo‘llanma. -T: “Mumtoz so‘z”, 2021. 331 b.
2. Содиков У., Тахирова М. Общая педагогика. Учебное пособие. - Т.: “Mumtoz so‘z”, 2021. - 312 с.
3. Худайкулов Х. Основы педагогического мастерства. Учебное пособие. –Т.: “Innovatsiya-Ziyo”, 2021. - 208 с.
4. Худойкулов Х.Ж. Общая педагогика. Учебник. – Т.: Ma’rifat, 2023. 316 с.
5. Голованова Н., Педагогика: учебник и практикум для вузов - 2-е изд., перераб.и доп. - М: Издательство Юрайт, 2023. - 372 с.
6. Коджаспирова Г. М., Педагогика: учебник для вузов. - 4-е изд., перераб и доп. — М.: - М: Издательство Юрайт, 2023. - 711 с.

Examination:

Assessment of students' knowledge is carried out in accordance with the Regulation on the system for monitoring and assessing students' knowledge in higher education institutions developed based on the credit-module system, Article 15

Type of assessment	Midterm	Final
Type of assessment	Midterm	Final
Time of assessment	Weeks 8-9	Weeks 19-20
Form of assessment	Written work	Written and oral work

Midterm Assessment: conducted after the completion of sections related to lectures and problem-solving, covering approximately half of the total course content. The material will be divided into versions (variants), each containing 3 questions. Answers must be submitted in written form. Students can earn up to 5 points for each correct answer.

Final Assessment: conducted based on prepared variants covering all topics studied during the semester. Each student receives a variant consisting of 3 questions on the covered topics. Answers are submitted in written form. After submitting the written answers, the student then provides oral responses to the questions. A maximum of 5 points can be awarded for each answer. The final grade is calculated as the arithmetic average of the scores.

Teaching materials and media

Projector; white/black board; hand-outs; flipchart; visualisation aids for presentation; demonstration materials.

Study Semester: 6 (full time)**ECTS:** 4**Workload**

Contact Time		Self-study	
Lectures	30 h	Preparation for Contact Time	30 h
Seminars	30 h	Literature review	30 h
Sum	60 h	Sum	60 h

Total Workload: 120 h**Lecturers**

T. Khudoynazarov – Associate Professor at Department of “Teacher education”,

M. Usmanov – Associate Professor at Department of “Psychology”.

Teaching Contents

History, subject, and functions of the science of psychology. Scientific research methods in psychology. Development of the psyche and mind. Structure of activity. Personality psychology. Attention and its psychological characteristics. Cognitive processes as the basis of the psyche. Understanding intuition. Cognition and the knowledge of perception. Memory as a psychological concept. Imagination and fantasy. The concept of thinking. Psychological features of speech. Psychology of communication. Emotions and emojis. Will and volitional actions. Temperament and its types. The concept of character and its manifestation in life. Abilities and talents.

Learning Outcomes:

To successfully complete this discipline, students:

- know the subject, objectives, and methods of psychological science, as well as the basic concepts and categories of general psychology, the stages of development and formation of the psyche, the patterns of mental processes such as perception, thinking, memory, emotions, and will, understand individual psychological characteristics of personality, including traits of temperament, character, and motivation; the structure and dynamics of mental processes; personality traits and their influence on behavior and activity; the connection between physiological characteristics and psychological manifestations¹;
- be able to analyze a person’s emotional and volitional states, as well as the characteristics of motivation and behavior in various life situations; take into account individual and age-related characteristics in the pedagogical and educational process; select psychophysiological workloads according to the type of nervous system, and adapt approaches to individuals based on their personality traits².
- be capable of applying general psychological knowledge in everyday and professional activities (in pedagogy, social work, management); engaging in psychological self-analysis, assessing one’s own mental states and capabilities, and adjusting them in various activity contexts; synthesizing knowledge of modern psychology, critically evaluating various theories and approaches, and applying them in independent projects and research³.

¹Knowledge; ²Skill; ³Competence.**Teaching and learning methods:**

Lecture; Seminars; Self-study; Group work.

Entrance requirements:

Mandatory: None

Recommended: None

Reading list

1. G‘oziyev E.G. Umumiy psixologiya. Toshkent. 2010.
2. A.Shamshetova, R.N.Melibaeva, X.Usmanova, I.Haydarov. Umumiy psixologiya. T. 2018.
3. David G. Mayers Psychology, USA , 2010.

Examination:

Assessment of students’ knowledge is carried out in accordance with the Regulation on the system for monitoring and assessing students’ knowledge in higher education institutions developed based on the credit-module system, Article 15

Type of assessment	Midterm	Final
Type of assessment	Midterm	Final
Time of assessment	Weeks 28-29	Weeks 36-37
Form of assessment	Written work	Written and oral work

Midterm Assessment: conducted after the completion of sections related to lectures and problem-solving, covering approximately half of the total course content. The material will be divided into versions (variants), each containing 3 questions. Answers must be submitted in written form. Students can earn up to 5 points for each correct answer.

Final Assessment: conducted based on prepared variants covering all topics studied during the semester. Each student receives a variant consisting of 3 questions on the covered topics. Answers are submitted in written form. After submitting the written answers, the student then provides oral responses to the questions. A maximum of 5 points can be awarded for each answer. The final grade is calculated as the arithmetic average of the scores.

Teaching materials and media

Projector; white/black board; hand-outs; flipchart; visualization aids for presentation; demonstration materials.

Study Semester: 2 (full time)**ECTS:** 6**Workload**

Contact Time		Self-study	
Lectures	20 h	Preparation for Contact Time	40 h
Exercises	20 h	Literature review	20 h
Laboratory	20 h		
Sum	60 h	Sum	60 h

Total Workload: 120 h**Lecturers**

G. Raxmonov – Associate Professor at the Department of “General Physics”.

F.Turgunboyev– Associate Professor at the Department of “General Physics”.

Teaching Contents

Introduction. Kinematics of a material point. Dynamics of a material point. Force and momentum of a body. Energy. Oscillations and waves. Properties of gases. Laws of thermodynamics. Fluid mechanics. Physics of solid bodies. Crystalline and amorphous solids. Electrostatics. Direct electric current and its laws. Electromagnetism. Laws of electromagnetic induction. Optics. Quantum properties of light. Atomic and nuclear physics. Physics of elementary particles.

Laboratory sessions.

Introduction. Methods for calculating the errors of experimental results Determination of the acceleration due to gravity using a mathematical pendulum Determination of the acceleration due to gravity using a physical pendulum Determination of the coefficient of viscosity of liquids using Stokes' method Measurement of small resistances and determination of the specific resistance of conductors Determination of the horizontal component of the Earth's magnetic field using a tangent compass Determination of the focal length of lenses Determination of the magnification of a microscope.

Learning Outcomes:

To successfully complete this discipline, students:

- Should understand the fundamental concepts and quantities related to mechanics, molecular physics, electric and magnetic fields¹.
- Should know the main physical laws such as Gauss's theorem, Coulomb's law, Ohm's law, Kirchhoff's rules, Faraday's law, and their applications¹.
- Should be familiar with the behavior of conductors, dielectrics, and semiconductors in electric and magnetic fields¹.
- Should understand the classical electron theory of conductivity and the nature of electrical current in metals, semiconductors, and vacuum¹.
- Should know about electromagnetic induction, electromagnetic waves, and energy transformations in electric and magnetic fields¹.
- Should be able to use physical laws (Newton's laws of motion, the universal law of gravitation, the laws of conservations, the law of conservation and transformation of energy, Boyle–Mariotte's law, Gay–Lussac's laws, Avogadro's law, etc.) to analyze and calculate parameters related to mechanics and molecular physics².
- Should be able to apply theoretical laws (Ohm's law, Kirchhoff's rules, Gauss's theorem, etc.) to analyze and calculate parameters of electric and magnetic circuits².
- Should be able to assemble electrical circuits in the laboratory and conduct measurements of voltage, current, and resistance².
- Should be able to carry out calculations of work and power of electric current, resonance frequency, reactive power, and other related quantities².
- Should be able to process experimental data, present results, and calculate absolute and relative errors².
- Should be able to analyze and explain mechanical and molecular physics phenomena based on fundamental physical laws, graphs, and data.³
- Should be able to analyze and explain electric and magnetic phenomena using fundamental physical laws, graphs, and data³.
- Should demonstrate independence in conducting experiments, using measuring equipment, and applying research methods to solve practical problems³.
- Should be able to explain physical processes such as induction, current generation, resonance, and electromagnetic wave propagation³.

- Should be capable of synthesizing knowledge of electric and magnetic fields to solve both standard and non-standard problems in general physics³.

¹Knowledge; ²Skill; ³Competence.

Teaching and learning methods:

Lectures, completing and summarizing practical tasks, interactive case studies, blitz surveys, working in groups, delivering presentations, teamwork and project development for defense.

Entrance requirements:

Mandatory: None

Recommended: Basic elements of elementary physics Basic elements of elementary mathematics

Reading list

1. Kalashnikov S.G. Umumiy fizika kursi. Elektr (lotin grafikasida). Oliy o‘quv yurtlarining fizika ixtisosi bo‘yicha o‘quv qo‘llanma. Universitet.Toshkent-2022.
2. Jearl Walker, David Halliday., R.Resnick. Fundamentals of physics. ISBN 978-8808-08797-3. 2014.
3. Douglas C. Giancoli. Physic sprinciples withapplications. 2014

Examination:

Assessment of students’ knowledge is carried out in accordance with the Regulation on the system for monitoring and assessing students’ knowledge in higher education institutions developed based on the credit-module system, Article 15

Type of assessment	Midterm	Final
Type of assessment	Midterm	Final
Time of assessment	8-9-th week	19-20-th week
Form of assessment	Written work	Written and oral examination

Midterm Assessment: The midterm assessment is conducted after approximately half of the discipline’s lecture and practical sessions have been completed. A written assessment is administered, consisting of 3 theoretical questions and 1 practical task based on the topics covered up to that point. Each task is pre-prepared in different versions. Students who provide complete and correct answers receive a maximum of 5 points per correct answer. The final score for the midterm is calculated as the average of the points obtained for each task. The midterm assessment questions are announced at the beginning of the class sessions.

Final Assessment: It is conducted based on prepared variants covering all the topics studied. Each student receives a set containing 3 theoretical questions and 1 problem related to the topics covered during the semester. Answers are submitted in written form. After submitting the written answers, the student answers the questions orally and can receive a maximum of 5 points for each answer. The final grade is calculated as the arithmetic average.

Teaching materials and media

Projector; white/black board; hand-outs; flipchart; visualisation aids for presentation; demonstration materials.

Study Semester: 1 (full time)

ECTS: 5

Workload

Contact Time		Self-study	
Lectures	30 h	Preparation for Contact Time	60 h
Exercises	30 h	Literature review	30 h
Sum	60 h	Sum	90 h

Total Workload: 150 h

Lecturers

E.P. Normatov – Associate Professor at the Department of “Algebra and Functional Analysis”.

Teaching Contents

Complex numbers and their trigonometric form. De Moivre’s formula. Matrices and operations on them. Permutations. Determinants of order n and their properties. Algebraic cofactors and minors. Cramer’s formulas. Inverse matrix. Linear spaces. Dimension and basis. Theorems on linear dependence and independence of vectors. Rank of a matrix. Solving systems of linear equations. Fundamental solutions of homogeneous systems. Linear subspace. Sum and intersection of subspaces. Euclidean space. Orthogonal and orthonormal systems. Orthogonalization process. Orthogonal complement of a subspace. Quadratic form and its canonical form. Linear transformations and their matrices. Image and kernel of a linear transformation. Relationship between transformation matrices in different bases. Invariant subspaces. Eigenvalues and eigenvectors of a linear transformation. Adjoin transformations in Euclidean space. Self-adjoin, unitary, and normal transformations.

Learning Outcomes:

To successfully complete this discipline, students:

- should be able to understand the properties of complex numbers and apply De Moivre’s formula¹;
- should be able to explain matrix operations, permutations, and determinant properties¹;
- should be able to describe the structure of vector spaces, linear dependence/independence, and matrix rank¹;
- should be able to solve systems of linear equations using matrix methods²;
- should be able to perform orthogonalization and find orthonormal bases²;
- should be able to compute eigenvalues/eigenvectors and canonical forms of quadratic functions²;
- should be able to apply linear algebra concepts in real-world problems and interdisciplinary contexts³;
- should be able to use mathematical software for matrix operations³;
- should be able to communicate mathematical reasoning effectively in both oral and written form³.

¹Knowledge; ²Skill; ³Competence.

Teaching and learning methods:

Lectures; interactive case studies; practical sessions (logical reasoning, rapid Q&A); group work; giving presentations

Entrance requirements:

Mandatory: None

Recommended: Ability to perform arithmetic operations with numbers. Ability to perform operations with algebraic fractions. Ability to think mathematically and find solutions to problem-based tasks. Ability to follow discipline and order, and to use necessary literature and internet resources by knowing Russian and English languages.

Mathematical Analysis (MANB117)

Reading list

1. Ayupov A.Sh., Omirov B.A., Xudoyberdiev A.X. Chiziqli algebra, Toshkent, «Muxr-Press», 392 bet, 2023-yil. Darslik.
2. Ayupov A.Sh., Omirov B.A., Xudoyberdiev A.X., Haydarov F.H. Algebra va sonlar nazariyasi, Toshkent, «Tafakkur bo’stoni», 296 bet, 2019-yil. O’quv qo’llanma.
3. Aslonov J.O. Chiziqli algebra va analitik geometriya, “Innovatsiya-Ziyo”, 206 bet, 2020 yil. O’quv qo’llanma.
4. Bayturayev A.M., Kucharov R.R. Algebra va geometriya, Toshkent, “Innovatsiya-Ziyo”, 259 bet, 2020 yil. O’quv qo’llanma.

Examination:

Assessment of students' knowledge is carried out in accordance with the Regulation on the system for monitoring and assessing students' knowledge in higher education institutions developed based on the credit-module system, Article 15

Type of assessment	Midterm	Final
Type of assessment	Midterm	Final
Time of assessment	Weeks 13-14	Weeks 19-20
Form of assessment	Written work	Written work

Midterm Assessment: The midterm assessment is conducted after approximately half of the discipline's lecture and practical sessions have been completed. A written assessment is administered, consisting of 1 theoretical questions and 2 practical task based on the topics covered up to that point. Each task is pre-prepared in different versions. Students who provide complete and correct answers receive a maximum of 5 points per correct answer. The final score for the midterm is calculated as the average of the points obtained for each task. The midterm assessment questions are announced at the beginning of the class sessions.

Final Assessment: The final assessment is conducted in written form based on the topics defined in the discipline syllabus, including both taught subjects and independent learning materials. Each version of the final assessment consists of 2 theoretical questions and 3 practical task.

Teaching materials and media

Projector; white/black board; hand-outs; flipchart; visualisation aids for presentation; demonstration materials.

Study Semester: 2 (full time)

ECTS: 5

Workload

Contact Time		Self-study	
Lectures	30 h	Preparation for Contact Time	60 h
Exercises	30 h	Literature review	30 h
Sum	60 h	Sum	90 h

Total Workload: 150 h

Lecturers

A.M. Bayturaev – Associate Professor at the Department of “Geometry and Topology”.

Teaching Contents

Vectors and Linear Operations on Vectors. Projection of a Vector onto an Axis. Scalar Product of Vectors. Vector Product and Mixed Product of Vectors. Polar, Cylindrical, and Spherical Coordinate Systems. Equations of Straight Lines in the Plane. Various Equations of Planes in Space. Relative Positions of Planes in Space. Distance from a Point to a Plane. Equations of Lines in Space. Relative Positions of Lines in Space. Relative Positions of Lines and Planes. Second-Order Curves in the Plane. The Ellipse and Its Canonical Equation. Canonical Equations of the Hyperbola and the Parabola. General Equations of Second-Order Curves. Center of a Second-Order Curve. Central and Non-Central Curves. Relative Positions of a Second-Order Curve and a Line. Reduction of the General Equation of a Second-Order Curve to Canonical Form. Canonical Equations of Second-Order Surfaces. Generating Lines of Second-Order Surfaces. General Equations of Second-Order Surfaces.

Learning Outcomes:

To successfully complete this discipline, students must demonstrate the following:

- Understand the fundamental concepts and operations involving vectors, including scalar, vector, and mixed products¹;
- Be familiar with the projection of vectors onto axes and its geometric implications¹;
- Recognize and apply polar, cylindrical, and spherical coordinate systems¹;
- Know the equations of lines and planes in both two-dimensional and three-dimensional space¹;
- Understand the classification, canonical forms, and properties of second-order curves and surfaces (ellipse, parabola, hyperbola, ellipsoid, etc.)¹;
- Know the principles for determining relative positions between geometric objects (lines, planes, curves) in space¹;
- Understand methods for reducing general second-order equations to their canonical forms¹;
- Perform linear operations on vectors and compute scalar, vector, and mixed products²;
- Construct and analyze the equations of lines, planes, and second-order curves and surfaces²;
- Convert between different coordinate systems (Cartesian, polar, cylindrical, and spherical)²;
- Determine distances and relative positions between points, lines, planes, and curves²;
- Apply algebraic transformations to reduce equations to canonical form²;
- Visualize and interpret geometric configurations through diagrams and mathematical expressions²;
- Solving practical problems in geometry, physics, and engineering using analytical and vector methods³;
- Selecting appropriate mathematical models and coordinate systems for analyzing geometric problems³;
- Demonstrating independent reasoning and problem-solving in unfamiliar spatial contexts³;
- Communicating mathematical ideas effectively through symbolic, graphical, and verbal representations³;
- Integrating theoretical knowledge in interdisciplinary applications, especially in technical and scientific fields³.

¹Knowledge; ²Skill; ³Competence.

Teaching and learning methods:

Lectures; interactive case studies; practical sessions (logical reasoning, rapid Q&A); group work; giving presentations

Entrance requirements:

Mandatory: None

Recommended: Ability to perform arithmetic operations with numbers. Ability to perform operations with algebraic fractions. Ability to think mathematically and find solutions to problem-based tasks. Ability to follow

discipline and order, and to use necessary literature and internet resources by knowing Russian and English languages.

Linear Algebra and Analytic Geometry I (AAGB110), Mathematical Analysis (MANB117)

Reading list

1. Aslonov J.O. Chiziqli algebra va analitik geometriya, "Innovatsiya-Ziyo", 206 bet, 2020 yil. O'quv qo'llanma.
2. Bayturayev A.M., Kucharov R.R. Algebra va geometriya, Toshkent, "Innovatsiya-Ziyo", 259 bet, 2020 yil. O'quv qo'llanma.
3. Narmanov A.Y. Analitik geometriya, Toshkent, "Innovatsiya-Ziyo", 154 bet, 2021-yil. Darslik.

Examination:

Assessment of students' knowledge is carried out in accordance with the Regulation on the system for monitoring and assessing students' knowledge in higher education institutions developed based on the credit-module system, Article 15

Type of assessment	Midterm	Final
Type of assessment	Midterm	Final
Time of assessment	Weeks 26-29	Weeks 36-37
Form of assessment	Written work	Written work

Midterm Assessment: The midterm assessment is conducted after approximately half of the discipline's lecture and practical sessions have been completed. A written assessment is administered, consisting of 1 theoretical questions and 2 practical task based on the topics covered up to that point. Each task is pre-prepared in different versions. Students who provide complete and correct answers receive a maximum of 5 points per correct answer. The final score for the midterm is calculated as the average of the points obtained for each task. The midterm assessment questions are announced at the beginning of the class sessions.

Final Assessment: The final assessment is conducted in written form based on the topics defined in the discipline syllabus, including both taught subjects and independent learning materials. Each version of the final assessment consists of 2 theoretical questions and 3 practical task.

Teaching materials and media

Projector; white/black board; hand-outs; flipchart; visualisation aids for presentation; demonstration materials.

Study Semester: 1 (full time)**ECTS:** 5**Workload**

Contact Time		Self-study	
Lectures	30 h	Preparation for Contact Time	60 h
Exercises	30 h	Literature review	30 h
Sum	60 h	Sum	90 h

Total Workload: 150 h**Lecturers**

N.K. Kasimov – Doctor of Physical and Mathematical Sciences, Professor at the Department of “Information Security”,

B.D. Farmonov – Senior Lecturer at the Department of “Information Security”.

Teaching Contents

Sets and operations on them. Relations. Binary relations. Functions. Special binary relations. Equivalence relations. Ordered sets. Ordinals and cardinals. Cantor’s theorem. Logical connectives. Propositional algebra. Truth tables. Formulas and sub formulas. Tautologies. Theorems about tautologies. Logical equivalence of formulas. Compound formulas. The theorem on the expansion of formulas with respect to variables. Perfect disjunctive and conjunctive normal forms. Applications of propositional algebra formulas. Propositional calculus. Derivation. The concept of proof. The concept of a theorem. Axioms of propositional calculus. Deduction theorem. Basic derivable formulas. Rules of inference. Lemma on consistent derivability. Gödel’s completeness theorem. Consistency of propositional calculus. Independence of the axiom system of propositional calculus.

Learning Outcomes:

To successfully complete this discipline, students:

- should have knowledge and understanding of set theory, relations, relational algebra, and special binary relations.¹
- should understand propositional algebra, formal axiomatic systems, and propositional calculus.¹
- should be familiar with Boolean functions and Post’s theorem.¹
- should be able to perform set and relation operations, construct truth tables, and find normal forms.²
- should be able to prove theorems and analyze the completeness of Boolean function systems.²
- should be able to solve basic combinatorial problems and apply combinatorial principles to practical situations.²
- should be competent in applying discrete structures and logical reasoning in simple practical contexts.³
- should be able to interpret logical formula structures and apply propositional logic methods.³
- should be able to relate formal logic systems to real-life algorithmic reasoning tasks.³

¹Knowledge; ²Skill; ³Competence.

Teaching and learning methods:

Lectures; interactive case studies; practical sessions (logical reasoning, rapid Q&A); group work; giving presentations

Entrance requirements:

Mandatory: None

Recommended: Elementary Mathematics.

Reading list

1. N.Kh.Kasymov, Dadajanov R.N, F.N.Ibragimov. Diskret matematika va matematik mantiq asoslari, Toshkent, 2021. 135 bet. (N.Kh.Kasymov, R.N. Dadajanov, F.N. Ibragimov. Foundations of Discrete Mathematics and Mathematical Logic, Tashkent, 2021. 135 pages.)
2. N.Kh.Kasymov, Dadajanov R.N, F.N.Ibragimov. Diskret matematika va matematik mantiq asoslari, Toshkent, 2019. 115 bet. (N.Kh.Kasymov, R.N. Dadajanov, F.N. Ibragimov. Foundations of Discrete Mathematics and Mathematical Logic, Tashkent, 2019. 115 pages.)
3. E. Mendelson. Introduction to Mathematical Logic, Sixth Edition, 2017. (E. Mendelson. Introduction to Mathematical Logic, Sixth Edition, 2017.)

4. Игошин В.И. Математическая логика и теория алгоритмов. – М.: Академия, 2018. (V.I. Igoshin. Mathematical Logic and Algorithm Theory. – Moscow: Akademiya, 2018.)
5. Игошин В.И. Задачник по математической логике и теории алгоритмов. – М.: Академия. (V.I. Igoshin. Problem Book on Mathematical Logic and Algorithm Theory. – Moscow: Akademiya.)
6. S.K. Javliyev. Diskret matematika va matematik mantiq: To‘plamlar nazariyasi, Toshkent, 2024. 61 bet. (S.K. Javliyev. Discrete Mathematics and Mathematical Logic: Set Theory, Tashkent, 2024. 61 pages.)

Examination:

Assessment of students’ knowledge is carried out in accordance with the Regulation on the system for monitoring and assessing students’ knowledge in higher education institutions developed based on the credit-module system, Article 15

Type of assessment	Midterm	Final
Time of assessment	Weeks 10-11	Weeks 19-20
Form of assessment	Written work	Written work

Midterm Assessment: The midterm assessment is conducted after approximately half of the discipline’s lecture and practical sessions have been completed. A written assessment is administered, consisting of 2 theoretical questions and 1 practical task based on the topics covered up to that point. Each task is pre-prepared in different versions. Students who provide complete and correct answers receive a maximum of 5 points per correct answer. The final score for the midterm is calculated as the average of the points obtained for each task. The midterm assessment questions are announced at the beginning of the class sessions.

Final Assessment: The final assessment is conducted in written form based on the topics defined in the discipline syllabus, including both taught subjects and independent learning materials. Each version of the final assessment consists of 2 theoretical questions and 1 practical task.

Teaching materials and media

Projector; white/black board; hand-outs; flipchart; visualization aids for presentation; demonstration materials

Study Semester: 2 (full time)**ECTS:** 5**Workload**

Contact Time		Self-study	
Lectures	30 h	Preparation for Contact Time	60 h
Exercises	30 h	Literature review	30 h
Sum	60 h	Sum	90 h

Total Workload: 150 h**Lecturers**

N.K. Kasimov – Doctor of Physical and Mathematical Sciences, Professor at the Department of “Information Security”,

B.D. Farmonov – Senior Lecturer at the Department of “Information Security”.

Teaching Contents

Elementary Boolean functions. The concept of a formula. Representation of functions in the form of formulas. Equivalence of formulas. Secondary functions. Principle of duality. Zhegalkin polynomial. Zhegalkin’s theorem. Completeness and closure of function systems. Important closed classes. Post’s theorem and its consequences. The concept of predicate. Constant objects and variable propositions. Elementary formulas. Quantifiers. Definition of a formula. Logically equivalent formulas. Satisfiable formulas. Normal form of a formula. Closed formulas. Axiomatic system of predicate calculus. Fundamentals of combinatorics. The "pigeonhole principle". Permutations and combinations. Recurrence relations. Inclusion-exclusion principle. Graphs, isomorphism, types, connectivity. Eulerian and Hamiltonian graphs. Trees and their applications. Traversals in trees. Spanning trees. The concept of algorithm. Computability. Turing machine. Primitive recursive functions. Minimization operator. Partial recursive and recursive functions. Recursive set. Recursively enumerable set. Post’s theorem. Fundamental theorem about recursively enumerable sets. Boolean algebra.

Learning Outcomes:

To successfully complete this discipline, students:

- should have knowledge of predicate algebra and predicate calculus.¹
- should understand the concept of formula satisfaction and methods in formal logic.¹
- should be familiar with Turing machines and primitive recursive functions.¹
- should be able to perform operations on predicates and solve advanced combinatorial problems.²
- should be able to apply graph coloring and tree algorithms.²
- should be able to use formal methods to solve problems in logic and theoretical computer science.²
- should be competent in applying methods of discrete mathematics and logic to real-world problems.³
- should be able to model complex systems using logical structures and computational theories.³
- should integrate knowledge of Turing machines and recursion theory into problem-solving.³

¹Knowledge; ²Skill; ³Competence.**Teaching and learning methods:**

Lectures; interactive case studies; practical sessions (logical reasoning, rapid Q&A); group work; giving presentations

Entrance requirements:

Mandatory: None

Recommended: Elementary Mathematics.

Reading list

1. N.Kh.Kasymov, Dadajanov R.N, F.N.Ibragimov. Diskret matematika va matematik mantiq asoslari, Toshkent, 2021. 135 bet. (N.Kh.Kasymov, R.N. Dadajanov, F.N. Ibragimov. Foundations of Discrete Mathematics and Mathematical Logic, Tashkent, 2021. 135 pages.)
2. N.Kh.Kasymov, Dadajanov R.N, F.N.Ibragimov. Diskret matematika va matematik mantiq asoslari, Toshkent, 2019. 115 bet. (N.Kh.Kasymov, R.N. Dadajanov, F.N. Ibragimov. Foundations of Discrete Mathematics and Mathematical Logic, Tashkent, 2019. 115 pages.)
3. E. Mendelson. Introduction to Mathematical Logic, Sixth Edition, 2017. (E. Mendelson. Introduction to Mathematical Logic, Sixth Edition, 2017.)

4. Игошин В.И. Математическая логика и теория алгоритмов. – М.: Академия, 2018. (V.I. Igoshin. Mathematical Logic and Algorithm Theory. – Moscow: Akademiya, 2018.)
5. Игошин В.И. Задачник по математической логике и теории алгоритмов. – М.: Академия. (V.I. Igoshin. Problem Book on Mathematical Logic and Algorithm Theory. – Moscow: Akademiya.)
6. S.K. Javliyev. Diskret matematika va matematik mantiq: To‘plamlar nazariyasi, Toshkent, 2024. 61 bet. (S.K. Javliyev. Discrete Mathematics and Mathematical Logic: Set Theory, Tashkent, 2024. 61 pages.)

Examination:

Assessment of students’ knowledge is carried out in accordance with the Regulation on the system for monitoring and assessing students’ knowledge in higher education institutions developed based on the credit-module system, Article 15

Type of assessment	Midterm	Final
Time of assessment	Weeks 31-32	Weeks 36-37
Form of assessment	Written work	Written work

Midterm Assessment: The midterm assessment is conducted after approximately half of the discipline’s lecture and practical sessions have been completed. A written assessment is administered, consisting of 2 theoretical questions and 1 practical task based on the topics covered up to that point. Each task is pre-prepared in different versions. Students who provide complete and correct answers receive a maximum of 5 points per correct answer. The final score for the midterm is calculated as the average of the points obtained for each task. The midterm assessment questions are announced at the beginning of the class sessions.

Final Assessment: The final assessment is conducted in written form based on the topics defined in the discipline syllabus, including both taught subjects and independent learning materials. Each version of the final assessment consists of 2 theoretical questions and 1 practical task.

Teaching materials and media

Projector; white/black board; hand-outs; flipchart; visualization aids for presentation; demonstration materials

Study Semester: 1 (full time)

ECTS: 6

Workload

Contact Time		Self-study	
Lectures	44 h	Preparation for Contact Time	60 h
Exercises	46 h	Literature review	30 h
Sum	90 h	Sum	90 h

Total Workload: 180 h

Lecturers

J.K. Tishabayev – Professor at the Department of “Mathematical Analysis”, Candidate of Physical and Mathematical Sciences;

T.O. Otaboyev – Senior Lecturer at the Department of “Mathematical Analysis”, Doctor of Philosophy (PhD) in Physical and Mathematical Sciences.

Teaching Contents

Concept of real numbers. The set of real numbers and its properties. Bounds of numerical sets. Operations on real numbers. Sequences of numbers and their limits. Properties of convergent sequences. Monotonic sequences and their limits. The principle of nested intervals. Subsequences and Cauchy (fundamental) sequences. Lower and upper limits of sequences. Concept of a function. Boundedness, monotonicity, parity (even/odd), and periodicity of functions. Inverse functions. Composite functions. Elementary functions and their properties. Definitions of the limit of a function. Properties of functions that have limits. Theorems on the existence of function limits. Important limits. Infinitesimal and infinite functions. Comparison of functions. Definitions of continuity. Operations on continuous functions. Continuity of composite functions. Continuity of elementary functions. Local properties of continuous functions. Discontinuities and their types. Global properties of continuous functions. Continuity and discontinuity of monotonic functions. Existence and continuity of inverse functions. Uniform continuity of functions. Cantor’s theorem. Derivative of a function. Geometric and mechanical interpretations of the derivative. Rules and formulas for calculating derivatives. Differentiability of a function. Differential of a function. Approximation formulas. Fundamental theorems of differential calculus. L’Hôpital’s rules. Higher-order derivatives and differentials. Taylor and Maclaurin formulas. Taylor expansions of elementary functions. Analyzing monotonicity using the derivative. Function extrema and how to find them using derivatives. Convexity and concavity of function graphs. Asymptotes of function graphs. Primitive function and the concept of the indefinite integral. Basic properties of integrals and basic rules for computing them. Table of basic indefinite integrals. Techniques of integration. Integration of rational functions.

Learning Outcomes:

To successfully complete this discipline, students:

- should have knowledge of the theory of limits.¹
- should understand function limits and continuity.¹
- should have knowledge of differential calculus.¹
- should be able to calculate the limits of sequences and functions.²
- should be able to check the continuity of functions.²
- should be able to calculate derivatives of functions and apply derivatives in practice.²

¹Knowledge; ²Skill;

Teaching and learning methods:

Lectures; interactive case studies; practical sessions (logical reasoning, rapid Q&A); group work; giving presentations

Entrance requirements:

Mandatory: None

Recommended: Elementary Mathematics.

Reading list

1. Tao T. Analysis 1, 2. Hindustan Book Agency, India, 2014. (Tao T. Analysis 1, 2. Hindustan Book Agency, India, 2014.)

2. Xudayberganov G., Vorisov A.K., Mansurov X.T., Shoimqulov B.A. Matematik analizdan ma'ruzalar, I, II q. T.: "Voris-nashriyot", 2010. (Khudayberganov G., Vorisov A.K., Mansurov Kh.T., Shoimqulov B.A. Lectures on Mathematical Analysis, Parts I and II. Tashkent: "Voris Publishing", 2010.)
3. Shoimqulov B.A., Tuychiyev T.T., Djumaboyev D.X. Matematik analizdan mustaqil ishlar. T.: "O'zbekiston faylasuflari milliy jamiyati", 2008. (Shoimqulov B.A., Tuychiyev T.T., Djumaboyev D.Kh. Independent Work on Mathematical Analysis. Tashkent: "National Society of Philosophers of Uzbekistan", 2008.)
4. Alimov Sh.O., Ashurov R.R. Matematik analiz 1, 2, 3 q. T.: "Mumtoz so'z", 2018. (Alimov Sh.O., Ashurov R.R. Mathematical Analysis, Parts 1, 2, 3. Tashkent: "Mumtoz So'z", 2018.)

Examination:

Assessment of students' knowledge is carried out in accordance with the Regulation on the system for monitoring and assessing students' knowledge in higher education institutions developed based on the credit-module system, Article 15

Type of assessment	Midterm	Final
Type of assessment	Midterm	Final
Time of assessment	Weeks 8-9	Weeks 19-20
Form of assessment	Written work	Written work

Midterm Assessment: The midterm assessment is conducted after approximately half of the discipline's lecture and practical sessions have been completed. A written assessment is administered, consisting of 2 theoretical questions and 1 practical task based on the topics covered up to that point. Each task is pre-prepared in different versions. Students who provide complete and correct answers receive a maximum of 5 points per correct answer. The final score for the midterm is calculated as the average of the points obtained for each task. The midterm assessment questions are announced at the beginning of the class sessions.

Final Assessment: The final assessment is conducted in written form based on the topics defined in the discipline syllabus, including both taught subjects and independent learning materials. Each version of the final assessment consists of 2 theoretical questions and 1 practical task.

Teaching materials and media

Projector; white/black board; hand-outs; flipchart; visualization aids for presentation; demonstration materials

Study Semester: 2 (full time)

ECTS: 6

Workload

Contact Time		Self-study	
Lectures	44 h	Preparation for Contact Time	60 h
Exercises	46 h	Literature review	30 h
Sum	90 h	Sum	90 h

Total Workload: 180 h

Lecturers

J.K. Tishabayev – Professor at the Department of “Mathematical Analysis”, Candidate of Physical and Mathematical Sciences;

T.O. Otaboyev – Senior Lecturer at the Department of “Mathematical Analysis”, Doctor of Philosophy (PhD) in Physical and Mathematical Sciences.

Teaching Contents

Definitions of the definite integral (Riemann integral). Existence of the definite integral and the class of integrable functions. Properties of definite integrals. Definite integrals with variable limits. Computing definite integrals. Approximate integration formulas. Applications of definite integrals: Calculating arc length and area of plane figures. Calculating volume and surface area of solids using definite integrals. Improper integrals of the first kind and their convergence. Improper integrals of non-negative functions. Absolute convergence of improper integrals. Principal value of an improper integral. Improper integrals of the second kind and their convergence. Multivariable functions and their limits. Continuity of multivariable functions. Properties of continuous multivariable functions. Uniform continuity of multivariable functions. Cantor's theorem. Partial derivatives of multivariable functions. Differentiability of multivariable functions. Differential of a multivariable function. Directional derivative. Derivative of a composite function. Higher-order partial derivatives and differentials of multivariable functions. Mean value theorem. Taylor's formula for multivariable functions. Extrema of multivariable functions: Necessary and sufficient conditions for extremum. Implicit functions: Existence, continuity, and differentiability of implicit functions.

Learning Outcomes:

To successfully complete this discipline, students:

- should have knowledge of the theory of indefinite and definite integrals.¹
- should have knowledge of the theory of improper integrals.¹
- should have knowledge of the limits and continuity of multivariable functions.¹
- should be able to compute definite and indefinite integrals and solve related application problems.²
- should be able to evaluate improper integrals and test for their convergence.²
- should be able to calculate limits of multivariable functions and test them for continuity.²

¹Knowledge; ²Skill;

Teaching and learning methods:

Lectures; interactive case studies; practical sessions (logical reasoning, rapid Q&A); group work; giving presentations

Entrance requirements:

Mandatory: None

Recommended: Mathematical Analysis I

Linear Algebra and Analytic Geometry I

Reading list

1. Tao T. Analysis 1, 2. Hindustan Book Agency, India, 2014. (Tao T. Analysis 1, 2. Hindustan Book Agency, India, 2014.)
2. Xudayberganov G., Vorisov A.K., Mansurov X.T., Shoimqulov B.A. Matematik analizdan ma'ruzalar, I, II q. T.: "Voris-nashriyot", 2010. (Khudayberganov G., Vorisov A.K., Mansurov Kh.T., Shoimqulov B.A. Lectures on Mathematical Analysis, Parts I and II. Tashkent: "Voris Publishing", 2010.)

3. Shoimqulov B.A., Tuychiyev T.T., Djumaboyev D.X. Matematik analizdan mustaqil ishlar. T.: "O'zbekiston faylasuflari milliy jamiyati", 2008. (Shoimqulov B.A., Tuychiyev T.T., Djumaboyev D.Kh. Independent Work on Mathematical Analysis. Tashkent: "National Society of Philosophers of Uzbekistan", 2008.)
4. Alimov Sh.O., Ashurov R.R. Matematik analiz 1, 2, 3 q. T.: "Mumtoz so'z", 2018. (Alimov Sh.O., Ashurov R.R. Mathematical Analysis, Parts 1, 2, 3. Tashkent: "Mumtoz So'z", 2018.)

Examination:

Assessment of students' knowledge is carried out in accordance with the Regulation on the system for monitoring and assessing students' knowledge in higher education institutions developed based on the credit-module system, Article 15

Type of assessment	Midterm	Final
Type of assessment	Midterm	Final
Time of assessment	Weeks 31-32	Weeks 36-37
Form of assessment	Written work	Written work

Midterm Assessment: The midterm assessment is conducted after approximately half of the discipline's lecture and practical sessions have been completed. A written assessment is administered, consisting of 2 theoretical questions and 1 practical task based on the topics covered up to that point. Each task is pre-prepared in different versions. Students who provide complete and correct answers receive a maximum of 5 points per correct answer. The final score for the midterm is calculated as the average of the points obtained for each task. The midterm assessment questions are announced at the beginning of the class sessions.

Final Assessment: The final assessment is conducted in written form based on the topics defined in the discipline syllabus, including both taught subjects and independent learning materials. Each version of the final assessment consists of 2 theoretical questions and 1 practical task.

Teaching materials and media

Projector; white/black board; hand-outs; flipchart; visualization aids for presentation; demonstration materials

Study Semester: 3 (full time)

ECTS: 5

Workload

Contact Time		Self-study	
Lectures	30 h	Preparation for Contact Time	60 h
Exercises	30 h	Literature review	30 h
Sum	60 h	Sum	90 h

Total Workload: 150 h**Lecturers**

J.K. Tishabayev – Professor at the Department of “Mathematical Analysis”, Candidate of Physical and Mathematical Sciences;

T.O. Otaboyev – Senior Lecturer at the Department of “Mathematical Analysis”, Doctor of Philosophy (PhD) in Physical and Mathematical Sciences.

Teaching Contents

Uniform convergence of functional sequences and series, Cauchy criterion, and convergence tests such as Abel, Weierstrass, Dirichlet, and Dini. Functional properties of sequences and series including termwise limit transition, continuity of the sum, termwise integration, and differentiation. Radius and domain of convergence of power series, Cauchy–Hadamard formula, and functional properties of power series. Taylor series and expansion of elementary functions into power series. Periodic functions, periodic extension, Fourier series of even and odd functions, Dirichlet integral, localization principle, and convergence of Fourier series. Double integrals, Darboux sums and their properties, existence of double integrals, class of integrable functions, basic properties of double integrals, computation techniques, change of variables, and applications to mechanics. Triple integrals with variable substitution, spherical and cylindrical coordinate systems. Line integrals and Green’s theorem.

Learning Outcomes:

To successfully complete this discipline, students:

- should have knowledge of the theory of functional sequences and functional series.¹
- should have knowledge of the theory of multiple integrals.¹
- should have knowledge of line integrals and their applications.¹
- should be able to test the uniform convergence of functional sequences and series.²
- should be able to expand functions into power series.²
- should be able to compute multiple and line integrals.²

¹Knowledge; ²Skill;

Teaching and learning methods:

Lectures; interactive case studies; practical sessions (logical reasoning, rapid Q&A); group work; giving presentations

Entrance requirements:

Mandatory: None

Recommended: Mathematical Analysis II

Reading list

1. Tao T. Analysis 1, 2. Hindustan Book Agency, India, 2014. (Tao T. Analysis 1, 2. Hindustan Book Agency, India, 2014.)
2. Xudayberganov G., Vorisov A.K., Mansurov X.T., Shoimqulov B.A. Matematik analizdan ma'ruzalar, I, II q. T.: "Vorish-nashriyot", 2010. (Khudayberganov G., Vorisov A.K., Mansurov Kh.T., Shoimqulov B.A. Lectures on Mathematical Analysis, Parts I and II. Tashkent: "Vorish Publishing", 2010.)
3. Shoimqulov B.A., Tuychiyev T.T., Djumaboyev D.X. Matematik analizdan mustaqil ishlar. T.: "O'zbekiston faylasuflari milliy jamiyati", 2008. (Shoimqulov B.A., Tuychiyev T.T., Djumaboyev D.Kh. Independent Work on Mathematical Analysis. Tashkent: "National Society of Philosophers of Uzbekistan", 2008.)
4. Alimov Sh.O., Ashurov R.R. Matematik analiz 1, 2, 3 q. T.: "Mumtoz so'z", 2018. (Alimov Sh.O., Ashurov R.R. Mathematical Analysis, Parts 1, 2, 3. Tashkent: "Mumtoz So'z", 2018.)

Examination:

Assessment of students' knowledge is carried out in accordance with the Regulation on the system for monitoring and assessing students' knowledge in higher education institutions developed based on the credit-module system, Article 15

Type of assessment	Midterm	Final
Type of assessment	Midterm	Final
Time of assessment	Weeks 8-9	Weeks 19-20
Form of assessment	Written work	Written work

Midterm Assessment: The midterm assessment is conducted after approximately half of the discipline's lecture and practical sessions have been completed. A written assessment is administered, consisting of 2 theoretical questions and 1 practical task based on the topics covered up to that point. Each task is pre-prepared in different versions. Students who provide complete and correct answers receive a maximum of 5 points per correct answer. The final score for the midterm is calculated as the average of the points obtained for each task. The midterm assessment questions are announced at the beginning of the class sessions.

Final Assessment: The final assessment is conducted in written form based on the topics defined in the discipline syllabus, including both taught subjects and independent learning materials. Each version of the final assessment consists of 2 theoretical questions and 1 practical task.

Teaching materials and media

Projector; white/black board; hand-outs; flipchart; visualization aids for presentation; demonstration materials

Study Semester: 1 (full time)**ECTS:** 6**Workload**

Contact Time		Self-study	
Lectures	30 h	Preparation for Contact Time	90 h
Exercises	30 h	Literature review	30 h
Sum	60 h	Sum	120 h

Total Workload: 180 h**Lecturers**

I.O. Khajiyev – Associate Professor at the Department of “Applied Mathematics and Computer Analysis”, National University of Uzbekistan (NUUZ), Doctor of Physical and Mathematical Sciences;

T.Q. Khodjiyev – Senior Lecturer at the Department of “Applied Mathematics and Computer Analysis”.

Teaching Contents

History and Development Stages of Programming Languages. Modern programming languages and technologies. The creation, structure of the C# programming language, and its relation to the .NET framework. .NET architecture. Features, advantages, and unique characteristics of the Visual Studio environment. C# language alphabet and keywords. Identifiers, literals, variables, constants, and data types. Arithmetic operations in C#. Assignment and compound assignment operators. Working with input and output functions in the console. Comparison and logical operations. Bitwise operations. Operator precedence. Mathematical functions. Type conversion rules and the data type hierarchy. The Convert class and its methods. Using the Convert class and Parse method to convert string data types. Enumerated types. The ?: ternary operator. Conditional operators: if, if-else, if-else-if. The switch selection operator. Looping operators: for, while, do-while. Different uses of the for loop. Using the break operator to exit loops. The continue operator and its application. The goto jump operator.

Learning Outcomes:

To successfully complete this discipline, students:

- should have knowledge of the basics of the C# programming language, data types, arithmetic and logical operations, control operators, declaring arrays, and working with their elements.¹
- should be able to write computer programs to solve practical problems²
- should begin developing algorithmic thinking and understanding how programming is used in applied mathematics contexts³

¹Knowledge; ²Skill; ³Competence.

Teaching and learning methods:

Lectures, Performing and summarizing practical tasks, Interactive case studies, Blitz surveys, Working in groups, Giving presentations, Teamwork and project defense

Entrance requirements:

Mandatory: Completed secondary education Basic computer literacy

Recommended: Familiarity with logical thinking and problem-solving. Prior exposure to basic programming concepts (optional but helpful).

Reading list

1. Adambayev U.E., Yusupov Yu.S., *Algoritmik tillar va dasturlash. C# tilida dasturlash asoslari. Darslik.* – Toshkent: "Universitet", 2023. – 272 bet. (Adambayev U.E., Yusupov Yu.S., *Algorithmic Languages and Programming. Fundamentals of Programming in C#. Textbook.* – Tashkent: "Universitet", 2023. – 272 pages.)
2. Xojiyev T.Q., Xajiyev I.O. *Algoritmik tillar va dasturlash. O'quv qo'llanma.* – Toshkent: "Ma'rifat", 2023. – 408 bet. (Khodjiyev T.Q., Khajiyev I.O. *Algorithmic Languages and Programming. Study Guide.* – Tashkent: "Ma'rifat", 2023. – 408 pages.)
3. Албахари Бен, Албахари Джозеф. *C# 7.0. Справочник. Полное описание языка, 6 изд... Пер. с англ.* – СПб: “Алфа-книга”, 2018. – 1024 с. (Ben Albahari, Joseph Albahari. *C# 7.0. Pocket Reference. Complete Language Description, 6th ed. Translated from English.* – St. Petersburg: “Alpha-kniga”, 2018. – 1024 pages.)

4. Василев А. Программирование на C# для начинающих. Основные сведения. – Москва: Эксмо, 2018. – 592 с.(A. Vasilev. Programming in C# for Beginners. Basic Information. – Moscow: Eksmo, 2018. – 592 pages.)
5. Герберт Шилдт. C# 4.0: полное руководство. Пер. с англ. – Москва: ООО "И.Д. Вильямс", 2011. – 1056 с. (Herbert Schildt. C# 4.0: The Complete Reference. Translated from English. – Moscow: ID Williams, 2011. – 1056 pages.)
6. Шарп Джон. Microsoft Visual C#. Подробное руководство. 8-е изд. – СПб.: Питер, 2017. – 848 с.(John Sharp. Microsoft Visual C#. Detailed Guide. 8th ed. – St. Petersburg: Piter, 2017. – 848 pages)

Examination:

Assessment of students' knowledge is carried out in accordance with the Regulation on the system for monitoring and assessing students' knowledge in higher education institutions developed based on the credit-module system, Article 15

Type of assessment	Midterm	Final
Time of assessment	Weeks 12-13	Weeks 19-20
Form of assessment	Written work	Written work

Midterm Assessment: The midterm assessment is conducted after approximately half of the discipline's lecture and practical sessions have been completed. A written assessment is administered, consisting of 2 theoretical questions and 1 practical task based on the topics covered up to that point. Each task is pre-prepared in different versions. Students who provide complete and correct answers receive a maximum of 5 points per correct answer. The final score for the midterm is calculated as the average of the points obtained for each task. The midterm assessment questions are announced at the beginning of the class sessions.

Final Assessment: The final assessment is conducted in written form based on the topics defined in the discipline syllabus, including both taught subjects and independent learning materials. Each version of the final assessment consists of 2 theoretical questions and 1 practical task.

Teaching materials and media

Projector; white/black board; hand-outs; flipchart; visualization aids for presentation; demonstration materials

Study Semester: 2 (full time)**ECTS:** 4**Workload**

Contact Time		Self-study	
Lectures	30 h	Preparation for Contact Time	40 h
Exercises	30 h	Literature review	20 h
Sum	60 h	Sum	60 h

Total Workload: 120 h**Lecturers**

I.O. Khajiyev – Associate Professor at the Department of “Applied Mathematics and Computer Analysis”, National University of Uzbekistan (NUUZ), Doctor of Physical and Mathematical Sciences;

T.Q. Khodjiyev – Senior Lecturer at the Department of “Applied Mathematics and Computer Analysis”.

Teaching Contents

One-dimensional and multidimensional arrays. Rectangular and jagged two-dimensional arrays The foreach loop operator. Declaring strings and working with them String formatting. Standard methods for string manipulation. Value-returning and non-returning methods. Methods with and without parameters. Local variables and methods. Parameter modifiers in methods. Defining recursive methods. High-order functions. Methods with array parameters and the params keyword. ref and out parameter modifiers in methods. Classes and Object-Oriented Programming (OOP) Principles: Creating classes and their objects. Class members: fields, constructors, and methods. Working with class objects. Method and constructor overloading. The Program class and the Main method. Properties. Destructors. Structures:

Declaring structures. Value types vs. reference types. Working with structures.

Learning Outcomes:

To successfully complete this discipline, students:

- should understand how to define methods and work with them.¹
- should have knowledge of how to add classes to a project and how to use them¹
- should be able to develop projects using classes and structures, build mathematical models for problems, and implement them in software.²
- should be able to apply structured programming techniques for solving subject-specific tasks using object-oriented programming principles.³

¹Knowledge; ²Skill; ³Competence.

Teaching and learning methods:

Lectures, Performing and summarizing practical tasks, Interactive case studies, Blitz surveys, Working in groups, Giving presentations, Teamwork and project defense

Entrance requirements:

Mandatory: Completed secondary education Basic computer literacy

Recommended: Familiarity with logical thinking and problem-solving. Prior exposure to basic programming concepts (optional but helpful).

Reading list

1. Adambayev U.E., Yusupov Yu.S., Algoritmik tillar va dasturlash. C# tilida dasturlash asoslari. Darslik. – Toshkent: "Universitet", 2023. – 272 bet. (Adambayev U.E., Yusupov Yu.S., Algorithmic Languages and Programming. Fundamentals of Programming in C#. Textbook. – Tashkent: "Universitet", 2023. – 272 pages.)
2. Xojiyev T.Q., Xajiyev I.O. Algoritmik tillar va dasturlash. O'quv qo'llanma. – Toshkent: "Ma'rifat", 2023. – 408 bet. (Khodjiyev T.Q., Khajiyev I.O. Algorithmic Languages and Programming. Study Guide. – Tashkent: "Ma'rifat", 2023. – 408 pages.)
3. Албахари Бен, Албахари Джозеф. C# 7.0. Справочник. Полное описание языка, 6 изд... Пер. с англ. – СПб: “Алфа-книга”, 2018. – 1024 с. (Ben Albahari, Joseph Albahari. C# 7.0. Pocket Reference. Complete Language Description, 6th ed. Translated from English. – St. Petersburg: “Alpha-kniga”, 2018. – 1024 pages.)

4. Василев А. Программирование на C# для начинающих. Основные сведения. – Москва: Эксмо, 2018. – 592 с.(A. Vasilev. Programming in C# for Beginners. Basic Information. – Moscow: Eksmo, 2018. – 592 pages.)
5. Герберт Шилдт. C# 4.0: полное руководство. Пер. с англ. – Москва: ООО "И.Д. Вильямс", 2011. – 1056 с. (Herbert Schildt. C# 4.0: The Complete Reference. Translated from English. – Moscow: ID Williams, 2011. – 1056 pages.)
6. Шарп Джон. Microsoft Visual C#. Подробное руководство. 8-е изд. – СПб.: Питер, 2017. – 848 с.(John Sharp. Microsoft Visual C#. Detailed Guide. 8th ed. – St. Petersburg: Piter, 2017. – 848 pages)

Examination:

Assessment of students' knowledge is carried out in accordance with the Regulation on the system for monitoring and assessing students' knowledge in higher education institutions developed based on the credit-module system, Article 15

Type of assessment	Midterm	Final
Time of assessment	Weeks 28-29	Weeks 36-37
Form of assessment	Written work	Written work

Midterm Assessment: The midterm assessment is conducted after approximately half of the discipline's lecture and practical sessions have been completed. A written assessment is administered, consisting of 2 theoretical questions and 1 practical task based on the topics covered up to that point. Each task is pre-prepared in different versions. Students who provide complete and correct answers receive a maximum of 5 points per correct answer. The final score for the midterm is calculated as the average of the points obtained for each task. The midterm assessment questions are announced at the beginning of the class sessions.

Final Assessment: The final assessment is conducted in written form based on the topics defined in the discipline syllabus, including both taught subjects and independent learning materials. Each version of the final assessment consists of 2 theoretical questions and 1 practical task.

Teaching materials and media

Projector; white/black board; hand-outs; flipchart; visualization aids for presentation; demonstration materials

Study Semester: 3 (full time)**ECTS:** 5**Workload**

Contact Time		Self-study	
Lectures	30 h	Preparation for Contact Time	60 h
Exercises	30 h	Literature review	30 h
Sum	60 h	Sum	90 h

Total Workload: 150 h**Lecturers**

I.O. Khajiyev – Associate Professor at the Department of “Applied Mathematics and Computer Analysis”, National University of Uzbekistan (NUUz), Doctor of Physical and Mathematical Sciences.

T.Q. Khodjiyev – Senior Lecturer at the Department of “Applied Mathematics and Computer Analysis”.

Teaching Contents

Encapsulation in C#. Access modifiers: public, private, protected, and internal. Encapsulation principles. Static members of a class. Static methods and accessing them. Static classes and their usage. Namespaces. Declaring namespaces and classes in separate files and linking them to the project. Working with aliases. Operator overloading. Overloading arithmetic binary and unary operators. Overloading rules. Overloading logical operators. Constant fields. Read-only fields. Partial classes. Splitting a class into multiple files and working with them. Concept of inheritance. Inheritance (or “Meros” in Uzbek). Using constructors in inheritance. Nested classes. Declaring and using them within a namespace. Creating a class library in the Visual Studio environment. Exceptions and their handling. Types of exceptions and how to raise them. The finally block. Working with disks and directories. File handling. File and FileInfo classes. Data streams. Writing and reading byte streams to/from a file using the FileStream object. Reading data from text files and writing text to files. Working with StreamReader and StreamWriter objects. Binary files. BinaryWriter and BinaryReader objects. File compression and archiving.

Learning Outcomes:

To successfully complete this discipline, students:

- should know how to implement structures and namespaces, perform operator overloading, and utilize these concepts.¹
- should understand how to create and manage programs using inheritance¹
- should be able to create and work with dynamic arrays and lists using List and ArrayList classes²
- should demonstrate the ability to build modular programs that reflect real-world scenarios and data management structures³

¹Knowledge; ²Skill; ³Competence.

Teaching and learning methods:

Lectures, Performing and summarizing practical tasks, Interactive case studies, Blitz surveys, Working in groups, Giving presentations, Teamwork and project defense

Entrance requirements:

Mandatory: Completed secondary education Basic computer literacy

Recommended: Familiarity with logical thinking and problem-solving. Prior exposure to basic programming concepts (optional but helpful).

Reading list

1. Adambayev U.E., Yusupov Yu.S., Algoritmik tillar va dasturlash. C# tilida dasturlash asoslari. Darslik. – Toshkent: "Universitet", 2023. – 272 bet. (Adambayev U.E., Yusupov Yu.S., Algorithmic Languages and Programming. Fundamentals of Programming in C#. Textbook. – Tashkent: "Universitet", 2023. – 272 pages.)
2. Xojjiyev T.Q., Xajiyev I.O. Algoritmik tillar va dasturlash. O‘quv qo‘llanma. – Toshkent: "Ma'rifat", 2023. – 408 bet. (Khodjiyev T.Q., Khajiyev I.O. Algorithmic Languages and Programming. Study Guide. – Tashkent: "Ma'rifat", 2023. – 408 pages.)
3. Албахари Бен, Албахари Джозеф. C# 7.0. Справочник. Полное описание языка, 6 изд... Пер. с англ. – СПб: “Алфа-книга”, 2018. – 1024 с. (Ben Albahari, Joseph Albahari. C# 7.0. Pocket Reference. Complete

- Language Description, 6th ed. Translated from English. – St. Petersburg: “Alpha-kniga”, 2018. – 1024 pages.)
4. Василев А. Программирование на C# для начинающих. Основные сведения. – Москва: Эксмо, 2018. – 592 с.(A. Vasilev. Programming in C# for Beginners. Basic Information. – Moscow: Eksmo, 2018. – 592 pages.)
 5. Герберт Шилдт. C# 4.0: полное руководство. Пер. с англ. – Москва: ООО "И.Д. Вилямс", 2011. – 1056 с. (Herbert Schildt. C# 4.0: The Complete Reference. Translated from English. – Moscow: ID Williams, 2011. – 1056 pages.)
 6. Шарп Джон. Microsoft Visual C#. Подробное руководство. 8-е изд. – СПб.: Питер, 2017. – 848 с.(John Sharp. Microsoft Visual C#. Detailed Guide. 8th ed. – St. Petersburg: Piter, 2017. – 848 pages)

Examination:

Assessment of students’ knowledge is carried out in accordance with the Regulation on the system for monitoring and assessing students’ knowledge in higher education institutions developed based on the credit-module system, Article 15

Type of assessment	Midterm	Final
Time of assessment	Weeks 12-13	Weeks 19-20
Form of assessment	Written work	Written work

Midterm Assessment: The midterm assessment is conducted after approximately half of the discipline’s lecture and practical sessions have been completed. A written assessment is administered, consisting of 2 theoretical questions and 1 practical task based on the topics covered up to that point. Each task is pre-prepared in different versions. Students who provide complete and correct answers receive a maximum of 5 points per correct answer. The final score for the midterm is calculated as the average of the points obtained for each task. The midterm assessment questions are announced at the beginning of the class sessions.

Final Assessment: The final assessment is conducted in written form based on the topics defined in the discipline syllabus, including both taught subjects and independent learning materials. Each version of the final assessment consists of 2 theoretical questions and 1 practical task.

Teaching materials and media

Projector; white/black board; hand-outs; flipchart; visualization aids for presentation; demonstration materials

Study Semester: 4 (full time)

ECTS: 5

Workload

Contact Time		Self-study	
Exercises	60 h	Preparation for Contact Time	30 h
		Literature review	30 h
		Course work	30 h
Sum	60 h	Sum	90 h

Total Workload: 150 h

Lecturers

I.O. Khajiyev – Associate Professor at the Department of “Applied Mathematics and Computer Analysis”, Doctor of Physical and Mathematical Sciences.

T.Q. Khodjiyev – Senior Lecturer at the Department of “Applied Mathematics and Computer Analysis”.

Teaching Contents

Solving examples related to virtual methods Abstract classes and abstract methods. Solving problems on overriding abstract methods in derived classes. Using and overriding interface methods – practical examples. Solving examples on generic types and their inheritance. Delegates. Solving examples related to generic delegates. Anonymous methods and lambda expressions. Solving examples with multi-parameter and parameters lambda expressions. Solving examples on events and their handling in C#. Windows Forms applications: form properties and events. Examples on linking multiple forms. Solving examples related to working with container elements in Windows Forms. Control element properties and events. Examples on working with menus and toolbars. Using the Graphics class to draw geometric objects. Examples involving line coloring. Techniques for filling regions, working with vector graphics, and creating simple animations. Using the Chart control to build diagrams, histograms, and other types of visual graphics. Using existing libraries to draw 2D graphics and solve examples on generating 3D graphics. Solving examples involving Lists, Stacks, and Queues. LINQ technology and operators: searching, sorting, grouping, and selecting. LINQ queries and aggregate methods. Introduction to WPF and XAML. XAML syntax, Application and Window classes. Creating WPF applications – examples. Solving examples involving control elements, layouts, and events in WPF.

Learning Outcomes:

To successfully complete this discipline, students:

- should understand the role of applied programming in interdisciplinary areas such as medicine, biology, chemistry, geology, and network technologies.¹
- should know advanced programming patterns used for building efficient and scalable solutions.¹
- should be able to apply programming skills to real-world applied mathematics problems, using visualizations and optimization algorithms.²
- should effectively use programming tools for code documentation, version control, and collaborative development.²
- should be able to apply theoretical knowledge of applied mathematics and programming in fields requiring data modeling, visualization, and optimization.³
- should be able to apply programming technologies to solve practical, industry-specific problems independently and in team-based projects³

¹Knowledge; ²Skill; ³Competence.

Teaching and learning methods:

Lectures, Performing and summarizing practical tasks, Interactive case studies, Blitz surveys, Working in groups, Giving presentations, Teamwork and project defense

Entrance requirements:

Mandatory: Completed secondary education Basic computer literacy

Recommended: Familiarity with logical thinking and problem-solving. Prior exposure to basic programming concepts (optional but helpful).

Reading list

1. Adambayev U.E., Yusupov Yu.S., Algoritmik tillar va dasturlash. C# tilida dasturlash asoslari. Darslik. – Toshkent: "Universitet", 2023. – 272 bet. (Adambayev U.E., Yusupov Yu.S., Algorithmic Languages and

- Programming. Fundamentals of Programming in C#. Textbook. – Tashkent: "Universitet", 2023. – 272 pages.)
2. Хоййев Т.Қ., Хаййев И.О. Алгоритмик tillar va dasturlash. О‘quv qo‘llanma. – Toshkent: "Ma'rifat", 2023. – 408 bet. (Khodjiyev T.Q., Khajiyev I.O. Algorithmic Languages and Programming. Study Guide. – Tashkent: "Ma'rifat", 2023. – 408 pages.)
 3. Албахари Бен, Албахари Джозеф. C# 7.0. Справочник. Полное описание языка, 6 изд... Пер. с англ. – СПб: "Алфа-книга", 2018. – 1024 с. (Ben Albahari, Joseph Albahari. C# 7.0. Pocket Reference. Complete Language Description, 6th ed. Translated from English. – St. Petersburg: "Alpha-kniga", 2018. – 1024 pages.)
 4. Василев А. Программирование на C# для начинающих. Основные сведения. – Москва: Эксмо, 2018. – 592 с. (A. Vasilev. Programming in C# for Beginners. Basic Information. – Moscow: Eksmo, 2018. – 592 pages.)
 5. Герберт Шилдт. C# 4.0: полное руководство. Пер. с англ. – Москва: ООО "И.Д. Вильямс", 2011. – 1056 с. (Herbert Schildt. C# 4.0: The Complete Reference. Translated from English. – Moscow: ID Williams, 2011. – 1056 pages.)
 6. Шарп Джон. Microsoft Visual C#. Подробное руководство. 8-е изд. – СПб.: Питер, 2017. – 848 с. (John Sharp. Microsoft Visual C#. Detailed Guide. 8th ed. – St. Petersburg: Piter, 2017. – 848 pages)

Examination:

Assessment of students' knowledge is carried out in accordance with the Regulation on the system for monitoring and assessing students' knowledge in higher education institutions developed based on the credit-module system, Article 15

Type of assessment	Midterm	Final
Time of assessment	Weeks 29-30	Weeks 37-38
Form of assessment	Written work	Written work

Midterm Assessment: The midterm assessment is conducted after approximately half of the discipline's lecture and practical sessions have been completed. A written assessment is administered, consisting of 2 theoretical questions and 1 practical task based on the topics covered up to that point. Each task is pre-prepared in different versions. Students who provide complete and correct answers receive a maximum of 5 points per correct answer. The final score for the midterm is calculated as the average of the points obtained for each task. The midterm assessment questions are announced at the beginning of the class sessions.

Final Assessment: The final assessment is conducted in written form based on the topics defined in the discipline syllabus, including both taught subjects and independent learning materials. Each version of the final assessment consists of 2 theoretical questions and 1 practical task.

Teaching materials and media

Projector; white/black board; hand-outs; flipchart; visualization aids for presentation; demonstration materials

Study Semester: 3 (full time)**ECTS:** 6**Workload**

Contact Time		Self-study	
Lectures	30 h	Preparation for Contact Time	50 h
Exercises	60 h	Literature review	40 h
Sum	90 h	Sum	90 h

Total Workload: 180 h**Lecturers**

Sh. Kasimov – Professor at the Department of “Differential equations and mathematical physics”,

Yu. Fayziev – Professor at the Department of “Differential equations and mathematical physics”.

Teaching Contents

Introduction to Differential Equations Basic concepts, vector fields, integral curves, physical and geometric problems. First-Order Differential Equations Separable equations, homogeneous and generalized homogeneous equations, linear and exact differential equations. Cauchy Problem Cauchy problem for first-order equations, existence and uniqueness theorems. First-Order Equations Not Solved for the Derivative Integration methods for such equations, existence theorems. Higher-Order Differential Equations Methods for solving higher-order differential equations. Linear Higher-Order Differential Equations General solution, Wronskian determinant, Euler equation, equations with constant coefficients. Systems of Differential Equations Linear and nonlinear systems, matrix form, Cauchy formula, exponential matrix. Continuity of Solutions Differentiability and continuity of solutions. Autonomous Systems Properties of solutions, stability, first integrals. Basics of Stability Theory Lyapunov stability, asymptotic stability, Lyapunov theorems. Boundary Value Problems Second-order equations, Green’s function, eigenvalues and eigenfunctions. First-Order Partial Differential Equations. First-order PDEs and their characteristics.

Learning Outcomes:

To successfully complete this discipline, students:

- should have knowledge and understanding of first-order and higher-order differential equations, including general and particular solutions.¹
- should be familiar with exact, linear, separable, and homogeneous differential equations, and systems of differential equations.¹
- should understand Cauchy problems, boundary value problems, and the theoretical foundations of stability including Lyapunov methods and the Wronskian determinant.¹
- should be able to solve first-order and higher-order differential equations using analytical techniques.²
- should be able to analyze and solve systems of differential equations, including matrix form, and work with direction fields and integral curves.²
- should be able to apply exponential matrices, determine stability using Lyapunov’s method, and model real-life phenomena with differential equations.²
- should be competent in applying differential equation theory and methods to solve scientific and engineering problems logically.³
- should be able to independently model and interpret physical processes using both ordinary and partial differential equations.³
- should be able to effectively use mathematical reasoning and computational tools to approach and explain complex academic or real-world tasks.³

¹Knowledge; ²Skill; ³Competence.**Teaching and learning methods:**

Lectures; interactive case studies; practical sessions (logical reasoning, rapid Q&A); group work; giving presentations

Entrance requirements:

Mandatory: None

Recommended: Mathematical Analysis MANB117 (1st year, 1st and 2nd semesters)

Linear Algebra and Analytic Geometry AAGB110 (1st year, 1st and 2nd semesters).

Reading list

1. Степанов В.В. Курс дифференциальных уравнений: Учебник. Изд. 11-е, исправ. М.: Издательство ЛЕНАНД, 2024. 512 с.
2. Арнольд В.И. Обыкновенные дифференциальные уравнения. – 2-е изд. М. МЦНМО, 2018. -344 с.
3. Abdulla A'zam. Differensial tenglamalar. Oliy o'quv yurtlari uchun darslik. Toshkent. "Turon-iqbol" nashriyoti. 2024. 408 b.
4. Филиппов А.Ф. Сборник задач по дифференциальным уравнениям. Учебное пособие. Изд. М.: ЛЕНАНД. 2024. 240 с.
5. Понтрягин Л.С. Обыкновенные дифференциальные уравнения. М., «Наука», 2023. 336 с.
6. Филиппов А.Ф. Введение в теорию дифференциальных уравнений. М., Изд-во МГУ, 2004.
7. Islomov B. Abdullaev O. Differensial tenglamalar fanidan masalalar to'plami. Toshkent. «Bayoz.» 2012.

Examination:

Assessment of students' knowledge is carried out in accordance with the Regulation on the system for monitoring and assessing students' knowledge in higher education institutions developed based on the credit-module system, Article 15

Type of assessment	Midterm	Final
Type of assessment	Midterm	Final
Time of assessment	Weeks 13-14	Weeks 19-20
Form of assessment	Written work	Written work

Midterm Assessment: The midterm assessment (MA) is conducted after approximately half of the discipline's lecture and practical sessions have been completed. A written assessment is administered, consisting of 2 theoretical questions and 2 practical task based on the topics covered up to that point. Each task is pre-prepared in different versions. Students who provide complete and correct answers receive a maximum of 5 points per correct answer. The final score for the midterm is calculated as the average of the points obtained for each task. The midterm assessment questions are announced at the beginning of the class sessions.

Final Assessment: The final assessment is conducted in written form based on the topics defined in the discipline syllabus, including both taught subjects and independent learning materials. Each version of the final assessment consists of 2 theoretical questions and 3 practical task.

Teaching materials and media

Projector; white/black board; hand-outs; flipchart; visualization aids for presentation; demonstration materials

Study Semester: 3 (full time)

ECTS: 6

Workload

Contact Time		Self-study	
Lectures	30 h	Preparation for Contact Time	90 h
Exercises	30 h	Literature review	30 h
Sum	60 h	Sum	120 h

Total Workload: 180 h

Lecturers

Z.R.Rakhmonov- Associate Professor at Department of “Applied mathematics and computer analysis”,
T.Q.Khojijev- Senior teacher of Department of “Applied mathematics and computer analysis”.

Teaching Contents

Analysis of Algorithms and Data Structures Intuitive, formal, and cybernetic definitions of an algorithm. Its properties, types, and efficiency. Complexity of algorithms and their computation and evaluation. Algorithm complexity in programming and its analysis. Time complexity (T) of algorithms: linear, polynomial, exponential, super-polynomial, and factorial forms. Recursive algorithms and recursive functions: their advantages and disadvantages in programming. Formalization of provable statements about algorithm properties. Search algorithms and their complexities. Search algorithm using Fibonacci numbers. Internal and external sorting algorithms. Pyramidal, tree-based, and binary tree sorting algorithms. External sorting algorithms. Static data structures. Dynamic data structures. Graphs as data structures. Optimization problems on graphs.

Learning Outcomes:

To successfully complete this discipline, students:

- should have a solid understanding of the fundamental concepts of algorithms, including their intuitive, formal, and cybernetic definitions.¹
- should know the properties, types, and efficiency of algorithms, along with the concept of algorithmic complexity (time and space), including linear, polynomial, exponential, super-polynomial, and factorial complexities.¹
- should be familiar with recursive algorithms, recursive functions, formal methods for proving algorithm properties of static and dynamic data structures, sorting and searching algorithms, and graph-based data structures and optimization problems is essential¹
- should be able to analyze and evaluate the computational complexity of algorithms and of to be implementing various algorithm types, such as sorting (e.g., binary tree, heap) and searching algorithms (e.g., Fibonacci search), using programming languages.²
- should apply recursive solutions effectively, assess their advantages and drawbacks, and optimize algorithms based on time and memory constraints with skills in designing and both static and dynamic data structures and solving graph-based optimization problems programmatically.²
- should be able to select and apply appropriate algorithmic techniques and data structures to solve real-world computational problems efficiently.³
- should be capable of evaluating the performance of algorithms, justifying their design choices, and adapting solutions to meet performance requirements.³
- should be competent in using analytical and practical tools to optimize code execution and maintain scalability in software applications.³

¹Knowledge; ²Skill; ³Competence.

Teaching and learning methods:

Lectures, Completing and summarizing seminar assignments, interactive case studies, quiz-based questioning (blitz survey), working in groups, giving presentations, teamwork and project development for defense

Entrance requirements:

Mandatory: Understanding of fundamental mathematical concepts (such as logic and sets)

Recommended: Prior completion of a course in Algorithmic Languages and Programming. Analytical thinking and problem-solving skills

Reading list

1. Gaynazarov S.M., Saidov D.Y. Algoritmlar va berilganlar tuzilmasi. O'quv qo'llanma-T. Marifat, 2023.-254b (Gaynazarov S.M., Saidov D.Y. Algorithms and data structure. educational-methodical manual T. Marifat, 2023.-254b)
2. Raxmonov Z.R., Xojiyev T.Q. T.Q. Aalgoritmlar va berilganlar strukturasi. Uslubiy qo'llanma. Toshkent. O'ZMU, 2022, -104b (Rakhmonov Z.R., Khojiyev T.Q. T.Q. Algorithms and data structure. Methodological manual. Tashkent. NUUZ, 2022, -104 p)

Examination:

Assessment of students' knowledge is carried out in accordance with the Regulation on the system for monitoring and assessing students' knowledge in higher education institutions developed based on the credit-module system, Article 15

Type of assessment	Midterm	Final
Time of assessment	Weeks 12-13	Weeks 19-20
Form of assessment	Written work	Written work or test

Midterm Assessment: The midterm assessment (MA) is conducted after approximately half of the discipline's lecture and practical sessions have been completed. A written assessment is administered, consisting of 2 theoretical questions and 1 practical task based on the topics covered up to that point. Each task is pre-prepared in different versions. Students who provide complete and correct answers receive a maximum of 5 points per correct answer. The final score for the midterm is calculated as the average of the points obtained for each task. The midterm assessment questions are announced at the beginning of the class sessions.

Final Assessment: The final assessment is conducted in written form based on the topics defined in the discipline syllabus, including both taught subjects and independent learning materials. Each version of the final assessment consists of 2 theoretical questions and 1 practical task.

Teaching materials and media

Projector; white/black board; hand-outs; flipchart; visualization aids for presentation; demonstration materials

Study Semester: 3 (full time)**ECTS:** 4**Workload**

Contact Time		Self-study	
Lectures	30 h	Preparation for Contact Time	30 h
Exercises	30 h	Literature review	30 h
Sum	60 h	Sum	60 h

Total Workload: 120 h**Lecturers**

A.S. Begmatov – Associate Professor at the Department of “Probability Theory and Mathematical Statistics”, PhD in Physical and Mathematical Sciences.

U.Kh. Kobilov – Lecturer at the Department of “Probability Theory and Mathematical Statistics”.

Teaching Contents

Sample space, Basic concepts of probability theory, Concept of probability, Discrete, classical and geometric probability models, Algebra of Events, Axioms of Probability, Properties of Probability, Conditional Probability, Independence of events, Law of total probability and Bayes’ theorem. Sequences of independent experiments. Bernoulli formula, Binomial distribution and its properties. Local and integral limit theorems of De Moivre–Laplace. Poisson’s theorem and their applications. Random variable and its distribution, Random vector and its distribution, Some important distributions, Multivariate distributions, Distributions of functions of random variables, Composition formulas, Expectation and its properties, variance and its properties, higher-order moments, correlation coefficient and its properties. Chebyshev’s inequality, Law of large numbers and its applications, Central limit theorem and its applications.

Learning Outcomes:

To successfully complete this discipline, students:

- should have an understanding and knowledge of sample space and basic concepts of probability theory.¹
- should understand the concept of probability and discrete, classical and geometric probability models.¹
- should be familiar with random variables, distribution functions, the law of large numbers, and the central limit theorem.¹
- should be able to calculate probability of events using classical and geometric definitions.²
- should be able to solve problems related to law of total probability and Bernoulli’s formula.²
- should be able to apply the De Moivre–Laplace theorem to practical tasks.²
- should be competent in analyzing and solving problems involving distribution functions of random variables.³
- should be able to calculate expectation, variance and correlations of random variables.³
- should be capable of applying the law of large numbers and the central limit theorem in real-life data analysis.³

¹Knowledge; ²Skill; ³Competence.

Teaching and learning methods:

Lectures; performing and summarizing practical tasks; interactive case studies; blitz surveys; working in groups; giving presentations; team-based projects and their defense

Entrance requirements:

Mandatory: None

Recommended: Mathematical Analysis (MANB117)

Linear Algebra and Analytic Geometry (AAGB110)

Discrete Mathematics and Mathematical Logic (DMM110)

Reading list

1. Sh.Q. Formanov. Ehtimolliklar nazariyasi. Toshkent, “Universitet”, 2014. (Sh.Q. Formanov. Theory of Probability. Tashkent, “University”, 2014)
2. M.U. Gafurov, Y.M. Xusanboyev, M.M. Toshmatova. Ehtimolliklar nazariyasi va matematik statistika. Darslik. Toshkent, 2023. (M.U. Gafurov, Y.M. Xusanboyev, M.M. Toshmatova. Theory of Probability and Mathematical Statistics. Textbook. Tashkent, 2023)

3. А.А. Боровков. Теория вероятностей. Москва, «Эдиториал-УРСС», 1999. (A.A. Borovkov. Theory of Probability. Moscow, "Editorial-URSS", 1999)
4. Г.И.Ивченко, Ю.И.Медведев. Введение в математическую статистику. Москва, «ЛКИ», 2010. (G.I. Ivchenko, Yu.I. Medvedev. Introduction to Mathematical Statistics. Moscow, "LKI", 2010)

Examination:

Assessment of students' knowledge is carried out in accordance with the Regulation on the system for monitoring and assessing students' knowledge in higher education institutions developed based on the credit-module system, Article 15

Type of assessment	Midterm	Final
Type of assessment	Midterm	Final
Time of assessment	Weeks 8-9	Weeks 19-20
Form of assessment	Written work	Written work

Midterm Assessment: The midterm assessment is conducted after approximately half of the discipline's lecture and practical sessions have been completed. A written assessment is administered, consisting of 2 theoretical questions and 1 practical task based on the topics covered up to that point. Each task is pre-prepared in different versions. Students who provide complete and correct answers receive a maximum of 5 points per correct answer. The final score for the midterm is calculated as the average of the points obtained for each task. The midterm assessment questions are announced at the beginning of the class sessions.

Final Assessment: The final assessment is conducted in written form based on the topics defined in the discipline syllabus, including both taught subjects and independent learning materials. Each version of the final assessment consists of 2 theoretical questions and 1 practical task.

Teaching materials and media

Projector; white/black board; hand-outs; flipchart; visualization aids for presentation; demonstration materials

ENMB209 Probability Theory and Mathematical Statistics II

Study Semester: 4 (full time)

ECTS: 5

Workload

Contact Time		Self-study	
Lectures	30 h	Preparation for Contact Time	60 h
Exercises	30 h	Literature review	30 h
Sum	60 h	Sum	90 h

Total Workload: 150 h

Lecturers

A.S. Begmatov – Associate Professor at the Department of “Probability Theory and Mathematical Statistics”, PhD in Physical and Mathematical Sciences.

U.Kh. Kobilov – Lecturer at the Department of “Probability Theory and Mathematical Statistics”.

Teaching Contents

Main problems of mathematical statistics, Population and sample sets, Polygon and histogram, Empirical distribution function and its properties, Sample mean and variance, Statistical estimation and its properties, Point estimators and methods for constructing estimators, Distributions related to the normal distribution: chi-square, Student’s T and Fisher distributions, Confidence interval method for estimating unknown parameters, Statistical hypotheses and their types, Parametric criteria, Pearson’s goodness-of-fit test, Nonparametric criteria for testing the homogeneity of samples, Two-dimensional sampling, Least squares method, Linear equation of regression.

Learning Outcomes:

To successfully complete this discipline, students:

- should understand population and sample sets and empirical distribution functions.¹
- should be familiar with sample mean and variance, statistical estimation, and their key properties.¹
- should know the concepts of point estimations and the method of substitution for constructing point estimations.¹
- should be able to analyze sample set and draw polygons and histograms.²
- should be able to compute empirical distribution functions and point estimations of unknown parameters.²
- should be able to construct confidence intervals and verify estimator properties.²
- should be competent in applying chi-square, Student’s T, and Fisher distributions in hypothesis testing.³
- should be able to test hypotheses regarding the homogeneity of samples and use goodness-of-fit test.³
- should apply parametric and non-parametric statistical criteria in practical research problems.³

¹Knowledge; ²Skill; ³Competence.

Teaching and learning methods:

Lectures; performing and summarizing practical tasks; interactive case studies; blitz surveys; working in groups; giving presentations; team-based projects and their defense

Entrance requirements:

Mandatory: None

Recommended: Mathematical Analysis (MANB117)

Linear Algebra and Analytic Geometry (AAGB110)

Discrete Mathematics and Mathematical Logic (DMM110)

Reading list

1. Sh.Q. Formanov. Ehtimolliklar nazariyasi. Toshkent, “Universitet”, 2014. (Sh.Q. Formanov. Theory of Probability. Tashkent, “University”, 2014)
2. M.U. Gafurov, Y.M. Xusanboyev, M.M. Toshmatova. Ehtimolliklar nazariyasi va matematik statistika. Darslik. Toshkent, 2023. (M.U. Gafurov, Y.M. Xusanboyev, M.M. Toshmatova. Theory of Probability and Mathematical Statistics. Textbook. Tashkent, 2023)
3. Г.И.Ивченко, Ю.И.Медведев. Введение в математическую статистику. Москва, «ЛКИ», 2010. (G.I. Ivchenko, Yu.I. Medvedev. Introduction to Mathematical Statistics. Moscow, "LKI", 2010)

Examination:

Assessment of students’ knowledge is carried out in accordance with the Regulation on the system for monitoring and assessing students’ knowledge in higher education institutions developed based on the credit-module system, Article 15

Type of assessment	Midterm	Final
Type of assessment	Midterm	Final

Time of assessment	Weeks 27-28	Weeks 37-38
Form of assessment	Written work	Written work

Midterm Assessment: The midterm assessment is conducted after approximately half of the discipline's lecture and practical sessions have been completed. A written assessment is administered, consisting of 2 theoretical questions and 1 practical task based on the topics covered up to that point. Each task is pre-prepared in different versions. Students who provide complete and correct answers receive a maximum of 5 points per correct answer. The final score for the midterm is calculated as the average of the points obtained for each task. The midterm assessment questions are announced at the beginning of the class sessions.

Final Assessment: The final assessment is conducted in written form based on the topics defined in the discipline syllabus, including both taught subjects and independent learning materials. Each version of the final assessment consists of 2 theoretical questions and 1 practical task.

Teaching materials and media

Projector; white/black board; hand-outs; flipchart; visualization aids for presentation; demonstration materials

Study Semester: 4 (full time)**ECTS:** 4**Workload**

Contact Time		Self-study	
Lectures	30 h	Preparation for Contact Time	40 h
Exercises	30 h	Literature review	20 h
Sum	60 h	Sum	60 h

Total Workload: 120 h**Lecturers**

A.A. Raximov – Professor at the Department of “Algebra and Functional Analysis”.

Teaching Contents

Sets. Operations on sets. Mappings and their types. Countable sets. Ring and algebra of sets. Metric space. Open and closed sets in metric spaces. Complete and separable metric spaces. Compact metric spaces. Contraction mapping principle. Concept of connectedness in a metric space. Continuous mappings in metric spaces. Lebesgue measure. Linear spaces. Linear and convex functionals. Minkowski functional. Hahn–Banach theorem. Normed spaces and their properties. Banach space. Factor spaces of normed and Banach spaces. Euclidean space. Orthogonalization process. Hilbert space and its properties. Pointwise and strong convergence of operators. Uniform boundedness principle. Bounded and continuous linear functionals. Space of operators. Adjoint operators. Self-adjoint operators. Spectrum and resolvent of an operator. Compact operators and their properties. Hilbert–Schmidt theorem.

Learning Outcomes:

To successfully complete this discipline, students:

- should have knowledge and understanding of metric space theory and normed vector spaces.¹
- should be familiar with Banach spaces and Hilbert spaces and their key properties.¹
- should understand the concept of bounded linear functionals and operators in functional analysis.¹
- should be able to perform set operations and determine set cardinality.²
- should be able to identify whether a set forms a metric space, and analyze open and closed subsets within it.²
- should be able to verify whether a given space is normed, Banach, or Hilbert; compute norms of functionals and operators; and find adjoint operators in Hilbert spaces.²
- should be capable of interpreting and analyzing the structure of advanced functional spaces.³
- should be able to identify and evaluate properties of linear operators.³
- should be able to apply functional analysis tools to solve real-world problems in mathematics, physics, or engineering involving abstract space structures and transformations.³

¹Knowledge; ²Skill; ³Competence.**Teaching and learning methods:**

Lectures; interactive case studies; practical sessions (logical reasoning, rapid Q&A); group work; giving presentations

Entrance requirements:

Mandatory: None

Recommended: Basic knowledge of set theory and mathematical logic. Familiarity with calculus (limits, continuity, differentiation, integration). Understanding of linear algebra (vector spaces, linear transformations, matrix operations). Introductory exposure to real analysis. Basic skills in a programming language such as MATLAB, Python.

Reading list

1. Abdullayev J.I., G'anikho'jayev R.N., Shermatov M.H., Egamberdiyev O.I. Funktsional analiz va integral tenglamalar, Toshkent: El-Press, 2013. (J.I. Abdullayev, R.N. G'anikho'jayev, M.H. Shermatov, O.I. Egamberdiyev. Functional Analysis and Integral Equations. Tashkent: El-Press, 2013.)
2. Kolmogorov A.N., Fomin S.V. Элементы теории функций и функционального анализа. М.: Физматлит, 2009. (A.N. Kolmogorov, S.V. Fomin. Elements of the Theory of Functions and Functional Analysis. Moscow: Fizmatlit, 2009.)
3. Sarimsoqov T.A. Funktsional analiz kursi. Toshkent: O'qituvchi, 1986. (T.A. Sarimsoqov. Course in Functional Analysis. Tashkent: O'qituvchi, 1986.)
4. Sh.A. Ayupov va boshq. Funktsional analizdan misol va masalalar, Nukus: Bilim, 2009. (Sh.A. Ayupov et al. Examples and Problems in Functional Analysis. Nukus: Bilim, 2009.)
5. Yu.X. Eshqobilov va boshq. Funktsional analiz (misol va masalalar yechish), I-qism, Toshkent: Tafakkur Bo'stoni, 2015. (Yu.X. Eshqobilov et al. Functional Analysis (Solving Examples and Problems), Part I. Tashkent: Tafakkur Bo'stoni, 2015.)

Examination:

Assessment of students' knowledge is carried out in accordance with the Regulation on the system for monitoring and assessing students' knowledge in higher education institutions developed based on the credit-module system, Article 15

Type of assessment	Midterm	Final
Type of assessment	Midterm	Final
Time of assessment	Weeks 8-9	Weeks 19-20
Form of assessment	Written work	Written work

Midterm Assessment: The midterm assessment (MA) is conducted after approximately half of the discipline's lecture and practical sessions have been completed. A written assessment is administered, consisting of 2 theoretical questions and 1 practical task based on the topics covered up to that point. Each task is pre-prepared in different versions. Students who provide complete and correct answers receive a maximum of 5 points per correct answer. The final score for the midterm is calculated as the average of the points obtained for each task. The midterm assessment questions are announced at the beginning of the class sessions.

Final Assessment: The final assessment is conducted in written form based on the topics defined in the discipline syllabus, including both taught subjects and independent learning materials. Each version of the final assessment consists of 2 theoretical questions and 1 practical task.

Teaching materials and media

Projector; white/black board; hand-outs; flipchart; visualization aids for presentation; demonstration materials

Study Semester: 4 (full time)

ECTS: 6

Workload

Contact Time		Self-study	
Lectures	30 h	Preparation for Contact Time	60 h
Exercises	60 h	Literature review	30 h
Sum	90 h	Sum	90 h

Total Workload: 180 h

Lecturers

N.A. Korshunova – Professor at the Department of “Mechanics and Mathematical Modeling”,
 A.Kh. Zakirov – Associate Professor at the Department of “Mechanics and Mathematical Modeling”.

Teaching Contents

Kinematics of a Material Point, velocity and acceleration of a point. Curvilinear coordinates. Velocity and acceleration of a point in curvilinear coordinates. Radial and transverse components of velocity and acceleration. Basic Cases of Rigid Body Motion. Motion of a rigid body about a fixed point. Motion of a body about a fixed point; Euler’s formula; velocity and acceleration of points on the body. Plane-parallel motion of a rigid body. Complex motion of a point. Dynamics: Fundamental definitions. Dynamics of a point. Motion of a material point under the influence of a central force. Mechanical systems. Moment of inertia of a rigid body. Fundamental theorems of dynamics. Analytical Statics: Actual and virtual displacements. Lagrange’s equations of the second kind. Canonical equations. Variational principles in mechanics.

Learning Outcomes:

To successfully complete this discipline, students:

- should possess a foundational understanding of the core concepts of theoretical mechanics, including statics, kinematics, and dynamics.¹
 - should be familiar with principles of force systems, equilibrium conditions, and motion analysis.¹
 - should know classical mechanics laws, vector algebra, Newton’s laws, and analytical methods used to solve mechanical problems.¹
- should be able to analyze and solve mechanical problems related to equilibrium, motion, and force interactions.²
- should be able to construct free-body diagrams, apply equilibrium equations, and use vector and coordinate systems effectively.²
 - should be able to model physical systems and apply theoretical principles to real-world mechanical situations.²
 - should demonstrate the ability to apply theoretical mechanics concepts in practical engineering and physics contexts.³
 - should be competent in evaluating mechanical systems, making reasonable assumptions, and choosing appropriate methods.³
 - should be able to integrate theoretical knowledge with problem-solving to accurately and efficiently model and analyze physical systems.³

¹Knowledge; ²Skill; ³Competence.

Teaching and learning methods:

Lectures; interactive case studies; group work; giving presentations; individual projects; team-based projects and their defense

Entrance requirements:

Mandatory: None

Recommended: A background in basic physics (especially classical mechanics), calculus (differentiation and integration), and linear algebra to facilitate understanding of vectors, matrices, and coordinate systems used in mechanical systems.

Reading list

1. Herbert Goldstein, Charles Poole, John Safko. Classical Mechanics. Pearson New International Edition. USA, 2013. (Herbert Goldstein, Charles Poole, John Safko. Classical Mechanics. Pearson New International Edition. USA, 2013.)
2. Buxgols N.N. Osnovnoy kurs teoreticheskoy mexaniki. Ch. 1, 2. Spb: Lan, 2009. (elektron variant) (N.N. Bukhgolts. Basic Course in Theoretical Mechanics. Parts 1 and 2. St. Petersburg: Lan, 2009. (electronic version))
3. Rashidov T.R. va bosh. Nazariy mexanika. T.: VNESHINVESTPROM, 2020.
4. Meshcherskiy I.V. Sbornik zadach po teoreticheskoy mexanike. Spb: Lan, 2012. (elektron variant) (I.V. Meshcherskiy. Problem Book on Theoretical Mechanics. St. Petersburg: Lan, 2012. (electronic version))

Examination:

Assessment of students' knowledge is carried out in accordance with the Regulation on the system for monitoring and assessing students' knowledge in higher education institutions developed based on the credit-module system, Article 15

Type of assessment	Midterm	Final
Type of assessment	Midterm	Final
Time of assessment	Weeks 29-30	Weeks 37-38
Form of assessment	Written work	Written work or test

Midterm Assessment: The midterm assessment is conducted after approximately half of the discipline's lecture and practical sessions have been completed. A written assessment is administered, consisting of 2 theoretical questions and 1 practical task based on the topics covered up to that point. Each task is pre-prepared in different versions. Students who provide complete and correct answers receive a maximum of 5 points per correct answer. The final score for the midterm is calculated as the average of the points obtained for each task. The midterm assessment questions are announced at the beginning of the class sessions.

Final Assessment: The final assessment is conducted in written form based on the topics defined in the discipline syllabus, including both taught subjects and independent learning materials. Each version of the final assessment consists of 2 theoretical questions and 1 practical task.

Teaching materials and media

Projector; white/black board; hand-outs; flipchart; visualization aids for presentation; demonstration materials

Study Semester: 5 (full time)**ECTS:** 6**Workload**

Contact Time		Self-study	
Lectures	30 h	Preparation for Contact Time	90 h
Seminar	30 h	Literature review	30 h
Sum	60 h	Sum	120 h

Total Workload: 180 h**Lecturers**

F.A. Kabiljanova – Associate Professor at the Department of “Applied Mathematics and Computer Analysis”, Candidate of Physical and Mathematical Sciences.

Z.Sh. Tulaganov – Senior Lecturer at the Department of “Applied Mathematics and Computer Analysis”.

Teaching Contents

Subject of Mathematics Teaching Methodology. Documents that define the content of mathematics education in secondary schools. Regulatory and legal foundations for teaching mathematics in schools. Scientific Methods in Mathematics Teaching. Forms of reasoning. Principles, methods, and forms of teaching mathematics. Professional Preparation of Mathematics Teachers. Technological approach to teaching mathematics. Concepts of "pedagogical technology," "educational technology," and "teaching technology." Information and Communication Technologies in Mathematics Teaching.

Methods for extracurricular activities in mathematics. Methodology of Teaching Computer Science in Higher Education. Didactic principles of teaching computer science. Educational-methodological and software support for teaching computer science. Organizing the Educational Process in Computer Science. Organizational forms of teaching computer science. Organizing independent learning in computer science. Methods for Assessing and Improving Student Knowledge. Use of distance learning systems in teaching mathematics and computer science. Computer Science Classroom: Its Main Purpose and Functions. Goals, tasks, and software infrastructure of the computer science

Learning Outcomes:

To successfully complete this discipline, students:

- should be familiar with the methods and tools used in teaching mathematics and computer science, as well as with techniques for analyzing educational literature.¹
- should understand the principles and laws of didactics and should possess knowledge of modern pedagogical technologies¹
- should be able to work with basic programming languages used in school computer systems and identify various information and communication technologies.²
- should know how to scientifically and psycho-pedagogically justify the structure and content of mathematics and computer science curricula in secondary education.²
- should be capable of applying appropriate forms and methods of assessing students' knowledge during lessons and evaluating the outcomes.²
- Awareness of age-related characteristics and their consideration in the teaching process is also essential²
- should be able to apply their understanding of modern pedagogical technologies in the teaching of mathematics and computer science.³
- should effectively utilize their theoretical knowledge to assess students' academic progress and should be able to adapt teaching strategies in accordance with learners' developmental needs.³

¹Knowledge; ²Skill; ³Competence.

Teaching and learning methods:

Lectures, Completing and summarizing seminar assignments, interactive case studies, quiz-based questioning (blitz survey), working in groups, giving presentations, teamwork and project development for defense

Entrance requirements:

Mandatory: None

Recommended: Linear Algebra and Analytic Geometry (AAGB110)

Algorithmic Languages and Programming (ATDB120)

General Pedagogy 1 (UPPB308)

Reading list

1. Mukhammadiyev J.O., Rakhmonov Z.R. "Methodology of Teaching Mathematics and Computer Science." Educational-methodical manual. Tashkent, National University of Uzbekistan, 2021. – 200 pages.
2. Mukhammadiyev J.O. "Methodology of Teaching Mathematics and Computer Science." Educational-methodical manual. Tashkent, National University of Uzbekistan, 2019. – 172 pages.

Examination:

Assessment of students' knowledge is carried out in accordance with the Regulation on the system for monitoring and assessing students' knowledge in higher education institutions developed based on the credit-module system, Article 15

Type of assessment	Midterm	Final
Type of assessment	Midterm	Final
Time of assessment	Weeks 9-10	Weeks 19-20
Form of assessment	Written work	Written work or test

Midterm Assessment: The midterm assessment (MA) is conducted after approximately half of the discipline's lecture and practical sessions have been completed. A written assessment is administered, consisting of 3 theoretical questions on the topics covered up to that point. Each task is pre-prepared in different versions. Students who provide complete and correct answers receive a maximum of 5 points per correct answer. The final score for the midterm is calculated as the average of the points obtained for each task. The midterm assessment questions are announced at the beginning of the class sessions.

Final Assessment: The final assessment is conducted in written form based on the topics defined in the discipline syllabus, including both taught subjects and independent learning materials. Each version of the final assessment consists of 3 theoretical questions.

Teaching materials and media

Projector; white/black board; hand-outs; flipchart; visualization aids for presentation; demonstration materials

Study Semester: 5 (full time)**ECTS:** 5**Workload**

Contact Time		Self-study	
Lectures	30 h	Preparation for contact time	60 h
Exercise	30 h	Literature review	30 h
Sum	60 h	Sum	90 h

Total Workload: 150 h**Lecturers**

Sh. Kasimov – Professor at the Department of “Differential equations and mathematical physics”,

Yu. Fayziev – Professor at the Department of “Differential equations and mathematical physics”,

Z. Madraximova – Associate Professor at the Department of “Differential equations and mathematical physics”.

Teaching Contents

Introduction. Concepts about the equations of mathematical physics and their solutions. Fundamental equations of mathematical physics. Hyperbolic type equations. The wave equation. D’Alembert’s formula. The physical meaning of the solution defined by D’Alembert’s formula. Combined differential operators. Parabolic type equations. Fourier method for the heat conduction equation. Elliptic type equations. Properties of harmonic functions. Dirichlet and Neumann problems. Green’s function and its properties. Applications of the Fourier method.

Learning Outcomes:

To successfully complete this discipline, students:

- should understand the integration of partial differential equations as applied to problems addressed during the discipline.¹
- should be familiar with the formulation of fundamental problems in the theory of partial differential equations.¹
- should understand the theoretical foundations of existence and uniqueness of solutions and the stability of those solutions.¹
- should be able to apply Green’s function methods for solving boundary value problems for linear partial differential equations.²
- should be able to formulate and solve initial-boundary value problems in mathematical physics.²
- should be able to use appropriate methods for proving the existence and uniqueness of solutions in applied contexts²
- should be capable of proving the existence and uniqueness of solutions to the Cauchy problem and related problems.³
- should possess the practical ability to apply theoretical concepts in solving complex differential equation models.³
- should be able to integrate analytical techniques into modeling and solving real-world problems in mathematical physics.³

¹Knowledge; ²Skill; ³Competence.**Teaching and learning methods:**

Lectures, individual projects, group work, delivering presentations, team-based project development and defense

Entrance requirements:

Mandatory: None

Recommended: Mathematical Analysis MANB117 Differential Equations (DFTB206)

Reading list

1. Сабитов К.Б. Уравнения математической физики. Учебник для ВУЗов. М.: ФИЗМАТЛИТ. 2013. 352 с.
2. Zikirov O. S. Matmatik fizika tenglamalari. Toshkent. Fan va texnologiya. 2017. 320 b.
3. Salohiddinov M., Islomov B. Matmatik fizika tenglamalari fanidan masalalar to’plami. Toshkent. Universitet. 2017. 370 b.
4. Владимиров В.С., Михайлов В.П., Михайлова Т.В., Шабунин М.И. Сборник задач по уравнениям математической физики. М. ФИЗМАТЛИТ. 2016. – 520 с.

Examination:

Assessment of students' knowledge is carried out in accordance with the Regulation on the system for monitoring and assessing students' knowledge in higher education institutions developed based on the credit-module system, Article 15

Type of assessment	Midterm	Final
Type of assessment	Midterm	Final
Time of assessment	Weeks 13-14	Weeks 19-20
Form of assessment	Written work	Written work

Midterm Assessment: The midterm assessment is conducted after approximately half of the discipline's lecture and practical sessions have been completed. A written assessment is administered, consisting of 2 theoretical questions and 1 practical task based on the topics covered up to that point. Each task is pre-prepared in different versions. Students who provide complete and correct answers receive a maximum of 5 points per correct answer. The final score for the midterm is calculated as the average of the points obtained for each task. The midterm assessment questions are announced at the beginning of the class sessions.

Final Assessment: The final assessment is conducted in written form based on the topics defined in the discipline syllabus, including both taught disciplines and independent learning materials. Each version of the final assessment consists of 2 theoretical questions and 2 practical task.

Teaching materials and media

Projector; white/black board; hand-outs; flipchart; visualization aids for presentation; demonstration materials

Study Semester: 5 (full time)

ECTS: 5

Workload

Contact Time		Self-study	
Lectures	30 h	Preparation for Contact Time	60 h
Exercises	30 h	Literature review	30 h
Sum	60 h	Sum	90 h

Total Workload: 150h

Lecturers

A. Khaydarov – Associate Professor at the Department of “Applied Mathematics and Computer Analysis”, Candidate of Physical and Mathematical Sciences.

A.S. Matyakubov – Head of the Department of “Applied Mathematics and Computer Analysis”, Doctor of Physical and Mathematical Sciences.

Teaching Contents

The Process of Abstraction in Social Thinking. Concepts of Model and Modeling. The Role of Modeling in the Process of Cognition and Human Practical Activity. The Concept of a Mathematical Model. Examples of Mathematical Models. Forms of Representing a Mathematical Model. Methods of Constructing and Studying Mathematical Models. Basic Requirements for Mathematical Models. Methods of Constructing Mathematical Models. Correspondence Between a Mathematical Model and Its Real Object. Theoretical and Practical Investigation of Mathematical Models and Their Adequacy. Using the Laws of Conservation of Nature and Other Methods in Process Modeling. Law of Conservation of Energy. Law of Conservation of Mass (Matter). Law of Conservation of Momentum.

The Method of Analogy in Mathematical Modeling. Linear Programming. Transportation Problem. Building Mathematical Models Using the Principle of Hierarchy. Computational Methods for Optimization. Methods for Solving First-Order Ordinary Differential Equations. Equilibrium Solutions of Differential Equations. Stability of Equilibria in Differential Equations (Graphical Method). Demographic Models. Malthus and Verhulst-Pearl Models of Social Development. Logistic Model. Behavior of the Logistic Map. Applications of the Logistic Map. Three Types of Regimes in the Nonlinear Population Model. Model of Predator-Prey Interaction. Bailey’s Epidemic Models. Diffusion Model of Microorganisms, Biosynthesis Models.

Learning Outcomes:

To successfully complete this discipline, students:

- should have knowledge of the modeling process, its stages, and its applications in various fields.¹
- should be knowledgeable about linear and nonlinear models, stochastic processes, and their practical uses.¹
- should possess an understanding of model analysis in areas such as physics, engineering, economics, biology, and others.¹
- Should be able to express a given problem using mathematical formulas.²
- Should be capable of interpreting model results and evaluating their accuracy.²

¹Knowledge; ²Skill.

Teaching and learning methods:

Lectures; performing and summarizing practical tasks; interactive case studies; blitz surveys; working in groups; giving presentations

Entrance requirements:

Mandatory: None

Recommended: Differential Equations (DFTB206) Theoretical Mechanics (NZMB206) Equations of Mathematical Physics (MFTB305) Algorithmic Languages and Programming (ATDB120)

Reading list

1. Жумаев Ж. Решение математических задач в пакетах математических программ. Учебное пособие.// Бухара. «Дурдона», 2020. 240 с. (Jumaev Zh. Solving Mathematical Problems Using Mathematical Software Packages. Study Guide. Bukhara: “Durдона”, 2020. 240 pages.)
2. Хайдаров А., Кабилжанова Ф.А., Матyakубов А.С. Математик modellashtirish asoslari. O‘quv qo‘llanma. Toshkent. 2023. 172 b. (Khaydarov A., Kabiljanova F.A., Matyakubov A.S. Fundamentals of Mathematical Modeling. Study Guide. Tashkent, 2023. 172 pages.)

3. Хайдаров А., Жумаев Ж., Шафиев Т.Р. Основы математического моделирования. Учебник. Бухара. 2022. 216 с. (Khaydarov A., Jumaev Zh., Shafiev T.R. Fundamentals of Mathematical Modeling. Textbook. Bukhara, 2022. 216 pages.)

Examination:

Assessment of students' knowledge is carried out in accordance with the Regulation on the system for monitoring and assessing students' knowledge in higher education institutions developed based on the credit-module system, Article 15

Type of assessment	Midterm	Final
Type of assessment	Midterm	Final
Time of assessment	Weeks 8-9	Weeks 19-20
Form of assessment	Written work	Written work

Midterm Assessment: The midterm assessment is conducted after approximately half of the discipline's lecture and practical sessions have been completed. A written assessment is administered, consisting of 2 theoretical questions and 1 practical task based on the topics covered up to that point. Each task is pre-prepared in different versions. Students who provide complete and correct answers receive a maximum of 5 points per correct answer. The final score for the midterm is calculated as the average of the points obtained for each task. The midterm assessment questions are announced at the beginning of the class sessions.

Final Assessment: The final assessment is conducted in written form based on the topics defined in the discipline syllabus, including both taught subjects and independent learning materials. Each version of the final assessment consists of 2 theoretical questions and 1 practical task.

Teaching materials and media

Projector; white/black board; hand-outs; flipchart; visualization aids for presentation; demonstration materials

Study Semester: 6 (full time)**ECTS:** 5**Workload**

Contact Time		Self-study	
Lectures	30 h	Preparation for Contact Time	30 h
Exercises	30 h	Literature review	30 h
		Course work	30 h
Sum	60 h	Sum	90 h

Total Workload: 150 h**Lecturers**

A. Khaydarov – Associate Professor at the Department of “Applied Mathematics and Computer Analysis”, Candidate of Physical and Mathematical Sciences.

A.S. Matyakubov – Head of the Department of “Applied Mathematics and Computer Analysis”, Doctor of Physical and Mathematical Sciences.

Teaching Contents

Some Models of Competition. Model of the Arms Race Between Two Countries. Combat Activity Model of Two Armies. Volterra–Lotka Model. Biological Models. Modeling the Population Sizes of Interacting Populations. Age-Structured Population Models. Model of Matter and Energy Balance. Some Models of Financial and Economic Processes. Eliminating Inter-Enterprise Debts. Organizing an Advertising Campaign. Macroeconomic Model of Market Economy Equilibrium. Macroeconomic Model of Economic Growth. Stochastic Modeling. Comparative Statics in Competitive Equilibrium Models. Equilibrium Model with Permitted Income. Budget Paradox. Mathematical Modeling of Complex Processes. Damped and Undamped Oscillatory Movements. The Concept of Synergetics (Self-Organization). Computational Experiment and Its Stages. Linear and Nonlinear Models. Special Numerical Methods for Nonlinear Models.

Learning Outcomes:

To successfully complete this discipline, students:

- should be familiar with mathematical and computational methods used in solving modeling problems.¹
- should be able to model mathematical processes using programming languages such as MATLAB and Python.¹
- should be able to compare mathematical models with real-world data and perform model fitting.¹
- should be able to forecast future processes based on models and know how to optimize them.¹
- should possess the ability to interpret results, compare them with real systems, and draw conclusions.³
- should be capable of selecting appropriate mathematical models for real-world problems (e.g., environmental issues, engineering systems, economic processes).³

¹Knowledge; ²Skill; ³Competence.

Teaching and learning methods:

Lectures; performing and summarizing practical tasks; interactive case studies; blitz surveys; working in groups; giving presentations

Entrance requirements:

Mandatory: None

Recommended: Differential Equations (DFTB206) Theoretical Mechanics (NZMB206) Equations of Mathematical Physics (MFTB305) Algorithmic Languages and Programming (ATDB120)

Reading list

1. Жумаев Ж. Решение математических задач в пакетах математических программ. Учебное пособие.// Бухара. «Дурдона», 2020. 240 с. (Jumaev Zh. Solving Mathematical Problems Using Mathematical Software Packages. Study Guide. Bukhara: “Durдона”, 2020. 240 pages.)
2. Хайдаров А., Кабилжанова Ф.А., Матякубов А.С. Математик modellash-tirish asoslari. O‘quv qo‘llanma. Toshkent. 2023. 172 b. (Khaydarov A., Kabiljanova F.A., Matyakubov A.S. Fundamentals of Mathematical Modeling. Study Guide. Tashkent, 2023. 172 pages.)
3. Хайдаров А., Жумаев Ж., Шафиев Т.Р. Основы математического моделирования. Учебник. Бухара. 2022. 216 с. (Khaydarov A., Jumaev Zh., Shafiev T.R. Fundamentals of Mathematical Modeling. Textbook. Bukhara, 2022. 216 pages.)

Examination:

Assessment of students' knowledge is carried out in accordance with the Regulation on the system for monitoring and assessing students' knowledge in higher education institutions developed based on the credit-module system, Article 15

Type of assessment	Midterm	Final
Type of assessment	Midterm	Final
Time of assessment	Weeks 31-32	Weeks 36-37
Form of assessment	Written work	Written work

Midterm Assessment: The midterm assessment is conducted after approximately half of the discipline's lecture and practical sessions have been completed. A written assessment is administered, consisting of 2 theoretical questions and 1 practical task based on the topics covered up to that point. Each task is pre-prepared in different versions. Students who provide complete and correct answers receive a maximum of 5 points per correct answer. The final score for the midterm is calculated as the average of the points obtained for each task. The midterm assessment questions are announced at the beginning of the class sessions.

Final Assessment: The final assessment is conducted in written form based on the topics defined in the discipline syllabus, including both taught subjects and independent learning materials. Each version of the final assessment consists of 2 theoretical questions and 1 practical task.

Teaching materials and media

Projector; white/black board; hand-outs; flipchart; visualization aids for presentation; demonstration materials

Study Semester: 3 (full time)

ECTS: 5

Workload

Contact Time		Self-study	
Lectures	30 h	Preparation for Contact Time	50 h
Exercises	30 h	Literature review	40 h
Sum	60 h	Sum	90 h

Total Workload: 150 h

Lecturers

Mamadaliyev N. – Professor at the Department of “Differential Equations and Mathematical Physics”,
 Mustapoqulov H.Ya. – Associate Professor at the Department of “Differential Equations and Mathematical Physics”.

Teaching Contents

Introduction. The history of the development of Process Research and Optimal Control (PR OC).
 Main stages of PR development and typical problems. Problem formulation. The Traveling Salesman Problem. Network and boundary methods. Dynamic programming. Inventory control problem. The Knapsack problem. Table representation. Mathematical model of the transportation problem. Potential method. Equipment replacement and repair model. Load distribution model. Normal form of a game.
 Game strategy. Equilibrium state. Two-boundary load distribution model. Von Neumann's minimax theorem. Measured (quantitative) games. Solving matrix games using linear programming. Game against nature. Decision making under risk. Linear programming. Formulation of the linear programming problem. Geometric interpretation of linear programming in the plane. Bringing the linear programming problem to canonical form. Concept of a basic solution. Duality theory in linear programming. Sufficient condition for optimality in linear programming. Simplex iteration. L.S. Pontryagin 's Maximum Principle. Admissible controls. Maximum principle for fast processes. Dynamic programming method. Formulation of the linear optimal control problem. Bellman function and its differentiability. Relationship between the maximum principle and the Lagrange method. Bellman equation. Synthesis problem of optimal control. Economic meaning of dual variables. Controllable systems (objects). Continuity and directional differentiability of convex functions. Theory of differential games. Pontryagin's first and second methods. Third method and pursuit method by direction.

Learning Outcomes:

To successfully complete this discipline, students:

- should acquire theoretical knowledge of controllable systems, their mathematical models, and control processes.¹
- should understand decision-making theory and both classical and modern optimization methods.¹
- should have a deep understanding of linear and nonlinear models, constrained and unconstrained optimization problems, dynamic programming, Markov processes, variational calculus, and control theory concepts.¹
- should be able to model control systems mathematically and define objective functions with constraints.²
- should be able to apply optimization methods such as the simplex method, gradient methods, and dynamic programming to solve optimal control problems.²
- should be able to translate real-world problems into mathematical models and analyze them using quantitative approaches.²
- should be competent in evaluating the efficiency of control systems and modeling decision-making processes.³
- should be able to solve optimization problems involving resource allocation, cost minimization, and efficiency maximization in economic and technical contexts.³
- should demonstrate the ability to think independently, use analytical reasoning, and apply mathematical modeling to find rational solutions to complex control and optimization problems.³

¹Knowledge; ²Skill; ³Competence.

Teaching and learning methods:

Lectures; interactive case studies; practical sessions (logical reasoning, rapid Q&A); group work; giving presentations

Entrance requirements:

Mandatory: None

Recommended: Mathematical Analysis MANB117 (1st year, 1st–2nd semesters, 2nd year, 1st-semester) Linear Algebra and Analytic Geometry AAG110 (1st year, 1st–2nd semesters) Differential Equations DFTB206 (2nd year, 3rd semester)

Reading list

1. M. To‘xtasinov. Jarayonlar tadqiqoti. Darslik. “Barkamol Fayz media”. Toshkent, 2017. – 572 b.(M. To‘xtasinov. Process Research. Textbook. "Barkamol Fayz Media", Tashkent, 2017 – 572 pages)
2. N. Mamadaliyev, M. Tuxtasinov. Variatsion hisob va optimal boshqaruvning asosiy masalalari. Toshkent, Universitet, 2013. – 188 b. (N. Mamadaliyev, M. Tuxtasinov. Basic Problems of Calculus of Variations and Optimal Control. Tashkent, University, 2013 – 188 pages)
3. V.I. Blagodatskix. Optimal boshqaruvga kirish. Toshkent, 2019. – 248 b. (V.I. Blagodatskikh. Introduction to Optimal Control. Tashkent, 2019 – 248 pages)
4. M. To‘xtasinov. Jarayonlar tadqiqotidan masalalar to‘plami (o‘quv qo‘llanma). “Universitet”, Toshkent, 2019. – 206 b. (M. To‘xtasinov. Collection of Problems in Process Research (Educational Manual). "University", Tashkent, 2019 – 206 pages)

Examination:

Assessment of students’ knowledge is carried out in accordance with the Regulation on the system for monitoring and assessing students’ knowledge in higher education institutions developed based on the credit-module system, Article 15

Type of assessment	Midterm	Final
Type of assessment	Midterm	Final
Time of assessment	Weeks 30-31	Weeks 37-38
Form of assessment	Written work	Written work

Midterm Assessment: The midterm assessment is conducted after approximately half of the discipline’s lecture and practical sessions have been completed. A written assessment is administered, consisting of 2 theoretical questions and 1 practical task based on the topics covered up to that point. Each task is pre-prepared in different versions. Students who provide complete and correct answers receive a maximum of 5 points per correct answer. The final score for the midterm is calculated as the average of the points obtained for each task. The midterm assessment questions are announced at the beginning of the class sessions.

Final Assessment: The final assessment is conducted in written form based on the topics defined in the discipline syllabus, including both taught subjects and independent learning materials. Each version of the final assessment consists of 2 theoretical questions and 1 practical task.

Teaching materials and media

Projector; white/black board; hand-outs; flipchart; visualization aids for presentation; demonstration materials

Study Semester: 6 (full time)**ECTS:** 6**Workload**

Contact Time		Self-study	
Lectures	30 h	Preparation for Contact Time	60 h
Exercises	60 h	Literature review	30 h
Sum	90 h	Sum	90 h

Total Workload: 180 h**Lecturers**

A.S. Matyakubov – Associate Professor at the “Applied Mathematics and Computer Analysis” Doctor of Physical and Mathematical Sciences

Teaching Contents

Subject and objectives of the course "Computer-based Mathematical Systems."

Classes of mathematical packages such as Maple, Mathematica, Mathcad, and MATLAB and their general descriptions. Solving elementary mathematics problems using computer-based mathematical systems. Arithmetic operations, numbers, and constants. Symbolic computations. Mathematical expressions and functions. Solving equations and inequalities in computer-based mathematical systems. Solving equations and systems of equations. Solving linear algebra problems using computer-based mathematical systems. General information about linear algebra packages. Solving systems of linear equations. Operations with matrices and vectors in computer-based mathematical systems. Methods of creating matrices and vectors. Operations with matrices and vectors. Solving mathematical analysis problems in computer-based mathematical systems. Calculating limits and derivatives. Differentiation, integration, and computing limits. Calculating the sum and product of series in computer-based mathematical systems. Working with series. Plotting function graphs in computer-based mathematical systems. Plotting two-dimensional graphs. Plotting three-dimensional graphs. Plotting explicit and implicit function graphs. Graphical command packages in computer-based mathematical systems. Adjusting graph parameters of functions. Animation in computer-based mathematical systems. Visualization of 2D and 3D graphics. Creating animations. Solving differential equations using computer-based mathematical systems. Functions for solving differential equations. Analytical solutions of ordinary differential equations (ODEs). Solving first, second, and higher-order differential equations in computer-based mathematical systems. Solving initial value and boundary value problems for ODEs. Solving differential equations and plotting their solutions in computer-based mathematical systems. Partial differential equations in computer-based mathematical systems. Programming elements in computer-based mathematical systems. Conditional (if) statements. Programming elements in computer-based mathematical systems. Operators. Procedures and functions.

Learning Outcomes:

To successfully complete this discipline, students:

- should acquire theoretical knowledge about computer-based mathematical systems that enable automated mathematical computations and modeling using specialized software tools such as MATLAB, Maple, Mathematica, and Mathcad.¹
- should learn the principles of performing algebraic, analytical, numerical, and graphical computations, constructing mathematical models, solving them, and analyzing the results.¹
- should develop skills to formulate mathematical problems within computer systems, model them in software environments, analyze outcomes, and present results in a visual format.²
- should become proficient in plotting graphs, solving equations interactively, and handling problems involving differential equations, matrices, and statistical analysis using computer-assisted tools.²
- should gain the competence to effectively use computer-based mathematical systems for solving real-world practical and scientific problems.³
- should be capable of combining analytical and experimental data, justifying their work through algorithmic thinking, and independently applying modern technologies in mathematical research and academic activities.³

¹Knowledge; ²Skill; ³Competence.

Teaching and learning methods:

Lectures; performing and summarizing practical tasks; interactive case studies; blitz surveys; working in groups; giving presentations; team-based project work and defense

Entrance requirements:

Mandatory: None
Recommended: Mathematical Analysis MANB117
Differential Equations (DFTB206)

Reading list

1. O.G. Korolkov, A.S. Chebotarev, Yu.D. Sheglova. Maple in Examples and Problems. A university-level textbook. Voronezh, 2011. 82 pages.
2. V.P. Dyakonov. Maple 10/11/12/13/14 in Mathematical Calculations. Moscow: DMK Press, 2014. 800 pages.
3. M.N. Kirsanov. Practical Programming in the Maple System. Moscow: Publishing House MEI, 2011. 208 pages.

Examination:

Assessment of students' knowledge is carried out in accordance with the Regulation on the system for monitoring and assessing students' knowledge in higher education institutions developed based on the credit-module system, Article 15

Type of assessment	Midterm	Final
Type of assessment	Midterm	Final
Time of assessment	Weeks 30-31	Weeks 37-38
Form of assessment	Written work	Written work

Midterm Assessment: The midterm assessment (MA) is conducted after approximately half of the discipline's lecture and practical sessions have been completed. A written assessment is administered, consisting of 2 theoretical questions and 1 practical task based on the topics covered up to that point. Each task is pre-prepared in different versions. Students who provide complete and correct answers receive a maximum of 5 points per correct answer. The final score for the midterm is calculated as the average of the points obtained for each task. The midterm assessment questions are announced at the beginning of the class sessions.

Final Assessment: The final assessment is conducted in written form based on the topics defined in the discipline syllabus, including both taught subjects and independent learning materials. Each version of the final assessment consists of 2 theoretical questions and 1 practical task.

Teaching materials and media

Projector; white/black board; hand-outs; flipchart; visualization aids for presentation; demonstration materials

Study Semester: 7 (full time)

ECTS: 6

Workload

Contact Time		Self-study	
Lectures	30 h	Preparation for Contact Time	40 h
Exercises	60 h	Literature review	20 h
		Course work	30 h
Sum	90 h	Sum	90 h

Total Workload: 180 h

Lecturers

M.O'. Khudoyberganov – Head of the Department of “Computational Mathematics and Information Systems”, Associate Professor, Doctor of Physical and Mathematical Sciences.

S.A. Baxramov – Associate Professor at the Department of “Computational Mathematics and Information Systems”, Candidate of Physical and Mathematical Sciences.

Teaching Contents

Introduction. Theory of errors. Numerical methods in algebra. Approximate solutions of nonlinear equations. Iterative methods. Iterative methods for solving systems of nonlinear equations. Finding eigenvalues and eigenvectors of a matrix. The problem of function approximation. Numerical integration. Numerical methods for solving the Cauchy problem for ordinary differential equations (ODEs). Approximate solution of boundary value problems for ODEs. Variational methods for the approximate solution of boundary value problems for ODEs. Approximate solution of partial differential equations (PDEs). Approximate solution of equations of mathematical physics. Methods for the approximate solution of boundary value problems for parabolic type PDEs. Methods for the approximate solution of boundary value problems for hyperbolic type PDEs. Methods for the approximate solution of integral equations.

Learning Outcomes:

To successfully complete this discipline, students:

- should acquire knowledge about the errors that occur within the scope of problems covered during the learning process and should understand their sources.¹
- should be able to apply direct and iterative methods for solving systems of linear equations, as well as methods for the approximate solution of nonlinear equations and systems of equations.¹
- should have knowledge of function approximation methods and the derivation of numerical integration formulas.¹
- should understand how to solve problems related to ordinary differential equations using numerical methods.¹
- should be able to estimate the errors of approximate calculation methods.²
- should be capable of selecting appropriate numerical solution methods.²
- should be able to evaluate the difference between exact and approximate solutions of a problem.²
- should be able to use a programming language to approximately solve a problem.²
- should be competent in applying numerical methods to solve mathematical problems.³
- should be able to independently analyze, model, and solve real-world problems using numerical approaches.³
- should be able to critically assess the reliability and accuracy of numerical results.³
- should demonstrate the ability to integrate theoretical knowledge with computational tools in practical situations.³

¹Knowledge; ²Skill; ³Competence.

Teaching and learning methods:

Lectures; interactive case studies; practical sessions (logical reasoning, rapid Q&A); group work; giving presentations

Entrance requirements:

- Mandatory: None
- Recommended: Mathematical Analysis (MANB117)
- Mathematical Modeling (MMLB310)
- Differential Equations (DFTB206)
- Algorithmic Languages and Programming (ATDB120)

Reading list

1. Ismatullaev G.P., Kosbergenova M.S. Hisoblash usullari. "Tafakkur-bo'stoni", Toshkent, 2014. (Ismatullaev G.P., Kosbergenova M.S. Numerical Methods. "Tafakkur-bo'stoni", Tashkent, 2014)
2. Xudoyberganov M.O'., Tulyaganova N.B. Sonli usullardan amaliy topshiriqlar to'plami. O'quv qo'llanma. – T., 2023, 125 bet. (Xudoyberganov M.O'., Tulyaganova N.B. Collection of Practical Tasks in Numerical Methods. Educational Manual. Tashkent, 2023, 125 pages)
3. Xudoyberganov M.O'., Boltayev A.K. Sonli usullar. O'quv qo'llanma. – T., 2023, 176 bet. (Xudoyberganov M.O'., Boltayev A.K. Numerical Methods. Educational Manual. Tashkent, 2023, 176 pages)

Examination:

Assessment of students' knowledge is carried out in accordance with the Regulation on the system for monitoring and assessing students' knowledge in higher education institutions developed based on the credit-module system, Article 15

Type of assessment	Midterm	Final
Type of assessment	Midterm	Final
Time of assessment	Weeks 9-10	Weeks 19-20
Form of assessment	Written work	Written work

Midterm Assessment: The midterm assessment (MA) is conducted after approximately half of the discipline's lecture and practical sessions have been completed. A written assessment is administered, consisting of 2 theoretical questions and 1 practical task based on the topics covered up to that point. Each task is pre-prepared in different versions. Students who provide complete and correct answers receive a maximum of 5 points per correct answer. The final score for the midterm is calculated as the average of the points obtained for each task. The midterm assessment questions are announced at the beginning of the class sessions.

Final Assessment: The final assessment is conducted in written form based on the topics defined in the discipline syllabus, including both taught subjects and independent learning materials. Each version of the final assessment consists of 2 theoretical questions and 1 practical task.

Teaching materials and media

Projector; white/black board; hand-outs; flipchart; visualization aids for presentation; demonstration materials

Study Semester: 7 (full time)**ECTS:** 6**Workload**

Contact Time		Self-study	
Lectures	30 h	Preparation for Contact Time	90 h
Exercises	30 h	Literature review	30 h
Sum	60 h	Sum	120 h

Total Workload: 180 h**Lecturers**

J.K. Tishabayev – Professor at the “Mathematical Analysis” Department, Candidate of Physical and Mathematical Sciences;

T.O. Otaboyev – Senior Lecturer at the “Mathematical Analysis” Department, Doctor of Philosophy (PhD) in Physical and Mathematical Sciences.

Teaching Contents

Complex Plane. Complex numbers and operations with them. The complex plane. The Riemann sphere. Lines and regions in the complex plane. Functions of a complex variable. Elementary functions of a complex variable. Fractional-linear (Möbius) functions and their properties. Classification of fractional-linear transformations. The Zhukovsky function, power and exponential functions, trigonometric functions, logarithmic functions and their properties. Integral of functions with a complex argument. Integrals of functions with complex arguments, their properties, and relation to line integrals. Cauchy's theorem. The concept of the antiderivative. Cauchy's integral formula. Power series. Abel's theorem. Cauchy-Hadamard formula. Expansion of holomorphic functions into series. Taylor series. Properties of holomorphic functions. Zeros of holomorphic functions. Laurent series. Elements of residue theory. Residue theory and its applications. Jordan's lemma.

Learning Outcomes:

To successfully complete this discipline, students:

- To have an understanding and knowledge of holomorphic functions, conformal mappings, integrals of functions of a complex variable, Taylor and Laurent series, and the theory of residues.¹
- To be able to solve problems related to holomorphic functions, conformal mappings, integrals of functions of a complex variable, Taylor and Laurent series, and the theory of residues, and to possess the skills to apply them.²
- The student must have a solid grasp of theoretical knowledge, understand the essence of the topics, and be capable of applying theoretical information to solve practical problems.³

¹Knowledge; ²Skill; ³Competence.

Teaching and learning methods:

Lectures; interactive case studies; practical sessions (logical reasoning, rapid Q&A); group work; giving presentations

Entrance requirements:

Mandatory: None

Recommended: A basic understanding of mathematical analysis, linear algebra, and differential equations is helpful for better comprehension of the subject content.

Reading list

1. Khudoyberganov G., Shoimqulov B.A. Theory of Functions of a Complex Variable. Tashkent: “Ma’rifat”, 2024.
2. Tuychiev T.T., Tishabayev J.K., Djumabayev D.Kh., Kitmanov A.M. Independent Work in the Subject of the Theory of Functions of a Complex Variable. Tashkent: “Mumtoz So‘z”, 2018.
3. Sadullaev A., Khudoyberganov G., Mansurov Kh.T., Vorisov A.K., Tuychiev T.T. Collection of Examples and Problems from the Course of Mathematical Analysis (Complex Analysis), Part 3. Tashkent: “Uzbekistan”, 2000.

Examination:

Assessment of students' knowledge is carried out in accordance with the Regulation on the system for monitoring and assessing students' knowledge in higher education institutions developed based on the credit-module system, Article 15

Type of assessment	Midterm	Final
Type of assessment	Midterm	Final
Time of assessment	Weeks 8-9	Weeks 19-20
Form of assessment	Written work	Written work

Midterm Assessment: The midterm assessment (MA) is conducted after approximately half of the discipline's lecture and practical sessions have been completed. A written assessment is administered, consisting of 2 theoretical questions and 1 practical task based on the topics covered up to that point. Each task is pre-prepared in different versions. Students who provide complete and correct answers receive a maximum of 5 points per correct answer. The final score for the midterm is calculated as the average of the points obtained for each task. The midterm assessment questions are announced at the beginning of the class sessions.

Final Assessment: The final assessment is conducted in written form based on the topics defined in the discipline syllabus, including both taught subjects and independent learning materials. Each version of the final assessment consists of 2 theoretical questions and 1 practical task.

Teaching materials and media

Projector; white/black board; hand-outs; flipchart; visualization aids for presentation; demonstration materials

Study Semester: 4 (full time)**ECTS:** 4**Workload**

Contact Time		Self-study	
Lectures	30 h	Independent study	60 h
Exercises	30 h		
Sum	60 h	Sum	60 h

Total Workload: 120 h**Lecturers**

Sh. F. Madraximov – Professor (DSc) at the Department of “Software Engineering and Artificial Intelligence”.

Teaching Contents

Introduction to Artificial Intelligence. Expert systems. Knowledge representation. Predicate logic and first-order logic. Resolution and logical reasoning. Methods of knowledge representation (semantic networks, frames, ontology). Feature space construction. Training dataset. Describing an object using features. Types of features. Data cleaning. Data cleaning tools (Pandas, NumPy). Data visualization. Visualizing quantitative data in feature space. Dimensionality reduction using PCA and t-SNE methods. Visualizing data using the capabilities of the Matplotlib library. Formal grammar. Terminal and non-terminal symbols in formal grammars. Production rules. Associative networks. Artificial life and animations. Ant colony algorithm. Concept of the algorithm. Ant movement equation. Introduction to fuzzy logic theory. Fuzzy inference. Fuzzy knowledge-based systems. Using confidence coefficients. Bayesian networks. Method for computing posterior probability. Evolutionary computation. Genetic algorithms. Applications of genetic algorithms. Decision trees. Classification trees. Regression trees. Building decision trees. Entropy. Intelligent agents. Fundamentals of machine learning. Introduction to machine learning. Prediction algorithms (linear regression, logistic regression, SVM). Cross-validation method. Artificial neural networks. Perceptron. Artificial neural networks. Perceptron. Biological neuron, mathematical model of a neuron. Training artificial neural networks. Training the perceptron. Multi-layer artificial neural networks.

Learning Outcomes:

To successfully complete this discipline, students:

- should have knowledge of fundamental concepts in artificial intelligence, including expert systems, knowledge representation techniques (semantic networks, frames, ontologies), logical reasoning with predicate and first-order logic, resolution methods, and associative networks.¹
- should understand the structure and principles of fuzzy logic systems, Bayesian networks, and decision trees (classification and regression).¹
- should be familiar with genetic algorithms, artificial neural networks (perceptron, multi-layer networks), and prediction models such as linear regression, logistic regression, and support vector machines.¹
- can implement AI models to represent and reason over structured knowledge, clean and prepare datasets using tools such as Pandas and NumPy, visualize data using Matplotlib, and reduce feature dimensions using PCA or t-SNE.²
- should be able to construct decision trees, fuzzy logic systems, and simple artificial neural networks, and apply them to various problem domains.²
- applying theoretical and algorithmic knowledge in artificial intelligence to solve practical tasks in areas such as data analysis, expert decision-making systems, natural computing, and intelligent agent design.³
- to build interpretable models, apply reasoning mechanisms, combine rule-based and statistical methods, and evaluate model accuracy, reliability, and generalizability.³

¹Knowledge; ²Skill; ³Competence.**Teaching and learning methods:**

Lectures, Hands-on implementation of AI algorithms and logic-based systems, Knowledge representation exercises, Case study discussions on expert systems and intelligent agents, Workshops on rule-based reasoning and fuzzy logic modeling, Group-based analysis of decision trees and Bayesian networks, Visual presentations of AI architectures, Artificial intelligence project development and defense.

Entrance requirements:

Mandatory: Completed secondary education, foundational knowledge in mathematics (including logic and set theory), and basic computer literacy.

Recommended: Familiarity with statistics and probability, basic programming skills (preferably in Python), and experience with logical reasoning, algorithmic thinking, and problem-solving

Reading list

1. Madraximov Sh. Sun'iy intellekt tizimlari. O'quv qo'llanma. – Toshkent: Metodist nashriyoti, 2023, 180 bet. (Madraximov Sh. Artificial Intelligence Systems. Study Guide. – Tashkent: Metodist Publishing, 2023, 180 pages.)
2. Душкин Р. В. Искусственный интеллект. – М.: ДМК Пресс, 2019. – 280 с. (Dushkin R.V. Artificial Intelligence. – Moscow: DMK Press, 2019. – 280 pages.)
3. Потапов А.С. Технологии искусственного интеллекта. – СПб: СПбГУ ИТМО, 2010. – 218 с. (Potapov A.S. Artificial Intelligence Technologies. – St. Petersburg: ITMO University, 2010. – 218 pages.)
4. Морозова В.А., Паутов В.И. Представление знаний в экспертных системах: учебное пособие. – Екатеринбург: Izd-vo Ural Univ., 2017. – 120 с. (Morozova V.A., Pautov V.I. Knowledge Representation in Expert Systems: Study Guide. – Yekaterinburg: Ural University Press, 2017. – 120 pages.)
5. Бурков А. Машинное обучение без лишних слов. – СПб: Питер, 2020. ISBN: 978-5-4461-1560-0. – 192 с. (Burkov A. Machine Learning Without the Hype. – St. Petersburg: Piter Publishing, 2020. ISBN: 978-5-4461-1560-0. – 192 pages.)

Examination:

Assessment of students' knowledge is carried out in accordance with the Regulation on the system for monitoring and assessing students' knowledge in higher education institutions developed based on the credit-module system, Article 15

Type of assessment	Midterm	Final
Time of assessment	Weeks 28-29	Weeks 37-38
Form of assessment	Written work	Test

Midterm Assessment: The midterm assessment (MA) is conducted after approximately half of the discipline's lecture and practical sessions have been completed. A written assessment is administered, consisting of 2 theoretical questions and 1 practical task based on the topics covered up to that point, such as knowledge representation, logical reasoning, fuzzy systems, and AI algorithms. Each task is pre-prepared in different versions to ensure academic integrity. Students who provide complete and correct answers receive a maximum of 5 points per correct answer. The final score for the midterm is calculated as the average of the points obtained for each task. The midterm assessment questions are announced at the beginning of the class sessions.

Final Assessment: Each version of the final assessment consists of two theoretical questions, one practical task, and a test section comprising 20 multiple-choice questions with 4 answer options each, designed to evaluate both theoretical understanding and practical application of core artificial intelligence concepts. The questions cover key topics such as expert systems, knowledge representation, fuzzy logic, decision trees, neural networks, and AI-based reasoning strategies.

Teaching materials and media

Projector; white/black board; hand-outs; computer with Python-based AI environments (e.g., Jupyter Notebook, Google Colab); logic modeling tools and knowledge representation diagrams; datasets for classification and decision tree construction; visualization aids for logic inference, fuzzy systems, and neural networks; demonstration materials including rule-based systems, code snippets, truth tables, graphs, and algorithmic workflows

Study Semester: 4 (full time)**ECTS:** 4**Workload**

Contact Time		Self-study	
Lectures	30 h	Preparation for Contact Time	10 h
Exercises	30 h	Literature review	10 h
		Independent study	40 h
Sum	60 h	Sum	60 h

Total Workload: 120 h**Lecturers**

D. Saidov – Associate Professor (PhD) at the Department of “Software Engineering and Artificial Intelligence”

Teaching Contents

Introduction to Machine Learning. Regression and Classification. Univariate Linear Regression Problem. Active Learning. Multivariate Regression Problem. Logistic Regression. Model Selection. Model Selection Criteria. Regularization for Learning Algorithms. Validation Sets. Metric Algorithms for Classification. Evaluation of Metrics. Naive Bayes Algorithm. Taxonomy Methods and Preliminary Analysis of Experimental Data. Class Separation. k-Nearest Neighbors Method. Generalization Ability and Its Evaluation. Isolation Forest Algorithm. Random Forest Algorithm. k-Means Algorithm. DBSCAN Clustering Algorithm. ISODATA Algorithm.

Learning Outcomes:

To successfully complete this discipline, students:

- should have knowledge of fundamental concepts in machine learning, including supervised and unsupervised learning methods such as regression, classification, and clustering.¹
- should understand core algorithms like linear regression, logistic regression, Naive Bayes, k-nearest neighbors, random forests, and clustering techniques such as k-means and DBSCAN.¹
- should be familiar with evaluation metrics, regularization techniques, and model selection strategies¹.
- can implement machine learning algorithms to solve real-world problems using proper training, validation, and testing procedures.²
- should be able to evaluate models based on various metrics, perform active learning, and apply clustering and classification methods to experimental datasets using appropriate tools and programming environments²
- should be able to apply theoretical knowledge in machine learning to analyze real-life data, construct predictive models, and apply them to fields such as medicine, finance, and natural sciences.³
- should have the ability to optimize model performance, generalize solutions to unseen data, and develop intelligent systems using efficient learning algorithms³.

¹Knowledge; ²Skill; ³Competence.**Teaching and learning methods:**

Lectures, Hands-on coding exercises, Case study discussions, Interactive model evaluations, Algorithm implementation workshops, Group-based data analysis, Poster presentations, Machine learning project defense

Entrance requirements:

Mandatory: Completed secondary education, basic mathematics knowledge, basic computer literacy.

Recommended: Familiarity with statistics and probability, basic programming knowledge (Python preferred), logical reasoning and analytical thinking

Reading list

1. Ian Goodfellow, Yoshua Bengio and Aaron Courville. Deep Learning, // 2016.
2. Aurélien Géron. Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow: Concepts, Tools, and Techniques to Build Intelligent System // 2019.
3. John D. Kelleher, Brian Mac Namee, and Aoife D'Arcy. Fundamentals of Machine Learning for Predictive Data Analytics: Algorithms, Worked Examples, and Case Studies.
4. Ian H. Witten, Eibe Frank, and Mark A. Hall. Data Mining: Practical Machine Learning Tools and Techniques
5. Peter Harrington. Machine Learning in Action
6. Christopher M. Bishop. Pattern Recognition and Machine Learning.

Examination:

Assessment of students' knowledge is carried out in accordance with the Regulation on the system for monitoring and assessing students' knowledge in higher education institutions developed based on the credit-module system, Article 15

Type of assessment	Midterm	Final
Time of assessment	Weeks 13	Weeks 19-20
Form of assessment	Written work	Written work or test

Midterm Assessment: The midterm assessment (MA) is conducted after approximately half of the discipline's lecture and practical sessions have been completed. A written assessment is administered, consisting of 2 theoretical questions and 1 practical task based on the topics covered up to that point. Each task is pre-prepared in different versions. Students who provide complete and correct answers receive a maximum of 5 points per correct answer. The final score for the midterm is calculated as the average of the points obtained for each task. The midterm assessment questions are announced at the beginning of the class sessions.

Final Assessment: Each version of the final assessment consists of two theoretical questions, one practical task, and a test section comprising 20 multiple-choice questions with 4 answer options each, designed to evaluate both theoretical understanding and practical application.

Teaching materials and media

Projector; white/black board; hand-outs; computer with Python-based ML environments (e.g., Jupyter Notebook, Google Colab); datasets for model training and testing; visualisation aids for presenting algorithm performance; demonstration materials including code snippets, graphs, and evaluation metrics

Study Semester: 4 (full time)**ECTS:** 4**Workload**

Contact Time		Self-study	
Lectures	30 h	Preparation for Contact Time	30 h
Exercises	30 h	Literature review	30 h
		Course work	
Sum	60 h	Sum	60 h

Total Workload: 120 h**Lecturers**

D. Saidov – Associate Professor (PhD) at the Department of “Software Engineering and Artificial Intelligence”

Teaching Contents

Differences between Artificial Intelligence, Machine Learning, and Deep Learning. Fundamental concepts of neural networks. Activation functions (ReLU, sigmoid, tanh). Loss functions and the backpropagation algorithm. Convolution and pooling operations. Popular CNN architectures: LeNet, AlexNet, VGG. Recurrent Neural Networks (RNNs) and their limitations. LSTM and GRU architectures. Attention mechanism. Transformer architecture and its advantages. Generative Adversarial Networks (GANs) and Variational Autoencoders (VAEs). GAN architecture and working principle. Concepts of transfer learning and fine-tuning. Using pretrained models. Adversarial examples and their impact. Setting up the Python, NumPy, and TensorFlow/PyTorch environment. Creating a simple neural network. Training a basic neural network on the MNIST dataset. Building and training a CNN model on the CIFAR-10 dataset. Working with text generation or time-series data. Translation or text synthesis using a Transformer-based model. Simple image generation using GANs (MNIST). Applying BERT or Vision Transformer with HuggingFace. Generating adversarial examples and studying their impact on the model.

Learning Outcomes:

To successfully complete this discipline, students:

- should have knowledge of the fundamental principles of deep learning, including the differences between artificial intelligence, machine learning, and deep learning.¹
- should understand the architecture and working principles of neural networks, activation functions (such as ReLU, sigmoid, and tanh), loss functions, and the backpropagation algorithm. They should be familiar with core deep learning models such as Convolutional Neural Networks (CNNs), Recurrent Neural Networks (RNNs), Long Short-Term Memory (LSTM), Gated Recurrent Unit (GRU), and the Transformer architecture.¹
- should understand concepts like attention mechanisms, transfer learning, fine-tuning, pretrained models, adversarial examples, and generative models such as GANs and VAEs.¹
- can build and train deep neural networks using tools such as Python, NumPy, TensorFlow, or PyTorch. They can implement CNNs on image datasets like MNIST and CIFAR-10, use RNNs for sequential data, and apply Transformer-based models for translation or text synthesis tasks.²
- should also be able to fine-tune pretrained models, generate images using GANs, and create adversarial examples to test model robustness.²
- Should be able to apply deep learning techniques to real-world problems involving image recognition, text processing, and generative modeling in domains such as healthcare, finance, natural language processing, and computer vision.³
- should have the ability to evaluate and compare architectures, optimize training performance, and integrate pretrained or custom models into practical applications³

¹Knowledge; ²Skill; ³Competence.**Teaching and learning methods:**

Lectures, Hands-on implementation of deep neural networks, Interactive coding labs using TensorFlow and PyTorch, Visualization of training and model evaluation, Case study analysis of deep learning applications, Architecture comparison workshops (CNN, RNN, Transformer), Group-based model training and tuning, Poster presentations on generative models, Deep learning project defense

Entrance requirements:

Mandatory: Completed secondary education, solid foundation in mathematics (especially linear algebra and calculus), and basic computer literacy.

Recommended: Prior knowledge of machine learning concepts, familiarity with statistics and probability, experience with Python programming, and understanding of fundamental neural network principles

Reading list

1. Ian Goodfellow, Yoshua Bengio and Aaron Courville. "Deep Learning", 2015, 801 pages.
2. François Chollet, "Deep Learning with Python", 2017, 504 pages.
3. Jeremy Howard, Sylvain Gugger, "Deep Learning for Coders with Fastai and PyTorch", 2020, 624 pages.
4. Adrian Rosebrock, "Deep Learning for Computer Vision with Python", 2019.

Examination:

Assessment of students' knowledge is carried out in accordance with the Regulation on the system for monitoring and assessing students' knowledge in higher education institutions developed based on the credit-module system, Article 15

Type of assessment	Midterm	Final
Time of assessment	Weeks 13	Weeks 19-20
Form of assessment	Test	Written work

Midterm Assessment: The midterm assessment (MA) is conducted after approximately half of the discipline's lecture and practical sessions have been completed. The assessment is administered in the form of a multiple-choice test, consisting of 20 questions, each with 4 open answer options. The test is prepared in different versions to ensure academic integrity. Each correctly answered question is awarded 1 point, with a maximum score of 20 points. The final score for the midterm is the total number of correct responses. The midterm test covers all topics discussed up to that point and is conducted during regularly scheduled class time.

Final Assessment: The final assessment (FA) is conducted at the end of the discipline and is administered in the form of a written examination. Each version of the final assessment consists of two theoretical questions and one practical task, based on the key topics covered throughout the discipline. All versions are pre-prepared to ensure fairness and consistency. Each question is graded separately, with students receiving full marks for complete and accurate responses. The final grade is determined by the total points accumulated across all three tasks. This assessment is designed to evaluate both the theoretical understanding and the practical problem-solving ability of the students.

Teaching materials and media

Projector; white/black board; hand-outs; computer with Python-based deep learning environments (e.g., Jupyter Notebook, Google Colab); deep learning frameworks such as TensorFlow and PyTorch; datasets for training and evaluating models (e.g., MNIST, CIFAR-10); visualization tools for neural network architectures and performance metrics; demonstration materials including annotated code snippets, layer visualizations, model outputs, and training curves.

Study Semester: 5 (full time)

ECTS: 5

Workload

Contact Time		Self-study	
Lectures	30 h	Preparation for Contact Time	10 h
Exercises	30 h	Literature review	40 h
		Independent study	40 h
Sum	60 h	Sum	90 h

Total Workload: 150 h

Lecturers

A.S. Matyakubov – Doctor of Physical and Mathematical Sciences, Associate Professor, Department of “Applied Mathematics and Computer Analysis”,

B.Abdurakhimov- Doctor of Physical and Mathematical Sciences, Professor, Department of “Applied Mathematics and Computer Analysis”.

Teaching Contents

The role and place of information security, areas of information security, information security policy, architecture and strategy of information security, categories of information security, the concept of substitution cipher, and table substitutions. Models of information security, main forms and sources of information attacks, the most common hacking methods, and the use of magic squares. Classification of information systems and cryptosystems, key concepts such as cryptology, cryptography, cryptanalysis, cipher, cryptogram, plaintext, key, cryptosystem, and cryptographic algorithm, as well as the concept of shared password usage and the Caesar cipher. The general system of secure information transmission, including sender, receiver, communication channel, and intruder, and the affine Caesar system. Rotor machines, steganography, one-time pad method, and scramblers. Cryptographic methods of information protection, information security standards, mathematical foundations of cryptography, and information theory. Algebra of parameters, hash functions, and fundamentals of cryptology. Key length in symmetric and asymmetric systems, symmetric algorithms, public-key algorithms, and the knapsack algorithm. RSA algorithm. Rabin and ElGamal algorithms and cryptographic protocols. Diffie–Hellman key exchange algorithm. Digital signature standards such as GOST, DSA, and ElGamal algorithms. Authentication and identification of messages, problems of authentication and identification, and the Feige–Fiat–Shamir scheme. Multi-public key cryptography. Covert channels and problems of secure data transmission.

Learning Outcomes:

To successfully complete this discipline, students:

- has an understanding of information, methods of its storage, processing, and transmission, mathematical and software support of computing systems, features of their application in science, industry, and education, computer software, and the types and characteristics of future programs;¹
- to study and use high-level programming languages, software, programming technologies, inheritance, rules of polymorphism, and to solve practical problems with their help;²
- must possess the skills to create algorithms for solving applied problems, develop algorithms and their software implementation, create passwords, and work with electronic digital signatures;³

¹Knowledge; ²Skill; ³Competence.

Teaching and learning methods:

Lectures, Performing and summarizing practical tasks, Interactive case studies, Blitz surveys, Working in groups, Giving presentations, Teamwork and project defense

Entrance requirements:

Mandatory: None

Recommended: Algorithmic Languages and Programming Algorithms and Data Structures

Mathematical Analysis

Reading list

1. Aripov M.M., Abdurahimov B.F., Matyakubov A.S. Kriptografik usullar. O‘quv qo‘llanma. Toshkent, O‘zMU, 2020, 235 b.
2. Hudoyqulov Z.T., Isломov Z.Sh., Mardiev U.R. - Kriptografia 1. Toshkent, TATU, 2021, 206 b.
3. Aripov M.M., Matyakubov A.S. Axborotlarni himoyalash usullari. O‘quv qo‘llanma. Toshkent, Universitet, 2012, 96 b.

4. Matyakubov A.S., Mamatov A. Axborotlarni himoyalash usullari. Uslubiy qo‘llanma. Toshkent, Universitet, 2023, 79b.
5. Брюс Шнайер. Прикладная криптография: протоколы, алгоритмы и исходный код на С. Издательство Вильямс, 2016 г.
6. Запечников С.В., Казарин О.В., Тарасов А.А. - Криптографические методы защиты информации - Москва Юрайт, 2019, 308с.

Examination:

Assessment of students' knowledge is carried out in accordance with the Regulation on the system for monitoring and assessing students' knowledge in higher education institutions developed based on the credit-module system, Article 15

Type of assessment	Midterm	Final
Time of assessment	Weeks 9-10	Weeks 19-20
Form of assessment	Written work	Written work

Midterm Assessment: The midterm assessment (MA) is conducted after approximately half of the course's lecture and practical sessions have been completed. A written assessment is administered, consisting of 2 theoretical questions and 1 practical task based on the topics covered up to that point. Each task is pre-prepared in different versions. Students who provide complete and correct answers receive a maximum of 5 points per correct answer. The final score for the midterm is calculated as the average of the points obtained for each task. The midterm assessment questions are announced at the beginning of the class sessions.

Final Assessment: Each version of the final assessment consists of two theoretical questions and one practical assignment, designed to assess theoretical understanding and practical application

Teaching materials and media

Projector; white/black board; hand-outs; flipchart; visualization aids for presentation; demonstration materials

Study Semester: 5 (full time)**ECTS:** 5**Workload**

Contact Time		Self-study	
Lectures	30 h	Preparation for Contact Time	10 h
Exercises	30 h	Literature review	40 h
		Independent study	40 h
Sum	60 h	Sum	90 h

Total Workload: 150 h**Lecturers**

A.S. Matyakubov – Doctor of Physical and Mathematical Sciences, Associate Professor, Department of “Applied Mathematics and Computer Analysis”.

Teaching Contents

The role and importance of information security. Fields of information security. Information security policy. Information security architecture and strategy. Categories of information security. Concept of substitution cipher. Tabular substitutions. Information security models. Main types and sources of attacks on information. The most common “hacking” methods. Use of magic squares. Classification of information systems and cryptosystems. Key concepts: cryptology, cryptography, cryptanalysis, cipher, cryptogram, plaintext, ciphertext, key, cryptosystem, and cryptographic algorithm. Concept of cipher exchange. Caesar cipher. General system of secure information transmission: sender, receiver, communication channel, intruder. Caesar’s affine system. Rotor machines. Steganography. One-time pad method. Scramblers. Cryptographic methods in information security. Information security standards. Mathematical foundations of cryptography. Information theory. Algebra of parameters. Hash functions. Fundamentals of cryptology. Key length in symmetric and asymmetric systems. Symmetric algorithms. Public key algorithms. Knapsack algorithm. RSA algorithm. Rabin and El-Gamal algorithms. Cryptographic protocols. Key exchange using the Diffie–Hellman algorithm. Electronic digital signature: GOST, DSA, El-Gamal algorithms. Message authentication and identification. Problems of authentication and identification. Feige–Fiat–Shamir scheme. Multi-user public key cryptography. Covert channels. Issues of secure data transmission.

Learning Outcomes:

To successfully complete this discipline, students:

- Should understand the basic concepts of information security and cryptography (encryption, decryption, authentication, integrity).¹
- Should understand the fundamentals of symmetric and asymmetric cryptographic algorithms (AES, RSA, ECC), the functions and principles of tools like digital signatures, hash functions (SHA-2, SHA-3), MAC, and HMAC.¹
- Should know the main types of cryptanalysis attacks (brute-force, chosen-plaintext, man-in-the-middle) and the methods of protection against them.¹
- Should be able to encrypt and decrypt texts using various cryptographic algorithms.²
- Should be able to perform the process of creating and verifying digital signatures in practice.²
- Should be able to analyze cryptographic protocols and assess their security²
- Should learn to work with digital certificates and keys (e.g., using the OpenSSL tool).²
- Should become a qualified specialist capable of analytical thinking in the field of information security and evaluating the security of real-world systems.³
- Should gain competence in correctly applying cryptographic protection tools in practical systems (web applications, networks, mobile applications).³
- Should be prepared to study and research new cryptographic technologies (such as post-quantum cryptography and blockchain security).³

¹Knowledge; ²Skill; ³Competence.

Teaching and learning methods:

Lectures, Performing and summarizing practical tasks, Interactive case studies, Blitz surveys, Working in groups, Giving presentations, Teamwork and project defense

Entrance requirements:

Mandatory: None

Recommended: Algorithmic Languages and Programming Algorithms and Data Structures

Reading list

1. Aripov M.M., Abdurahimov B.F., Matyakubov A.S. Cryptographic Methods. Textbook. Tashkent, National University of Uzbekistan, 2020, 235 pages.
2. Hudoyqulov Z.T., Islomov Z.Sh., Mardiev U.R. Cryptography 1. Tashkent, Tashkent University of Information Technologies, 2021, 206 pages.
3. Aripov M.M., Matyakubov A.S. Methods of Information Protection. Textbook. Tashkent, University Publishing, 2012, 96 pages.

Examination:

Assessment of students' knowledge is carried out in accordance with the Regulation on the system for monitoring and assessing students' knowledge in higher education institutions developed based on the credit-module system, Article 15

Type of assessment	Midterm	Final
Time of assessment	Weeks 9-10	Weeks 19-20
Form of assessment	Written work	Written work

Midterm Assessment: The midterm assessment (MA) is conducted after approximately half of the course's lecture and practical sessions have been completed. A written assessment is administered, consisting of 2 theoretical questions and 1 practical task based on the topics covered up to that point. Each task is pre-prepared in different versions. Students who provide complete and correct answers receive a maximum of 5 points per correct answer. The final score for the midterm is calculated as the average of the points obtained for each task. The midterm assessment questions are announced at the beginning of the class sessions.

Final Assessment: Each version of the final assessment consists of two theoretical questions and one practical assignment, designed to assess theoretical understanding and practical application

Teaching materials and media

Projector; white/black board; hand-outs; flipchart; visualization aids for presentation; demonstration materials

SKMB305 Conditionally well-posed problems

Study Semester: 5 (full time)

ECTS: 5

Workload

Contact Time		Self-study	
Lectures	30 h	Preparation for Contact Time	10 h
Exercises	30 h	Literature review	40 h
		Independent study	40 h
Sum	60 h	Sum	90 h

Total Workload: 150 h

Lecturers

Y. Khudayberganov – Associate Professor (PhD) at the Department of “Applied Mathematics Computer Analysis”

Teaching Contents

Mathematical Foundations of Ill-Posed Problems: Hadamard Conditions. Inverse Problems: Concepts and Examples. Noise Consideration and Regularization Methods in Ill-Posed Problems. Tikhonov Regularization and Its Applications. Fredholm Integral Equations and Their Well-Posedness. Inverse Time Problems for Parabolic Equations. Inverse Problems for Elliptic Equations. Comparison of Well-Posed and Ill-Posed Problems. Uncertainties in Systems and Their Impact on Stability. The Inverse Cauchy Problem and Its Characteristics. Spectral Methods in Ill-Posed Problems. Singular Operators and Their Role in Ill-Posed Problems. Numerical Ill-Posed Problems: Discretization and Stabilization. Problems with Incomplete Data: The Challenge of Data Reconstruction. Reconstruction Problems and Regularization in Image Restoration. Inverse Heat Conduction Problems. Optimal Parameter Selection Methods for Ill-Posed Problems. Inverse Spectral Problems and Their Physical Applications. Identification of Problems with Noisy Measurements. Multidimensional Inverse Problems and Their Computer Models

Learning Outcomes:

To successfully complete this module, students:

- should have knowledge of the fundamental principles of ill-posed problems, including Hadamard’s conditions for well-posedness, examples of inverse problems, and the mathematical nature of instability and non-uniqueness in solutions.¹
- should understand classical regularization techniques such as Tikhonov regularization, truncated SVD, and iterative methods. Familiarity with integral equations of the first kind, inverse problems in partial differential equations, and the impact of data noise on solution accuracy is essential.¹
- Should be able to formulate and analyze ill-posed problems arising in applied sciences, identify the lack of stability or uniqueness, and select appropriate regularization methods. They should be capable of implementing regularization techniques in numerical environments (e.g., MATLAB, Python) to obtain stable solutions.²
- should be able to perform error analysis, parameter selection (e.g., L-curve, cross-validation), and interpret the quality of reconstruction in inverse problems with noisy data.²
- should be able to apply theoretical knowledge of ill-posed problems to solve practical inverse problems in domains such as medical imaging (e.g., tomography), geophysics, and heat conduction.³
- should have the ability to model uncertainty, design stable computational algorithms, and generalize solution techniques for real-world applications.³
- should be able to critically assess model limitations, propose improvements, and contribute to interdisciplinary problem-solving using concepts from ill-posed problem theory.³

¹Knowledge; ²Skill; ³Competence.

Teaching and learning methods:

Lectures. Mathematical derivation sessions. Hands-on coding exercises. Case study discussions. Interactive solution stability analysis. Algorithm implementation workshops. Group-based inverse problem modeling. Poster presentations. Project defense.

Entrance requirements:

Mandatory: Completed secondary education or equivalent. Basic knowledge of calculus and linear algebra
Basic computer literacy (e.g., using scientific calculators or simple software).

Recommended: Familiarity with differential equations and functional analysis. Basic understanding of numerical methods. Programming skills in MATLAB or Python. Logical reasoning and the ability to interpret mathematical models.

Reading list

1. Anatoly B. Bakushinsky, Mikhail M. Kokurin, Mikhail Yu. Kokurin. Regularization Algorithms for Ill-Posed Problems. // De Gruyter, 2018. – p. 312.
2. Christian Clason, Barbara Kaltenbacher, Elena Resmerita. Regularization of Ill-Posed Problems with Non-negative Solutions. // In: Handbook of Mathematical Models and Algorithms in Computer Vision and Imaging. Springer, 2019. – pp. 1–23.
3. Michael Hintermüller (Ed.). Inverse Problems and Related Topics: Contributions of the International Conference on Inverse Problems Shanghai 2018. // Springer Proceedings in Mathematics & Statistics, 2020. – p. 400.
4. Mike Ongie, Rebecca Willett, Roarke Horstmeyer, Mathews Jacob. Deep Learning Techniques for Inverse Problems in Imaging. // arXiv preprint arXiv:2004.13650, 2020. – 30 p.
5. Christian Clason, Tuomo Valkonen. Introduction to Nonsmooth Analysis and Optimization: With Applications in Machine Learning and Inverse Problems. // Preprint, 2020. arXiv:2001.00216 – 126 p.

Examination:

Assessment of students' knowledge is carried out in accordance with the Regulation on the system for monitoring and assessing students' knowledge in higher education institutions developed based on the credit-module system, Article 15

Type of assessment	Midterm	Final
Time of assessment	Weeks 9	Weeks 19-20
Form of assessment	Written work	Written work

Midterm Assessment: The midterm assessment (MA) is conducted after approximately half of the course's lecture and practical sessions have been completed. A written assessment is administered, consisting of 2 theoretical questions and 1 practical task based on the topics covered up to that point. Each task is pre-prepared in different versions. Students who provide complete and correct answers receive a maximum of 5 points per correct answer. The final score for the midterm is calculated as the average of the points obtained for each task. The midterm assessment questions are announced at the beginning of the class sessions.

Final Assessment: Each version of the final assessment consists of two theoretical questions and one practical assignment, designed to assess theoretical understanding and practical application

Teaching materials and media

Projector – for visual presentation of concepts, equations, and graphs; White/black board – for live derivations of mathematical formulations and algorithmic steps; Hand-outs – lecture notes, problem sets, and algorithm summaries; Computer with MATLAB or Python-based numerical environments (e.g., Jupyter Notebook, MATLAB Live Scripts); Simulated and real datasets – for testing inverse problem algorithms under noisy or incomplete data; Visualisation aids – to illustrate the effects of instability, regularization, and parameter tuning (e.g., L-curve plots, residual error graphs); Demonstration materials – including code snippets for regularization methods, step-by-step algorithm implementation, and numerical results; Interactive tools – small programs or notebooks that allow students to experiment with regularization parameters and observe changes in outputs; Scientific articles or case studies – for reading assignments and discussions on real-world applications.

Study Semester: 5 (full time)

ECTS: 5

Workload

Contact Time		Self-study	
Lectures	30 h	Preparation for Contact Time	10 h
Exercises	30 h	Literature review	40 h
		Independent study	40 h
Sum	60 h	Sum	90 h

Total Workload: 150 h

Lecturers

Y. Khudayberganov – Associate Professor (PhD) at the Department of “Applied Mathematics Computer Analysis”

Teaching Contents

The Concept of a Well-Posed Problem. Definition of a Well-Posed Problem. The Cauchy Problem for the Wave Equation. The Cauchy Problem for the Heat Conduction Equation. Definition of Ill-Posed Problems and Examples. Modeling of Inverse Problems. The Intrinsic Connection Between Ill-Posed and Inverse Problems and Practical Applications. The Concept of Conditional Well-Posedness. Stability Estimates for Ill-Posed Problems. The Concept of a Regularizing Family and the Regularization Parameter. First-Kind Integral Equations. Ill-Posed Problems in Mathematical Physics. Inverse Problems for Parabolic Equations. Inverse Problems for Hyperbolic Equations. Ill-Posed Boundary Problem for a Parabolic Equation with Time-Reversed Direction. Ill-Posed Boundary Problem for a Differential Equation of Mixed Type. Differential Equations with First-Order Operator Coefficients.

Differential Equations with Second-Order Operator Coefficients.

Learning Outcomes:

To successfully complete this discipline, students:

- should possess knowledge of the methods and tools used for ill-posed and inverse problems, as well as techniques for analyzing relevant literature. ¹
- should be able to demonstrate whether a problem is well-posed or ill-posed, identify conditional well-posedness in ill-posed problems, and study methods for solving such problems. ¹
- understand how to solve inverse problems, acquire knowledge of numerical solutions for inverse and ill-posed problems, and be familiar with the development of corresponding software tools. ¹
- should be capable of identifying whether a problem is well-posed or ill-posed and be able to select appropriate solution methods for inverse and ill-posed problems.
- should be proficient in implementing numerical solutions and developing software programs for solving these problems.
- should be able to analyze results in graphical and tabular forms and compare them with practical outcomes.
- should develop the skills to construct mathematical models related to ill-posed and inverse problems, analyze them, select appropriate solution methods, and design software for computing numerical solutions. ²
- should have the ability to express real-world problems using mathematical formulas, equations, and systems
- should possess skills in performing calculations, graphical analysis, numerical modeling, and simulations using various modern programming languages.
- should be able to understand, analyze, and interpret the results of mathematical models and make informed decisions based on these models. ³

¹Knowledge; ²Skill; ³Competence.

Teaching and learning methods:

Lectures. Mathematical derivation sessions. Hands-on coding exercises. Case study discussions. Interactive solution stability analysis. Algorithm implementation workshops. Group-based inverse problem modeling. Poster presentations. Project defense.

Entrance requirements:

Mandatory: Completed secondary education or equivalent. Basic knowledge of calculus and linear algebra
Basic computer literacy (e.g., using scientific calculators or simple software).

Recommended: Mathematical Analysis (MANB117) Differential Equations (DFTB206) Functional Analysis (FANB204)

Reading list

1. Fayazov, K.S., Khajiyev, I.O. Ill-Posed and Inverse Problems. Textbook. – Tashkent: “Ma’rifat”, 2024. 176 pages.
2. Kabanikhin, S.I. Inverse and Ill-Posed Problems. Siberian Scientific Publishing House, Novosibirsk, 2008.
3. Lavrentyev, M.M., Savelev, L.Ya. Operator Theory and Ill-Posed Problems. 2nd ed., revised and expanded. Novosibirsk: Institute of Mathematics Publishing, SB RAS, 2010. 912 pages.

Examination:

Assessment of students’ knowledge is carried out in accordance with the Regulation on the system for monitoring and assessing students’ knowledge in higher education institutions developed based on the credit-module system, Article 15

Type of assessment	Midterm	Final
Time of assessment	Weeks 9	Weeks 19-20
Form of assessment	Written work	Written work

Midterm Assessment: The midterm assessment (MA) is conducted after approximately half of the course’s lecture and practical sessions have been completed. A written assessment is administered, consisting of 2 theoretical questions and 1 practical task based on the topics covered up to that point. Each task is pre-prepared in different versions. Students who provide complete and correct answers receive a maximum of 5 points per correct answer. The final score for the midterm is calculated as the average of the points obtained for each task. The midterm assessment questions are announced at the beginning of the class sessions.

Final Assessment: Each version of the final assessment consists of two theoretical questions and one practical assignment, designed to assess theoretical understanding and practical application

Teaching materials and media

Projector – for visual presentation of concepts, equations, and graphs; White/black board – for live derivations of mathematical formulations and algorithmic steps; Hand-outs – lecture notes, problem sets, and algorithm summaries; Computer with MATLAB or Python-based numerical environments (e.g., Jupyter Notebook, MATLAB Live Scripts); Simulated and real datasets – for testing inverse problem algorithms under noisy or incomplete data; Visualisation aids – to illustrate the effects of instability, regularization, and parameter tuning (e.g., L-curve plots, residual error graphs); Demonstration materials – including code snippets for regularization methods, step-by-step algorithm implementation, and numerical results; Interactive tools – small programs or notebooks that allow students to experiment with regularization parameters and observe changes in outputs; Scientific articles or case studies – for reading assignments and discussions on real-world applications.

Study Semester: 5 (full time)**ECTS:** 5**Workload**

Contact Time		Self-study	
Lectures	30 h	Preparation for Contact Time	10 h
Exercises	30 h	Literature review	40 h
		Independent study	40 h
Sum	60 h	Sum	90 h

Total Workload: 150 h**Lecturers**

Y. Khudayberganov – Associate Professor (PhD) at the Department of “Applied Mathematics Computer Analysis”

Teaching Contents

This course focuses on the fundamental equations of mathematical physics — the heat equation, wave equation, and Laplace equation — their derivation from physical principles, and their applications. Key topics include the expansion of functions into Fourier series, properties of special functions such as Chebyshev, Bessel, and Legendre functions, and their roles in solving physical problems. The course also emphasizes boundary and initial value problems, using methods like separation of variables, Green’s functions, and integral transforms such as the Fourier and Laplace transforms. A detailed study is made of hyperbolic, elliptic, and parabolic partial differential equations (PDEs), including their classification, physical interpretation, and appropriate solution techniques. Problems involving constant and variable coefficients, stationary and non-stationary processes, and generalized solutions using fixed-point theorems and variational principles are also included. Multidimensional problems, particularly in two- and three-dimensional domains, are addressed through coordinate transformations to cylindrical and spherical systems, where separation of variables and the use of eigenfunctions (e.g., Bessel functions) play a critical role. The course also explores wave propagation, resonance phenomena, wave interactions with boundary conditions, and introduces concepts from inverse problems and integral equations in physics. Further topics involve mathematical modeling of physical processes both in idealized and practical scenarios, application of numerical methods for approximating solutions, and interpreting results within a physical context. The course aims to develop both analytical and computational skills in solving real-world physical models using advanced mathematical tools.

Learning Outcomes:

To successfully complete this discipline, students:

- should have knowledge of the fundamental mathematical models in physics, including the classification and derivation of partial differential equations such as the heat equation, wave equation, and Laplace equation.¹
- should understand key solution techniques such as separation of variables, Fourier series, and special functions (e.g., Bessel, Legendre, Chebyshev)¹
- should have a solid understanding of boundary and initial value problems, Green’s functions, and integral transform methods (Fourier, Laplace)¹
- should be familiar with the physical interpretation of PDEs and their classification into parabolic, hyperbolic, and elliptic types¹
- should be able to apply skills to formulate and solve mathematical models for physical processes using analytical methods²
- should be able to derive PDEs from physical laws, apply separation of variables to obtain solutions, and use special functions and orthogonal systems in multi-dimensional settings²
- should be capable of using mathematical software (e.g., MATLAB, Mathematica, Python) to visualize and analyze solutions, handle boundary/initial conditions, and interpret mathematical results in the context of physical systems.²
- should be competent in applying theoretical knowledge to real-world physical scenarios, such as heat distribution in materials, wave propagation in elastic media, or electrostatic potentials³
- should be able to analyze model assumptions, adapt analytical and numerical techniques to complex domains, and critically assess the suitability of different mathematical approaches³
- should be able to synthesize and present mathematical models, explain the relevance of their results, and clearly communicate their findings in scientific and interdisciplinary contexts.³

¹Knowledge; ²Skill; ³Competence.**Teaching and learning methods:**

Lectures. Mathematical derivation sessions. Hands-on coding exercises. Case study discussions. Interactive solution stability analysis. Algorithm implementation workshops. Group-based inverse problem modeling. Poster presentations. Project defense.

Entrance requirements:

Mandatory: Completed secondary education or equivalent. Basic knowledge of calculus and linear algebra
Basic computer literacy (e.g., using scientific calculators or simple software).
Recommended: Familiarity with differential equations and functional analysis. Basic understanding of numerical methods. Programming skills in MATLAB or Python. Logical reasoning and the ability to interpret mathematical models.

Reading list

1. Alexey N. Karapetyants, Vladislav V. Kravchenko. *Methods of Mathematical Physics: Classical and Modern*. // Birkhäuser, 2022. – 405 p
2. V. Balakrishnan. *Mathematical Physics: Applications and Problems*. // Springer, 2020. – taxminan 400 yechimli masalalar bilan.
3. Iva Stavrov. *Curvature of Space and Time, with an Introduction to Geometric Analysis*. // American Mathematical Society (Student Mathematical Library), 2020. – p–ch 5 bo‘limli kirish, umumiy nisbiylikka oid geometriya.
4. Solomon Manukure, Wen Xiu Ma (eds.). *Nonlinear and Modern Mathematical Physics (Proceedings of NMMP 2022)*. // Springer, 2024. – 459 PROMS, maqolalar to‘plami.
5. Maria Ulan, Eivind Schneider (eds.). *Differential Geometry, Differential Equations, and Mathematical Physics (Wisła 19 Summer School lectures)*. // Birkhäuser, 2021. – 231 p.

Examination:

Assessment of students’ knowledge is carried out in accordance with the Regulation on the system for monitoring and assessing students’ knowledge in higher education institutions developed based on the credit-module system, Article 15

Type of assessment	Midterm	Final
Time of assessment	Weeks 9	Weeks 19-20
Form of assessment	Written work	Written work

Midterm Assessment: The midterm assessment (MA) is conducted after approximately half of the course’s lecture and practical sessions have been completed. A written assessment is administered, consisting of 2 theoretical questions and 1 practical task based on the topics covered up to that point. Each task is pre-prepared in different versions. Students who provide complete and correct answers receive a maximum of 5 points per correct answer. The final score for the midterm is calculated as the average of the points obtained for each task. The midterm assessment questions are announced at the beginning of the class sessions.

Final Assessment: Each version of the final assessment consists of two theoretical questions and one practical assignment, designed to assess theoretical understanding and practical application

Teaching materials and media

Projector – for visual presentation of concepts, equations, and graphs; White/black board – for live derivations of mathematical formulations and algorithmic steps; Hand-outs – lecture notes, problem sets, and algorithm summaries; Computer with MATLAB or Python-based numerical environments (e.g., Jupyter Notebook, MATLAB Live Scripts); Simulated and real datasets – for testing inverse problem algorithms under noisy or incomplete data; Visualisation aids – to illustrate the effects of instability, regularization, and parameter tuning (e.g., L-curve plots, residual error graphs); Demonstration materials – including code snippets for regularization methods, step-by-step algorithm implementation, and numerical results; Interactive tools – small programs or notebooks that allow students to experiment with regularization parameters and observe changes in outputs; Scientific articles or case studies – for reading assignments and discussions on real-world applications.

Study Semester: 6 (full time)**ECTS:** 4**Workload**

Contact Time		Self-study	
Lectures	30 h	Independent study	60 h
Exercises	30 h		
Sum	60 h	Sum	60 h

Total Workload: 120 h**Lecturers**

B.B. Allaberdiev – PhD, Senior Lecturer, Department of “Applied Mathematics and Computer Analysis”,
 Z.Sh. Tulaganov – Senior Lecturer, Department of “Applied Mathematics and Computer Analysis”.

Teaching Contents

Introduction to Python. Basic operators of the Python language. Working with exceptions in Python. Working with functions. Working with lists in Python. Working with tuples in Python. Working with sets in Python. Working with dictionaries in Python. Working with files in Python. Working with strings in Python. Declaring classes in Python. Encapsulation. Inheritance. Polymorphism. Function and class decorators. Iterators and function generators. Working with graphical interfaces in Python. The Tkinter library. Creating projects using the Tkinter library.

Learning Outcomes:

To successfully complete this discipline, students:

- should have in-depth knowledge of Python programming language syntax, basic operators, and data types¹
- should understand concepts such as functions, modules, packages, object-oriented programming (OOP), working with files, and handling exceptions¹
- should be familiar with libraries used in Python (e.g., math, random, datetime, os) and external modules (e.g., NumPy, Pandas, Matplotlib).¹
- should understand algorithms and their complexity, as well as how to implement them in the Python environment.¹
- should have the ability to write, analyze, and debug programs that solve problems of varying complexity in Python.²
- should be able to create Python software solutions in academic and practical projects, including data storage, processing, and result visualization.²
- should be able to develop an algorithm for real-world problems, implement it in Python, and create applications that interact with users via a simple interface.²
- should be able to write modular and reusable code using the OOP approach.²
- should be able to apply Python independently and collaboratively in practical software development projects.³
- should have the competence to write code for web applications, automation scripts, or scientific computations using Python.³
- should develop skills in managing projects with Git, documenting code, and maintaining it under version control.³

¹Knowledge; ²Skill; ³Competence.

Teaching and learning methods:

Lectures, Performing and summarizing practical tasks, Interactive case studies, Blitz surveys, Working in groups, Giving presentations, Teamwork and project defense

Entrance requirements:

Mandatory: None

Recommended: Discrete Mathematics and Mathematical Logic Algorithmic Languages and Programming Algorithms and Data Structures

Reading list

1. Z.Sh. Tulaganov, B. Allaberdiev. Python Programming Language. Textbook. National University of Uzbekistan, 2023. 148 pages.
2. A.M. Polatov. Fundamentals of Programming. Practice in Python. Textbook. National University of Uzbekistan, Tashkent, 2023. 158 pages.

Examination:

Assessment of students' knowledge is carried out in accordance with the Regulation on the system for monitoring and assessing students' knowledge in higher education institutions developed based on the credit-module system, Article 15

Type of assessment	Midterm	Final
Time of assessment	Weeks 28-29	Weeks 37-38
Form of assessment	Written work	Test

Midterm Assessment: The midterm assessment (MA) is conducted after approximately half of the discipline's lecture and practical sessions have been completed. A written assessment is administered, consisting of 2 theoretical questions and 1 practical task based on the topics covered up to that point. Each task is pre-prepared in different versions. Students who provide complete and correct answers receive a maximum of 5 points per correct answer. The final score for the midterm is calculated as the average of the points obtained for each task. The midterm assessment questions are announced at the beginning of the class sessions.

Final Assessment: The final assessment is conducted in written form based on the topics defined in the discipline syllabus, including both taught subjects and independent learning materials. Each version of the final assessment consists of 2 theoretical questions and 1 practical task.

Teaching materials and media

Projector; white/black board; hand-outs; flipchart; visualization aids for presentation; demonstration materials

Study Semester: 6 (full time)

ECTS: 4

Workload

Contact Time		Self-study	
Lectures	30 h	Independent study	60 h
Exercises	30 h		
Sum	60 h	Sum	60 h

Total Workload: 120 h

Lecturers

B.B. Allaberdiyev – PhD, Senior Lecturer, Department of “Applied Mathematics and Computer Analysis”,
 Z.Sh. Tulaganov – Senior Lecturer, Department of “Applied Mathematics and Computer Analysis”.

Teaching Contents

Familiarization with Python libraries. NumPy: N-dimensional arrays and mathematical operations. Pandas: Working with Series and DataFrames. Matplotlib: Introduction to visualization. Seaborn: Statistical visualization. Scikit-learn: Introduction to machine learning. TensorFlow and Keras: Basics of neural networks. OpenCV: Working with images and video. Requests and BeautifulSoup: Fundamentals of web scraping. Tkinter: Standard library for creating GUIs. SQLAlchemy: Working with databases in Python. Pygame: Basics of game development. PyPDF2 and docx: Working with documents (PDF/Word). Datetime and time libraries: Working with time. Optimization and profiling of Python libraries.

Learning Outcomes:

To successfully complete this discipline, students:

- Should gain a deep understanding of Python programming language syntax, basic operators, and data types.¹
- Should understand concepts such as functions, modules, packages, object-oriented programming (OOP), file handling, and exception processing.¹
- Should become familiar with commonly used Python libraries (such as math, random, datetime, os) and external modules (such as NumPy, Pandas, Matplotlib).¹
- Should understand algorithms and their complexity, as well as how to implement them in the Python environment.¹
- Should develop the ability to write, analyze, and debug programs in Python that solve problems of varying complexity.²
- Should be able to create Python-based software solutions for educational and practical projects, including data storage, processing, and result visualization.²
- Should be able to design an algorithm for real-world problems, code it in Python, and build an application that interacts with users through a simple interface.²
- Should be able to write modular and reusable code using the OOP approach.²
- Should be able to apply Python independently and in teams during the software development process in practical projects.³
- Should acquire the competence to write code for web applications, automation scripts, or scientific computations based on Python.³
- Should develop the skills to manage projects using Git, document code, and maintain it under version control.³

¹Knowledge; ²Skill; ³Competence.

Teaching and learning methods:

Lectures, Performing and summarizing practical tasks, Interactive case studies, Blitz surveys, Working in groups, Giving presentations, Teamwork and project defense

Entrance requirements:

Mandatory: None

Recommended: Discrete Mathematics and Mathematical Logic Algorithmic Languages and Programming Algorithms and Data Structures

Reading list

1. Z.Sh. Tulaganov, B. Allaberdiyev. Python Programming Language. Textbook. National University of Uzbekistan, 2023. 148 pages.

2. A.M. Polatov. Fundamentals of Programming. Practice in Python. Textbook. National University of Uzbekistan, Tashkent, 2023. 158 pages.

Examination:

Assessment of students' knowledge is carried out in accordance with the Regulation on the system for monitoring and assessing students' knowledge in higher education institutions developed based on the credit-module system, Article 15

Type of assessment	Midterm	Final
Time of assessment	Weeks 28-29	Weeks 37-38
Form of assessment	Written work	Test

Midterm Assessment: The midterm assessment (MA) is conducted after approximately half of the discipline's lecture and practical sessions have been completed. A written assessment is administered, consisting of 2 theoretical questions and 1 practical task based on the topics covered up to that point. Each task is pre-prepared in different versions. Students who provide complete and correct answers receive a maximum of 5 points per correct answer. The final score for the midterm is calculated as the average of the points obtained for each task. The midterm assessment questions are announced at the beginning of the class sessions.

Final Assessment: The final assessment is conducted in written form based on the topics defined in the discipline syllabus, including both taught subjects and independent learning materials. Each version of the final assessment consists of 2 theoretical questions and 1 practical task.

Teaching materials and media

Projector; white/black board; hand-outs; flipchart; visualization aids for presentation; demonstration materials

Study Semester: 6 (full time)

ECTS: 4

Workload

Contact Time		Self-study	
Lectures	30 h	Independent study	60 h
Exercises	30 h		
Sum	60 h	Sum	60 h

Total Workload: 120 h

Lecturers

B.B. Allaberdiyev – PhD, Senior Lecturer, Department of “Applied Mathematics and Computer Analysis”,
Z.Sh. Tulaganov – Senior Lecturer, Department of “Applied Mathematics and Computer Analysis”.

Teaching Contents

Introduction to software project development. What is project development in Python? Modules and packages: organizing code structure. Writing code based on the DRY principle (Don't Repeat Yourself). Creating file structure and project directory layout. Version control: introduction to Git and GitHub. Integrating logging, exception handling, and testing into the project. MVC (Model-View-Controller) architecture. Applying OOP (Object-Oriented Programming) in projects. Software testing (unit tests, integration tests). Designing GUI applications (Tkinter, PyQt). Introduction to web projects: Flask architecture. REST API design: Flask + Postman + JSON. Database integration (SQLite, PostgreSQL). Modules, components, and services. Documenting and publishing a Python project.

Learning Outcomes:

To successfully complete this discipline, students:

- Gains deep knowledge of Python programming language syntax, basic operators, and data types.¹
- Understands key concepts such as functions, modules, packages, object-oriented programming (OOP), file handling, and exception management.¹
- Becomes familiar with commonly used Python libraries (e.g., math, random, datetime, OS) and external modules (e.g., NumPy, Pandas, Matplotlib).¹
- Understands algorithms and their complexity, as well as how to implement them within the Python environment.¹
- Develops the skills to write, analyze, and debug Python programs that solve problems of various levels of complexity.²
- Creates Python-based software solutions in educational and practical projects, including data storage, processing, and visualization.²
- Designs algorithms for real-world problems, codes them in Python, and creates applications with simple user interfaces.²
- Writes modular and reusable code using the object-oriented programming (OOP) approach²
- Applies Python independently and in teams during software development in practical projects.³
- Gains the ability to write code for web applications, automation scripts, or scientific calculations using Python.³
- Develops competence in managing projects using Git, documenting code, and maintaining version control.³

¹Knowledge; ²Skill; ³Competence.

Teaching and learning methods:

Lectures, Performing and summarizing practical tasks, Interactive case studies, Blitz surveys, Working in groups, Giving presentations, Teamwork and project defense

Entrance requirements:

Mandatory: None

Recommended: Discrete Mathematics and Mathematical Logic Algorithmic Languages and Programming Algorithms and Data Structures

Reading list

1. Z.Sh. Tulaganov, B. Allaberdiyev. Python Programming Language. Textbook. National University of Uzbekistan, 2023. 148 pages.
2. A.M. Polatov. Fundamentals of Programming. Practice in Python. Textbook. National University of Uzbekistan, Tashkent, 2023. 158 pages.

Examination:

Assessment of students' knowledge is carried out in accordance with the Regulation on the system for monitoring and assessing students' knowledge in higher education institutions developed based on the credit-module system, Article 15

Type of assessment	Midterm	Final
Time of assessment	Weeks 28-29	Weeks 37-38
Form of assessment	Written work	Test

Midterm Assessment: The midterm assessment (MA) is conducted after approximately half of the discipline's lecture and practical sessions have been completed. A written assessment is administered, consisting of 2 theoretical questions and 1 practical task based on the topics covered up to that point. Each task is pre-prepared in different versions. Students who provide complete and correct answers receive a maximum of 5 points per correct answer. The final score for the midterm is calculated as the average of the points obtained for each task. The midterm assessment questions are announced at the beginning of the class sessions.

Final Assessment: The final assessment is conducted in written form based on the topics defined in the discipline syllabus, including both taught subjects and independent learning materials. Each version of the final assessment consists of 2 theoretical questions and 1 practical task.

Teaching materials and media

Projector; white/black board; hand-outs; flipchart; visualization aids for presentation; demonstration materials

Study Semester: 6 (full time)

ECTS: 4

Workload

Contact Time		Self-study	
Lectures	30 h	Preparation for Contact Time	30 h
Exercises	30 h	Literature review	30 h
Sum	60 h	Sum	60 h

Total Workload: 120 h

Lecturers

S. Sulaymanov – Professor at the Department of “Ecology”, Doctor of Technical Sciences, Professor.

R.Z. Okhunov – Associate Professor at the Department of “Ecology”.

Teaching Contents

Basic concepts and definitions of the subject life safety. The concept of risk. Risk assessment. General classification of risks. Damage. Principles and methods of safety of live activity. Human factor in the system “human – environment”. Economic aspects safety of life activity. Legal framework of safety of life activity. Dangerous and harmful factors affecting the labor activity. Principles of human physiology. Ergonomics and human factors at work. Industrial sanitation and hygiene. Negative factors affecting human activities, their types, nature and methods of protection. Technical safety. Legal framework of technical safety. The technical safety equipment. Instructions and trainings to provide labor safety. Electrical safety. The State system of the prevention and response to emergency situations of the Republic of Uzbekistan. Emergency situations, their types and characteristics. Weapons of mass destruction. Public safety facilities. Protection equipment. Public notification in the event of an emergency. Evacuation people and property from the dangerous zones. Preparing population for the protection in emergency situations. The concept of increasing the stability of the industries and objects of economy. Protecting the economy and the population from terrorism. Fire safety. Fire and explosion. Fire fighting service, technical devices. First medical aid in emergency situations. Psychological first aid in emergency situations.

Learning Outcomes:

To successfully complete this discipline, students:

Have knowledge of:

- theoretical foundations of life safety, principles of labor physiology and comfortable living conditions;
- the nature and main characteristics of emergency situations of natural and man-made origin;
- the nature of the impact of harmful and dangerous factors on humans and the environment;
- the possible consequences of accidents, catastrophes, natural disasters and methods of using modern means of destruction;
- methods of protecting humans and the environment from harmful and dangerous factors of emergency situations;
- recommended methods of providing first aid (self-help and first aid to the victim).

Have the skills to:

- identify problems related to safety violations in the workplace and participate in their elimination, based on available resources;
- assess emergency situations of natural and man-made origin and make decisions on their elimination, based on available resources;
- select and use methods for protecting people and the environment from harmful and dangerous factors of emergency situations;
- provide first aid (self-help and assistance to the victim);
- create and maintain safe living conditions.

Have competence in:

- mastering the techniques and methods of using personal protective equipment in emergency situations;
- using the basic methods of protecting people and the environment in emergency situations;
- applying first aid methods to victims in emergency situations;
- monitoring the implementation of measures to ensure safe working conditions;
- ensuring the development and implementation of regulatory acts in the field of labor protection.

Teaching and learning methods:

Lectures, completing and summarizing practical tasks, interactive case studies, blitz surveys, working in groups, delivering presentations, teamwork and project development for defense.

Entrance requirements:

Mandatory: None

Recommended: Basic elements of mathematics, natural, general and specialized subjects included in the curriculum.

Reading list

1. Okhunov R., Safety of life activities. Textbook – T.: “Ma’rifat”, 2023. 280 p.
2. Narziyev Sh.M., Kurbonov Sh.Kh. Safety of life activities. Textbook–T.:“Yangi nashr”, 2019.–234 p.
3. Yuldashev O.R. Special course on labor protection. Textbook. –T.:“ Tafakkur qanoti”, 2015.–336 p.
4. Yusupkhodzhayeva E.N., Abdurakhmonova S.P., Kholmatova N.G. Emergency situations and population protection. Textbook/.– T.: -«AKTIV PRINT», 2021. – 185 p.

Examination:

Assessment of students’ knowledge is carried out in accordance with the Regulation on the system for monitoring and assessing students’ knowledge in higher education institutions developed based on the credit-module system, Article 15

Type of assessment	Midterm	Final
Time of assessment	Weeks 8-9	Weeks 16-17
Form of assessment	Written work	Written work or test

Midterm Assessment: The midterm assessment (MA) is conducted after approximately half of the discipline’s lecture and practical sessions have been completed. A written assessment is administered, consisting of 3 theoretical questions based on the topics covered up to that point. Each task is pre-prepared in different versions. Students who provide complete and correct answers receive a maximum of 5 points per correct answer. The final score for the midterm is calculated as the average of the points obtained for each task. The midterm assessment questions are announced at the beginning of the class sessions.

Final Assessment: The final assessment is conducted in written form based on the topics defined in the discipline syllabus, including both taught subjects and independent learning materials. Each version of the final assessment consists of 3 theoretical questions.

If the final assessment is conducted in the form of a test, students will be provided with versions consisting of 20 test questions each. A score of 18–20 correct answers is graded as 5 (excellent); A score of 14–17 correct answers is graded as 4 (good); A score of 12–13 correct answers is graded as 3 (satisfactory); A score of 0–11 correct answers is graded as 2 (unsatisfactory).

Teaching materials and media

Projector; white/black board; hand-outs; flipchart; visualization aids for presentation; demonstration materials

Study Semester: 6 (full time)

ECTS: 4

Workload

Contact Time		Self-study	
Lectures	30 h	Preparation for Contact Time	30 h
Exercises	30 h	Literature review	30 h
Sum	60 h	Sum	60 h

Total Workload: 120 h

Lecturers

L. S. Kuchkarova – Professor at the Department of “Human and Animal physiology”, Doctor of Science.

I. I. Karimova – Associate Professor at the Department of “Human and Animal physiology”, PhD.

Teaching Contents

Theories of aging. Age-related physiology and hygiene of the musculoskeletal system. Age-related physiology and hygiene of the nervous system. Higher nervous activity and its age-related physiology and hygiene. Sensory system. Hearing and vision loss. Age-related physiology and hygiene of the endocrine system. Age-related features and hygiene of the blood system. Age-related physiology and hygiene of the cardiovascular system. Age-related physiology and hygiene of the respiratory system. Metabolism and energy exchange. Age-related physiology and hygiene of digestion and nutrition. Age-related physiology and hygiene of the excretory system. General health issues and physical activity. Age-related physiology and hygiene of the reproductive system. Age-related physiology and hygiene of the immune system. Drawing up a table of age periods of the human organism. Determining biological age using the Voytenko method. Anthropometry. Measuring anthropometric indicators. Assessing the physical development of children and adolescents using index and coefficient methods. Observing unconditioned reflexes in humans. Developing conditioned reflexes in humans. Studying the properties of attention. Color discrimination test. Auditory analyzer. Studying the structure of the ear and determining the level of hearing. Binaural hearing. Studying the structure and functions of the endocrine system. Morphology of blood. Assessing physical work capacity by measuring maximal oxygen consumption. Determining basal metabolic rate using tables. Identifying deviations from the norm in basal metabolism using the Rid formula and nomogram. Designing and hygienically evaluating a diet according to the child’s age. The effects of alcohol, tobacco, and toxic substances on the human body.

Learning Outcomes:

To successfully complete this discipline, students:

- should possess an understanding of the basic physiological concepts and hygiene¹;
- should know the age-related structural features of organs during the periods of growth and development¹;
- should know the age-related physiology and hygiene of excitable tissues and the musculoskeletal system¹;
- should have knowledge about the age-related physiology and hygiene of the nervous system¹;
- should know the physiology and hygiene of sensory systems and higher nervous activity;
- should be able to describe the age-related physiology and hygiene of the endocrine and visceral systems, and to be able to apply this knowledge¹.
- should be able to select mental and physical loads appropriate to the age of children²;
- should choose individual loads based on the characteristics of the higher nervous system²;
- should to determine anthropometric indicators²;
- should give a hygienic assessment of the environment under various conditions³;
- should take age-related characteristics into account in the educational process³.

¹Knowledge; ²Skill; ³Competence.

Teaching and learning methods:

- Lectures;
- Performing and summarizing practical work;
- Seminars (logical reasoning, quick Q&A sessions);
- Interactive case studies;
- Working in groups;
- Preparing and delivering presentations;
- Developing and defending projects as a team.

Entrance requirements:

Mandatory: None

Recommended: Basic elements of elementary biology and elementary physiology

Reading list

1. Kuchkarova L.S., Karimova I.I. Physiology and hygiene of adolescence. Textbook. - T., "University" publishing house, 2020. -308 p.
2. Kuchkarova L.S., Karimova I.I. Youth physiology and hygiene (electronic textbook) - Tashkent, 2023.
3. Age anatomy, physiology and hygiene: a textbook / R.I. Aizman, N.F. Lysova, Ya.L. Zavyalova. - Moscow: KNORUS, 2017. - 404 p. - (Bachelor's degree).
4. Mamatova Z.A., Djabbarova G.M., Yusupova U.R., Karimova I.I. Yosh physics va gigiyena. Toshkent 2024. "Demal nashiriyoti" 180 b.
5. Age-related anatomy, physiology and hygiene: a textbook / Kazan, KFU, 2013. - 166 p.
6. Practical work on the course "Age-related anatomy, physiology and hygiene" / Vladimir. state University named after Alexander Grigorievich and Nikolai Grigorievich Stoletov; compiled by: E.P. Grachev [and others]. - Vladimir: Publishing house of Vladimir State University, 2012. - 63 p.
7. Dzhabbarova G.M., Mamatova Z.A., Yusupova U.R., Karimova I.I., Mirzakulov S.O. Methodological manual for practical work of the fund "Youth physiology and hygiene". T.: UzMU nashr. 2019.-72 p.

Examination:

Assessment of students' knowledge is carried out in accordance with the Regulation on the system for monitoring and assessing students' knowledge in higher education institutions developed based on the credit-module system, Article 15

Type of assessment	Midterm	Final
Time of assessment	Weeks 29-30	Weeks 36-37
Form of assessment	Written work	Written work or test

Midterm Assessment: The midterm assessment (MA) is conducted after approximately half of the discipline's lecture and practical sessions have been completed. A written assessment is administered, consisting of 3 theoretical questions based on the topics covered up to that point. Each task is pre-prepared in different versions. Students who provide complete and correct answers receive a maximum of 5 points per correct answer. The final score for the midterm is calculated as the average of the points obtained for each task. The midterm assessment questions are announced at the beginning of the class sessions.

Final Assessment: The final assessment is conducted in written form based on the topics defined in the discipline syllabus, including both taught subjects and independent learning materials. Each version of the final assessment consists of 3 theoretical questions.

If the final assessment is conducted in the form of a test, students will be provided with versions consisting of 50 test questions each. A score of 18–20 correct answers is graded as 5 (excellent); A score of 14–17 correct answers is graded as 4 (good); A score of 12–13 correct answers is graded as 3 (satisfactory); A score of 0–11 correct answers is graded as 2 (unsatisfactory).

Teaching materials and media

Projector; white/black board; hand-outs; flipchart; visualization aids for presentation; demonstration materials

Study Semester: 7 (full time)

ECTS: 5

Workload

Contact Time		Self-study	
Lectures	30 h	Preparation for Contact Time	60 h
Exercises	30 h	Literature review	30 h
Sum	60 h	Sum	90 h

Total Workload: 150 h

Lecturers

Z.Sh. Tulaganov – Senior Lecturer at the Department of “Applied Mathematics and Computer Analysis”.

Teaching Contents

Introduction to Java Programming Language Overview of the Java programming language. Java programming environment. Fundamentals of Programming in Java Data types and variables. Basic operators. Methods. Introduction to Android Studio Getting started with Android Studio. Android Studio development environment. Basics of Developing Applications for Android OS Classification of mobile devices. Android SDK. Android SDK Package Manager. Creating projects. Project structure. Working with Android Emulator and AVD Manager Running applications on emulator and real devices.

Android Project Structure Components of an Android application. Manifest file. Intents and Activities. Declaring activities in the manifest file. Activity and Its Lifecycle What is an Activity? Activity lifecycle.

Calling an Activity through an Intent. Retrieving data from an Intent. Returning results from an Activity.

Working with Resources Concept of resources and their capabilities. Classifying resources. Using resources in an application. User Interface Defining the interface (layout). Types of layouts. Basic Widgets of the Graphical Interface Text fields. Buttons. Tools for displaying graphics. Dialogs and message windows, and menus. Simple pop-up message windows. Displaying long texts. Dialog boxes. Two-Dimensional Graphics Drawable class. Transition Drawable class. Shape Drawable class. Multimedia Multimedia formats. Working with sound and video.

Learning Outcomes:

To successfully complete this discipline, students:

- should have detailed knowledge of the mobile application lifecycle, main components, platforms, and their features¹
- should understand programming principles in the Android environment (Java/Kotlin); should possess knowledge of selecting, placing, and prototyping user interface components¹
- should be able to create a complete mobile application prototype and deliver it to users.¹
- should be able to configure and manage the technical environment;²
- should be able to write code and develop small-scale projects; should perform the development and deployment of mobile applications across various platforms (Android, iOS).²
- should be capable of independently developing, coding, testing, publishing, and updating mobile applications³
- should adapt to the technical specifications of various platforms; should prepare applications for different platforms and support their deployment and usage by real users³

¹Knowledge; ²Skill; ³Competence.

Teaching and learning methods:

Lectures, Performing and summarizing practical tasks, Interactive case studies, Blitz surveys, Working in groups, Giving presentations, Teamwork and project defense

Entrance requirements:

Mandatory: None

Recommended: Algorithmic Languages and Programming (ATDB120)

Reading list

1. Z.Sh. Tulaganov. Developing Mobile Applications. Educational Manual. National University of Uzbekistan, 2023. 120 pages.
2. D.N. Kolisnichenko. Programming for Android. St. Petersburg: BHV-Petersburg, 2021. 228 pages.

Examination:

Assessment of students' knowledge is carried out in accordance with the Regulation on the system for monitoring and assessing students' knowledge in higher education institutions developed based on the credit-module system, Article 15

Type of assessment	Midterm	Final
Time of assessment	Weeks 8-9	Weeks 19-20
Form of assessment	Written work	Written work

Midterm Assessment: The midterm assessment (MA) is conducted after approximately half of the discipline's lecture and practical sessions have been completed. A written assessment is administered, consisting of 2 theoretical questions and 1 practical task based on the topics covered up to that point. Each task is pre-prepared in different versions. Students who provide complete and correct answers receive a maximum of 5 points per correct answer. The final score for the midterm is calculated as the average of the points obtained for each task. The midterm assessment questions are announced at the beginning of the class sessions.

Final Assessment: The final assessment is conducted in written form based on the topics defined in the discipline syllabus, including both taught subjects and independent learning materials. Each version of the final assessment consists of 2 theoretical questions and 1 practical task.

Teaching materials and media

Projector; white/black board; hand-outs; flipchart; visualization aids for presentation; demonstration materials

MILB405 Mobile Application Design

Study Semester: 7 (full time)

ECTS: 5

Workload

Contact Time		Self-study	
Lectures	30 h	Preparation for Contact Time	60 h
Exercises	30 h	Literature review	30 h
Sum	60 h	Sum	90 h

Total Workload: 150 h

Lecturers

Z.Sh. Tulaganov – Senior Lecturer at the Department of “Applied Mathematics and Computer Analysis”.

Teaching Contents

Introduction and Design Concepts Design Thinking, Persona Creation, and User Journey Mapping Wireframes: Screen Structure and User Flows Visual Design: Color, Typography, Icons, and Brand Styling Platform-Specific Design: Material Design & HIG Guidelines Navigation Patterns and Micro-Interactions (Feedback) Inclusive Design: Accessibility, POUR Principles, WCAG Standards Interactive Prototyping: High-Fidelity Prototypes Usability Testing: Methodology and User Analysis Information Architecture and Screen Linking App Deployment: App Store & Play Store Requirements, Screenshots, Marketing Analytics and KPIs: Analyzing User Behavior Project Management and Team Collaboration: Feedback and Iteration Cycles Final Project: UX/UI Improvement and Preparation

Learning Outcomes:

To successfully complete this discipline, students:

- should understand concepts such as Material Design, user interface structure, wireframes, prototypes, and interactivity¹
- should have conceptual knowledge of data storage using Firebase and Freezed, abstract types, and mobile data architecture¹
- should possess an in-depth understanding of preparing, building, and publishing mobile applications for different platforms (Android, iOS)¹
- should be able to deeply understand user needs and study their behavior²
- should learn to create professional wireframes and interactive prototypes using tools like Figma or Adobe XD²
- should be capable of applying visual design, inclusive interfaces, usability testing, and project collaboration in practice.²
- should be able to accurately analyze user problems;³
- should independently organize the design stages;³
- should be able to create real-world-oriented designs through prototypes and testing.³

¹Knowledge; ²Skill; ³Competence.

Teaching and learning methods:

Lectures, Performing and summarizing practical tasks, Interactive case studies, Blitz surveys, Working in groups, Giving presentations, Teamwork and project defense

Entrance requirements:

Mandatory: None

Recommended: Algorithmic Languages and Programming (ATDB120)

Reading list

1. Z.Sh. Tulaganov. Developing Mobile Applications. Educational Manual. National University of Uzbekistan, 2023. 120 pages.
2. D.N. Kolisnichenko. Programming for Android. St. Petersburg: BHV-Petersburg, 2021. 228 pages.

Examination:

Assessment of students' knowledge is carried out in accordance with the Regulation on the system for monitoring and assessing students' knowledge in higher education institutions developed based on the credit-module system, Article 15

Type of assessment	Midterm	Final
Time of assessment	Weeks 8-9	Weeks 19-20
Form of assessment	Written work	Written work

Midterm Assessment: The midterm assessment (MA) is conducted after approximately half of the discipline's lecture and practical sessions have been completed. A written assessment is administered, consisting of 2 theoretical questions and 1 practical task based on the topics covered up to that point. Each task is pre-prepared in different versions. Students who provide complete and correct answers receive a maximum of 5 points per correct answer. The final score for the midterm is calculated as the average of the points obtained for each task. The midterm assessment questions are announced at the beginning of the class sessions.

Final Assessment: The final assessment is conducted in written form based on the topics defined in the discipline syllabus, including both taught subjects and independent learning materials. Each version of the final assessment consists of 2 theoretical questions and 1 practical task.

Teaching materials and media

Projector; white/black board; hand-outs; flipchart; visualization aids for presentation; demonstration materials

Study Semester: 7 (full time)

ECTS: 5

Workload

Contact Time		Self-study	
Lectures	30 h	Preparation for Contact Time	60 h
Exercises	30 h	Literature review	30 h
Sum	60 h	Sum	90 h

Total Workload: 150 h

Lecturers

Z.Sh. Tulaganov – Senior Lecturer at the Department of Applied Mathematics and Computer Analysis.

Teaching Contents

Introduction Opportunities of Mobile Applications in Education The Role of Pedagogical Platforms like MOODLE and Google Classroom in Education Opportunities of Kahoot! and Quizlet for Interactive Lessons Language Learning through Duolingo and Brilliant: Methodological Orientation Teaching Coding and Logical Thinking: Swift Playgrounds Studying Khan Academy and the Flipped Classroom Model Brain-Training Applications: Brilliant, Lumosity Analysis of Educational Resources like EPathshala Assessment and Feedback Mechanisms in Mobile Applications App Integration and Backend: Quizz App Case Study Gamification and Motivation Elements in Educational Apps Analytics and Usage Monitoring Collaborative Tools: Padlet, Jamboard Final Project Development – Lesson Plan Using a Mobile App

Learning Outcomes:

To successfully complete this discipline, students:

- should have knowledge of the basics of mobile technologies; should understand the structure and functions of mobile applications, devices, and platforms.¹
- should understand the role of mobile applications in education, including how they enhance learning effectiveness, increase interactivity, and support personalized learning.¹
- should know the foundations of pedagogical technologies and methodologies, including how to organize lessons using mobile apps through concepts such as gamification and the flipped classroom model.¹
- should possess knowledge of assessment and monitoring methods, including how to evaluate learning activities via mobile apps, create tests, and conduct statistical analysis.¹
- should be capable of conducting lessons using interactive applications by organizing real-time quizzes, tests, and discussions with tools such as Socrative, Kahoot!, and Quizlet.²
- should be able to implement U.S.-based assessment and feedback systems by organizing prompt responses based on time, results, and errors, and effectively monitoring student performance.²
- should have professional collaboration and communication skills to actively participate in group projects and use chat/forum functions on platforms like Padlet, Jam board, and Google Classroom²
- should support the development of cognitive skills, as mobile applications significantly enhance students' critical thinking, memory, and attention.³
- should demonstrate pedagogical application competence by enriching lesson content and improving effectiveness through integration of interactive mobile apps aligned with SMART pedagogical project models³
- should have high-level technical and information literacy by being able to manage mobile technologies and integrate various educational applications and platforms.³

¹Knowledge; ²Skill; ³Competence.

Teaching and learning methods:

Lectures, Performing and summarizing practical tasks, Interactive case studies, Blitz surveys, Working in groups, Giving presentations, Teamwork and project defense

Entrance requirements:

Mandatory: None

Recommended: Algorithmic Languages and Programming (ATDB120)

Reading list

1. Z.Sh. Tulaganov. Developing Mobile Applications. Educational Manual. National University of Uzbekistan, 2023. 120 pages.
2. D.N. Kolisnichenko. Programming for Android. St. Petersburg: BHV-Petersburg, 2021. 228 pages.

Examination:

Assessment of students' knowledge is carried out in accordance with the Regulation on the system for monitoring and assessing students' knowledge in higher education institutions developed based on the credit-module system, Article 15

Type of assessment	Midterm	Final
Time of assessment	Weeks 7-9	Weeks 19-20
Form of assessment	Written work	Written work

Midterm Assessment: The midterm assessment (MA) is conducted after approximately half of the discipline's lecture and practical sessions have been completed. A written assessment is administered, consisting of 2 theoretical questions and 1 practical task based on the topics covered up to that point. Each task is pre-prepared in different versions. Students who provide complete and correct answers receive a maximum of 5 points per correct answer. The final score for the midterm is calculated as the average of the points obtained for each task. The midterm assessment questions are announced at the beginning of the class sessions.

Final Assessment: The final assessment is conducted in written form based on the topics defined in the discipline syllabus, including both taught subjects and independent learning materials. Each version of the final assessment consists of 2 theoretical questions and 1 practical task.

Teaching materials and media

Projector; white/black board; hand-outs; flipchart; visualization aids for presentation; demonstration materials

Study Semester: 7 (full time)**ECTS:** 4**Workload**

Contact Time		Self-study	
Lectures	30 h	Preparation for Contact Time	30 h
Exercises	30 h	Literature review	30 h
Sum	60 h	Sum	60 h

Total Workload: 120 h**Lecturers**

B.Kh. Khayitkulov – Associate Professor at the Department of “Software engineering and artificial intelligence”, Doctor of Philosophy (PhD) on physical-mathematical sciences.

Teaching Contents

Development stages of IT infrastructure. Modern infrastructure solutions. Blade systems. Blade servers. Storage systems and networks. SAN topologies. Strengthening IT infrastructure. Basic concepts of virtualization and virtual machines. Advantages of virtualization. Virtualization technologies. Types of virtualization. VMWare. Microsoft. VirtualBox. General description of cloud architecture. Infrastructure-as-a-Service (IaaS). Advantages and risks associated with IaaS. Areas of application of IaaS. Software-as-a-Service (SaaS). Major SaaS solutions. Advantages and risks associated with SaaS. Areas of application of SaaS. Platform-as-a-Service (PaaS). CaaS. MaaS. Network models of cloud services. Public clouds. Architecture of public clouds. Advantages and disadvantages of public cloud architecture. Areas of application of public clouds. Private clouds. Architecture of private clouds. Advantages and disadvantages of private cloud architecture. Areas of application of private clouds. Hybrid clouds. Architecture of hybrid clouds. Advantages and disadvantages of hybrid cloud architecture. Amazon Web Services platform. Amazon cloud services. Microsoft Azure platform. Microsoft Azure cloud services. Microsoft's cloud services. Microsoft Office web applications. Office 365. OneDrive. Google's cloud services. Google Cloud Platform. Use of cloud technologies in education. Programming in the “cloud”.

Learning Outcomes:

To successfully complete this discipline, students:

- should have knowledge of the basic concepts of cloud technologies, areas of application of cloud technologies, the concept of cloud computing used in entrepreneurial activities¹
- evaluating software efficiency, long-term prospects, and understanding the economics of cloud computing¹.
- should acquire skills related to security, scalability, distribution, backup in the context of cloud infrastructure, cloud programming techniques²
- the competencies of a system administrator to develop and ensure the regular operation of applications deployed in the cloud².
- should have the competence to assess the technical and economic possibilities of migrating existing applications to a cloud environment³
- understand cloud computing infrastructure, and be able to effectively use these systems³.

¹Knowledge; ²Skill; ³Competence.

Teaching and learning methods:

Lectures, Performing and summarizing practical tasks, Interactive case studies, Blitz surveys, Working in groups, Giving presentations, Teamwork and project defense

Entrance requirements:

Mandatory: Completed secondary education Basic computer literacy

Recommended: Programming, Computer Networks, Databases, Cybersecurity Fundamentals, Artificial Intelligence Fundamentals, Operating Systems

Reading list

1. Barrie Sosinsky. Cloud Computing Bible. – Wiley Publishing Inc., 2011. 450 bet. (Barrie Sosinsky. Cloud Computing Bible. – Wiley Publishing Inc., 2011. 450 pages.)
2. K. Chandrasekaran. Essential of Cloud Computing. – CRC Press, 2015. 369 bet. (K. Chandrasekaran. Essentials of Cloud Computing. – CRC Press, 2015. 369 pages.)
3. Ric Messier, Allan Konar. Collaboration with Cloud Computing: Security, Social Media, and Unified Communications. – Elsevier Inc., 2014. 222 bet. (Ric Messier, Allan Konar. Collaboration with Cloud Computing: Security, Social Media, and Unified Communications. – Elsevier Inc., 2014. 222 pages.)

4. Haishi Bai. Zen of Cloud: Learning Cloud Computing by Examples on Microsoft Azure. – CRC Press, 2015. 489 bet. (Haishi Bai. Zen of Cloud: Learning Cloud Computing by Examples on Microsoft Azure. – CRC Press, 2015. 489 pages.)
5. Джордж Риз. Облачные вычисления. – БХВ-Петербург, 2011. 288 бет. (George Reese. Cloud Computing. – BHV-Petersburg, 2011. 288 pages.)
6. Клементьев И.П., Устинов В.А. Введение в облачные вычисления. – М.: Национальный Открытый Университет “ИНТУИТ”, 2016. 311 бет. (Klementyev I.P., Ustinov V.A. Introduction to Cloud Computing. – Moscow: National Open University “INTUIT”, 2016. 311 pages.)
7. Ayupov R.N., Xidirov B.B. Bulutli texnologiyalar. – O‘zDJTU, 2021. 94 бет. (Ayupov R.Kh., Khidirov B.B. Cloud Technologies. – UzSWLU, 2021. 94 pages.)
8. Зиангирова Л.Ф. Технологии облачных вычислений. – Саратов: Издательство «Вузовское образование», 2016. 300 бет. (Ziangirova L.F. Cloud Computing Technologies. – Saratov: “Higher Education” Publishing, 2016. 300 pages.)

Examination:

Assessment of students’ knowledge is carried out in accordance with the Regulation on the system for monitoring and assessing students’ knowledge in higher education institutions developed based on the credit-module system, Article 15

Type of assessment	Midterm	Final
Time of assessment	Weeks 7-8	Weeks 17-18
Form of assessment	Written work	Written work

Midterm Assessment: The midterm assessment is conducted after approximately half of the discipline’s lecture and practical sessions have been completed. A written assessment is administered, consisting of 2 theoretical questions and 1 practical task based on the topics covered up to that point. Each task is pre-prepared in different versions. Students who provide complete and correct answers receive a maximum of 5 points per correct answer. The final score for the midterm is calculated as the average of the points obtained for each task. The midterm assessment questions are announced at the beginning of the class sessions.

Final Assessment: The final assessment is conducted in written form based on the topics defined in the discipline syllabus, including both taught subjects and independent learning materials. Each version of the final assessment consists of 2 theoretical questions and 1 practical task.

Teaching materials and media

Projector; white/black board; hand-outs; flipchart; visualization aids for presentation; demonstration materials

Study Semester: 7 (full time)

ECTS: 4

Workload

Contact Time		Self-study	
Lectures	30 h	Preparation for Contact Time	30 h
Exercises	30 h	Literature review	30 h
Sum	60 h	Sum	60 h

Total Workload: 120 h

Lecturers

S. Pulatov – Associative Professor at the Department of “Applied Mathematics and Intelligence Technologies”,
 N. Latipov – Senior Lecturer at the Department of “Applied Mathematics and Intelligence Technologies”.

Teaching Contents

Introduction. History of development of computing networks. Classification of computer networks. **Basic principles of network construction.** Network topologies and architecture. Network devices. **Open systems communication.** Protocols, interfaces, standards. ISO/OSI model. **Methods of data transmission.** Physical media for data transmission. Methods of data encoding and transmission. Ethernet technologies. Addressing network nodes and MAC address. Token Ring and other technologies. **TCP/IP protocol stack.** Principles of data exchange between networks. Concept of IP protocols. Addressing network nodes based on the IPv4 protocol. **Network protocols, services and routing.** Routing protocols and their principles of operation. **Transport layer functions.** TCP and UDP protocols. The concept of sockets. **Application layer protocols and services.** Web server service. HTTP, FTP, email protocols. Internet and DNS service. **Basic concepts of administrative management of computer networks.** Server operating systems and their functions. Workgroups and domain systems. **Requirements for computer networks.** Planning of network. Basic concepts of administrative management of computer networks. **Network support services.** Active Directory service. Managing users and groups. File system and print service. **Managing network resources.** Network tasks and their management. Creating shared resources. User policies. **Ensuring security in a computer network.** Troubleshooting a local area network.

Learning Outcomes:

To successfully complete this module, students:

- should know and be able to use local network devices and their functions, IP-addressing tasks in the network, division into network classes, control and optimization of local network work, division and integration into sub-networks, diagnostic tools of TCP/IP local network, troubleshooting methods¹.
- should have the skills to use the network functions of the Windows operating system²
- should have the skills to use local network devices - bridges, hubs, concentrators and routers²
- should have the skills to allocate and use common resources in the local network².
- should have an idea of the principles of organization and operation of computer networks, classification of computing networks, the OSI reference model and its division into layers, connections between layers, local, regional and global types of networks, their similarities and differences, types of communication channels, organization of interconnection of devices in local networks, basic technologies of local networks, modern, widespread TCP/IP protocol, network addressing and routing basics, routing algorithms³.

¹Knowledge; ²Skill; ³Competence.

Teaching and learning methods:

Lectures, Performing and summarizing practical tasks, Interactive case studies, Blitz surveys, Working in groups, Giving presentations, Teamwork and project defense

Entrance requirements:

Programming 1, Computer organization, Electronics and circuits

Reading list

1. Tanenbaum A.S., Feamster N., Wetherall D.J. Computer Networks. Global edition. 6th ed. – Prentice Hall, Inc., 2021. (Tanenbaum A.S., Feamster N., Wetherall D.J. Computer Networks. Global Edition. 6th ed. – Prentice Hall, Inc., 2021.)

2. Олифер В., Олифер Н. Компьютерные сети. Принципы, технологии, протоколы: Юбилейное издание. – СПб.: Питер, 2020. (Olifer V., Olifer N. Computer Networks: Principles, Technologies, Protocols. Anniversary Edition. – St. Petersburg: Piter, 2020.)
3. Чарльз Р. Северанс. Как работают компьютерные сети и интернет / пер. с англ. П. М. Бомбаковой – М.: ДМК Пресс, 2022. (Charles R. Severance. How Computer Networks and the Internet Work / translated from English by P. M. Bombakova – Moscow: DMK Press, 2022.)
4. Hayitqulov B.H. “Kompyuter tarmoqlari fani bo‘yicha amaliy mashg‘ulotlar” uslubiy qo‘llanma. – T.: TDPU, 2017. (Hayitqulov B.Kh. Methodological Guide for Practical Exercises in Computer Networks. – Tashkent: TSPU, 2017.)
5. Miryusupov Z.Z., Djumanov J.X. Kompyuter tarmoqlari. (O‘quv qo‘llanma). – T.: "Aloqachi", 2020. (Miryusupov Z.Z., Djumanov J.Kh. Computer Networks. (Study Guide). – Tashkent: "Aloqachi", 2020.)

Examination:

Assessment of students’ knowledge is carried out in accordance with the Regulation on the system for monitoring and assessing students’ knowledge in higher education institutions developed based on the credit-module system, Article 15

Type of assessment	Midterm	Final
Time of assessment	Weeks 14-15	Weeks 19-20
Form of assessment	Written work	Test

Midterm Assessment: The midterm assessment is conducted after approximately half of the module’s lecture and practical sessions have been completed. A written assessment is administered, consisting of 2 theoretical questions and 1 practical task based on the topics covered up to that point. Each task is pre-prepared in different versions. Students who provide complete and correct answers receive a maximum of 5 points per correct answer. The final score for the midterm is calculated as the average of the points obtained for each task. The midterm assessment questions are announced at the beginning of the class sessions.

Final Assessment: The final assessment is conducted after approximately half of the module’s lecture and practical sessions have been completed. The evaluation is carried out in the form of a multiple-choice test consisting of 20 questions, each with 4 open answer options. To ensure academic integrity, the test is prepared in multiple versions. Each correct answer is awarded 1 point, with a maximum score of 20 points. The final score for the final assessment equals the number of correct answers. The test covers all topics studied up to that point and is administered during the regularly scheduled class time.

Teaching materials and media

Projector; white/black board; hand-outs; flipchart; visualisation aids for presentation; demonstration materials

Study Semester: 7 (full time)**ECTS:** 4**Workload**

Contact Time		Self-study	
Lectures	30 h	Preparation for Contact Time	30 h
Exercises	30 h	Literature review	30 h
Sum	60 h	Sum	60 h

Total Workload: 120 h**Lecturers**

T. A. Makharov – The Associate Professor at the Department of “Applied Mathematics and Intelligence Technologies”,

N. Q. Latipov – Senior Lecturer at the Department of “Applied Mathematics and Intelligence Technologies”.

Teaching Contents

Basic concepts of Project Management. Types of IT companies. The difference between outsourcing, out staffing and product. Stages of the development life cycle. Planning stage. Development stage. Support stage. Roles in the software development life cycle. **Preparatory phase of the project.** Definition of the concepts of Stakeholder and Project. Project structure. System of constraints and organizational structure. Overview of models, methodologies, frameworks. Definition of a model, methodology and framework. Agile Methodology. Scrum framework overview, advantages and disadvantages. Working with Backlog and task prioritization. Sprint planning and monitoring. Choosing a methodology for a project. **Preparing project documentation.** Commercial offer and contract structure. Contract types. Approaches to selecting a contract and project methodology. Project implementation management. Project charter development. Description of work (SOW). Defining the business value of the project, high-level business needs, project assumptions and constraints, project boundaries. List of stakeholders. Developing a project plan, creating and structuring a project plan. Rules for drafting technical documentation. Writing a technical assignment. Management, monitoring and control of project. Closing an entire project or its phase. **Project Scope.** Creating a project scope management plan. Business requirements: defining functional and non-functional requirements. Requirements description rules. Product acceptance criteria. Assumptions and constraints of the delivered product. Decomposition of project creation work. **Use Cases and User Stories.** Definition, structure, principles of checking user stories for quality and compilation. **Project deadlines management. Project cost management. Project quality management.** Definition of quality management. Quality principles. Quality planning. Control charts. Program implementation process diagrams. Definition and characteristics of a defect. Classification of defect importance. Defect life cycle. **Human Resource Management.** Human Resource Management Planning. **Project Communications Management. Project Risk Management.** Risk Management Planning. Risk Identification. Qualitative Risk Analysis. Formation of a Probability and Impact Matrix. Determination of Risk Categories. Risk Response Planning. **Project Change Management.** Planning Change Management on the Project, Drawing Up a Plan. **Project Procurement Management. Release and Deployment Management. The concept of usability.** Working with guidelines. Features of creating a product/project. Usability features.

Learning Outcomes:

To successfully complete this discipline, students:

- must know and be able to use optimal labor utilization and plan effectiveness analysis, costing, budget estimates, forecasting, final evaluation methodology, and the role of team members in the Agile methodology to achieve economic efficiency¹.
- should have the skills to understand and apply the hierarchical structure of work and product breakdown structure²
- should be able to plan the completion of all work elements, master (earn) the scope of work, control and monitor productivity, evaluate planned cost and schedule performance²
- should assess the effectiveness of periodic project audits, identify success and failure factors, and should complete the project effectively after its execution²
- should have an idea of the theoretical and practical significance of project management topics, project management technologies, and project characteristics³
- should understand the need for project management, the role of the project manager within the organization, system development life cycles, and the role of systems management and analysis throughout the project life cycle³

- should be able to identify methods for organizing project teams, responsibilities and roles of project team members, technical assignments, and the overall objectives of a project³
- ¹Knowledge; ²Skill; ³Competence.

Teaching and learning methods:

Lectures, Performing and summarizing practical tasks, Interactive case studies, Blitz surveys, Working in groups, Giving presentations, Teamwork and project defense

Entrance requirements:

Mandatory: Completed secondary education Basic computer literacy

Recommended: Familiarity with logical thinking and problem-solving. Prior exposure to basic programming concepts (optional but helpful)

Reading list

1. A Guide to the Project Management Body of Knowledge (PMBOK® Guide): <http://www.pmi.org/>.
2. Schwalbe, Kathy. Information Technology Project Management, Ninth Edition. // 2019, Cengage Learning, Inc. ISBN-13: 978-1-337-10135-6
3. Graham, Nick. Project Management For Dummies (2nd Edition), ISBN: 1119025737, 2015.
4. Хорин Г. Управление проектами с нуля. — СПб.: Питер, 2022. — 464 с.: ил.
5. Леоненков А.В. Самоучитель UML 2. — СПб.: БХВ-Петербург, 2007. — 576 с.: ил.

Examination:

Assessment of students' knowledge is carried out in accordance with the Regulation on the system for monitoring and assessing students' knowledge in higher education institutions developed based on the credit-module system, Article 15

Type of assessment	Midterm	Final
Time of assessment	Weeks 14-15	Weeks 19-20
Form of assessment	Written work	Test

Midterm Assessment: The midterm assessment (MA) is conducted after approximately half of the discipline's lecture and practical sessions have been completed. A written assessment is administered, consisting of 2 theoretical questions and 1 practical task based on the topics covered up to that point. Each task is pre-prepared in different versions. Students who provide complete and correct answers receive a maximum of 5 points per correct answer. The final score for the midterm is calculated as the average of the points obtained for each task. The midterm assessment questions are announced at the beginning of the class sessions.

Final Assessment: The final assessment is conducted after approximately half of the discipline's lecture and practical sessions have been completed. The evaluation is carried out in the form of a multiple-choice test consisting of 20 questions, each with 4 open answer options. To ensure academic integrity, the test is prepared in multiple versions. Each correct answer is awarded 1 point, with a maximum score of 20 points. The final score for the final assessment equals the number of correct answers. The test covers all topics studied up to that point and is administered during the regularly scheduled class time

Teaching materials and media

Projector; white/black board; hand-outs; flipchart; visualization aids for presentation; demonstration materials

Study Semester: 7 (full time)**ECTS:** 5**Workload**

Contact Time		Self-study	
Exercises	60 h	Preparation for Contact Time	20 h
		Literature review	20 h
		Independent study	50 h
Sum	60 h	Sum	90 h

Total Workload: 150 h**Lecturers**

A. Tillaev – Senior lecturer, (PhD) at the Department of “Applied Mathematics and Computer Analysis”.

Teaching Contents

Introduction to “Computer Graphics”. The theoretical foundations of computer graphics, which are related to the input, storage and processing of digital images into computer memory, as well as the algorithms and methods used by modern systems for processing raster and vector images. It studies the processes of creating images using computer technology, modeling them, processing them and displaying them on the screen. Its main goal is to ensure visual communication between the user and the computer. Types of graphic data: raster (pixel-based) and vector (based on mathematical formulas) graphics. Color models: color systems such as RGB, CMYK, HSV and their effect on images. Geometric modeling: mathematical models that determine the shape, size and location of objects (point, line, polygon). Transformations: translation, rotation, scaling and other geometric transformations. 2D and 3D graphics: methods for creating two- and three-dimensional objects and visualizing them. Image processing: filters, effects, contrast, brightness, etc. Animation fundamentals: creating motion and controlling moving images. Interface design: principles of organizing effective visual communication with the user. This discipline develops not only theoretical knowledge, but also practical skills - for example, working with graphic programs (Adobe Photoshop, CorelDraw, Adobe Illustrator, and animation creation software).

Learning Outcomes:

- Must know color models Computer graphics, must know the areas of application, Graphic formats. Representation of colors.¹
- Must have knowledge of computer graphics programs, mathematical foundations of computer graphics, Raster graphics programs.¹
- Must be able to use the Adobe Photoshop raster graphics editor, Vector graphics programs.¹
- Must be able to effectively use the capabilities of Corel Draw, Adobe Illustrator¹.
- Must be able to work with the Adobe Animate editor. Graphic formats. Compression algorithms. Software tools for creating animation.²
- Has knowledge of color representation²
- Knows how to create raster and vector images².
- Applies and can use the functions of the system for creating and processing raster and vector images. Creates and processes vector images.³
- Knows how to use tools for creating vector objects of varying complexity. Can work with software tools for creating animation³.

¹Knowledge; ²Skill; ³Competence.**Teaching and learning methods:**

Practical assignments; Case study discussions, Interactive case studies, Group work, Presentations, Individual projects.

Entrance requirements:Mandatory: Completed secondary education, basic mathematics knowledge, basic computer literacy.
Recommended: Linear Algebra and Analytical Geometry, Algorithmic Languages and Programming**Reading list**

1. Tillaev AI Photodesign, Adobe Photoshop. Tutorial. Tashkent 2022, “NIF MSH”. 170 p.
2. Tillaev AI Computer graphics. Methodological manual. –T.: "University", 2021. 140 p.
3. D. Rodgers, D. Adams. Mathematical basic machine graphics. "Mir" Moscow. 2001. 604 p.
4. CorelDRAW® User Guide, 2022, 1057 p.

5. James D. Foley, Andries van Dam, Steven K. Feiner, John Hughes. Computer Graphics: Principles and Practice. -Third edition. Pearson Education Inc, USA. 2014. 1263 p.
6. Evening Martin, Adobe Photoshop 2020 for Photographers: A professional image editor's guide to the creative use of Photoshop for Mac and PC, 2020, 788 p.
7. Adobe Photoshop Help. (https://helpx.adobe.com/pdf/photoshop_reference.pdf), 2019, 1017 p.
8. <http://www.gafica.me>
9. <https://compgraphics.info>

Examination:

Assessment of students' knowledge is carried out in accordance with the Regulation on the system for monitoring and assessing students' knowledge in higher education institutions developed based on the credit-module system, Article 15

Type of assessment	Midterm	Final
Time of assessment	Weeks 11-12	Weeks 19-20
Form of assessment	Practical work	Practical work or test*

Midterm Assessment: Intermediate control is practical. After completing the equivalent half of the practical science exercises, an intermediate control is taken. In this, each student is given one of 3 practical tasks on the topics covered. Assignments are announced at the beginning of the semester.

Final Assessment: a) Practical tasks for the final examination are prepared according to the options based on the curriculum and independent study topics. Each student is given 3 practical tasks.

b) If the final examination is conducted in the form of a test, students will be given options consisting of 50 test questions each and will be administered on a computer.

Teaching materials and media

Computer classroom; Projector; White/blackboard; Handouts; Computer graphics software; Hemis platform; Presentation materials including graphs and assessment indicators.

Study Semester: 7 (full time)

ECTS: 5

Workload

Contact Time		Self-study	
Exercises	60 h	Preparation for Contact Time	20 h
		Literature review	20 h
		Independent study	50 h
Sum	60 h	Sum	90 h

Total Workload: 150 h

Lecturers

A. Tillaev – Senior lecturer, (PhD) at the Department of “Applied Mathematics and Computer Analysis”

Teaching Contents

Introduction to Computer geometry, theoretical foundations and practical methods for creating and manipulating visual images on a computer. Methods for creating digital models of objects and describing them mathematically, geometric primitives, Transformations: rotating, scaling, moving objects and other geometric transformations. Curves and surfaces: creating complex curves and surfaces such as Bezier, B-spline, and NURBS. Methods for simplifying complex geometric models and increasing efficiency are studied. This subject develops practical skills along with theoretical knowledge - for example, the capabilities of graphic programs (Adobe Photoshop, CorelDraw, Adobe Illustrator and animation creation software) are studied.

Learning Outcomes:

- Must know color models Computer geometry and graphics, areas of application, Graphic formats. Representation of colors.¹
- Must have knowledge of graphic programs used by computer geometry,
- Must know the mathematical foundations of computer graphics, Raster graphics programs ¹
- Must be able to use the Adobe Photoshop raster graphics editor, Vector graphics programs. Must be able to effectively use the capabilities of Corel Draw¹.
- Knows the theoretical foundations of geometric modeling. Graphic formats. Compression algorithms².
- Has skill of color representation²
- Knows how to create raster and vector images².
- Applies and can use the functions of the system for creating and processing raster and vector images³
- Can work with graphic representation algorithms³
- Knows how to use tools for creating vector objects of varying complexity³
- Can work with innovations and areas of application in the field of modern computer graphics³.

¹Knowledge; ²Skill; ³Competence.

Teaching and learning methods:

Practical assignments; Case study discussions, Interactive case studies, Group work, Presentations, Individual projects.

Entrance requirements:

Mandatory: Completed secondary education, basic mathematics knowledge, basic computer literacy.

Recommended: Linear Algebra and Analytical Geometry, Algorithmic Languages and Programming, Mathematical Analysis

Reading list

1. D. Rodgers, D. Adams. Mathematical basic machine graphics. "Mir" Moscow. 2001. 604 p.
2. Tillaev A.I. Computer graphics. Methodological manual. -T.: "Universitet", 2021. 140 p.
3. James D. Foley, Andries van Dam, Steven K. Feiner, John Hughes. Computer Graphics: Principles and Practice. -Third edition. Pearson Education Inc, USA. 2014. 1263 p.
4. CorelDRAW® User Guide, 2022, 1057 p.
5. Boreskov A. V., Shishkin E.V. Computer graphics: uchebnik and practical for suitable bachelor's degree Moscow: Izdatelstvo Yurayt, 2019.
6. Evening Martin, Adobe Photoshop 2020 for Photographers: A professional image editor’s guide to the creative use of Photoshop for Mac and PC, 2020, 788 p.
7. <http://www.gafica.me>

Examination:

Assessment of students' knowledge is carried out in accordance with the Regulation on the system for monitoring and assessing students' knowledge in higher education institutions developed based on the credit-module system, Article 15

Type of assessment	Midterm	Final
Time of assessment	Weeks 11-12	Weeks 19-20
Form of assessment	Practical work	Practical work or test*

Midterm Assessment: Intermediate control is practical. After completing the equivalent half of the practical science exercises, an intermediate control is taken. In this, each student is given one of 3 practical tasks on the topics covered. Assignments are announced at the beginning of the semester.

Final Assessment: a) Practical tasks for the final examination are prepared according to the options based on the curriculum and independent study topics. Each student is given 3 practical tasks.

b) If the final examination is conducted in the form of a test, students will be given options consisting of 50 test questions each and will be administered on a computer.

Teaching materials and media

Computer classroom; Projector; White/blackboard; Handouts; Computer graphics software; Hemis platform; Presentation materials including graphs and assessment indicators.

Study Semester: 7 (full time)**ECTS:** 5**Workload**

Contact Time		Self-study	
Exercises	60 h	Preparation for Contact Time	20 h
		Literature review	20 h
		Independent study	50 h
Sum	60 h	Sum	90 h

Total Workload: 150 h**Lecturers**

A. Tillaev – Senior lecturer, (PhD) at the Department of “Applied Mathematics and Computer Analysis”

Teaching Contents

Introduction to vector graphics. Theoretical foundations of computer graphics related to the input, storage and processing of digital images into computer memory, primitive elements of vector graphics, mathematical foundations of vector graphics, transformations in the plane and space, algorithms and methods used by modern systems for processing vector (including raster) images. During the course of teaching the basics of vector graphics, programs such as CorelDraw and Adobe Illustrator are also taught.

Learning Outcomes:

- should know the areas of application of computer graphics and various graphic formats; ¹
- should understand color representation and should be familiar with color models and compression algorithms and the basics of color representation ¹
- should have knowledge of computer graphics software and the mathematical foundations of computer graphics ¹
- should be able to use vector graphics programs effectively, including CorelDRAW and Adobe Illustrator. ¹
- Should be able to work with systems for creating and processing vector images²
- Should understand graphic formats and compression algorithms²
- Should have knowledge of color representation and animation creation tools ²
- Should be able to work with Adobe Animate editor and should know how to create vector images.²
- Should be able to apply and use the functions of vector image creation and processing systems³
- Should be able to create and edit vector images ³
- Should know how to use tools for creating vector objects of varying complexity³
- Should be able to work with software tools for creating animations.³

¹Knowledge; ²Skill; ³Competence.**Teaching and learning methods:**

Practical assignments; Case study discussions, Interactive case studies, Group work, Presentations, Individual projects.

Entrance requirements:

Mandatory: Completed secondary education, basic mathematics knowledge, basic computer literacy.

Recommended: Linear Algebra and Analytical Geometry, Algorithmic Languages and Programming, Mathematical Analysis

Reading list

1. D. Rodgers, D. Adams. Mathematical basic machine graphics. «Mir» Moscow. 2001. 604 p.
2. Tillaev A.I. Computer graphics. Methodological manual. -T.: «Universitet», 2021. 140 p.
3. CorelDRAW® User Guide, 2022, 1057 p.
4. James D. Foley, Andries van Dam, Steven K. Feiner, John Hughes. Computer Graphics: Principles and Practice. -Third edition. Pearson Education Inc, USA. 2014. 1263 p.
5. Boreskov A. V., Shishkin E.V. Computer graphics: uchebnik and practical for suitable bachelor's degree. Moscow: Izdatelstvo Yurayt, 2019.
6. William K. Pratt. Digital Image Processing: PIKS Scientific inside Fourth Edition. John Wiley & Sons, Inc. Los Altos, California. USA. 2007. 807 p.
7. <http://www.gafica.me>
8. <https://compgraphics.info>

Examination:

Assessment of students' knowledge is carried out in accordance with the Regulation on the system for monitoring and assessing students' knowledge in higher education institutions developed based on the credit-module system, Article 15

Type of assessment	Midterm	Final
Time of assessment	Weeks 11-12	Weeks 19-20
Form of assessment	Practical work	Practical work or test*

Midterm Assessment: Intermediate control is practical. After completing the equivalent half of the practical science exercises, an intermediate control is taken. In this, each student is given one of 3 practical tasks on the topics covered. Assignments are announced at the beginning of the semester.

Final Assessment: a) Practical tasks for the final examination are prepared according to the options based on the curriculum and independent study topics. Each student is given 3 practical tasks.

b) If the final examination is conducted in the form of a test, students will be given options consisting of 50 test questions each and will be administered on a computer.

Teaching materials and media

Computer classroom; Projector; White/blackboard; Handouts; Computer graphics software; Hemis platform; Presentation materials including graphs and assessment indicators.

Study Semester: 7 (full time)

ECTS: 4

Workload

Contact Time		Self-study	
Lectures	30 h	Preparation for Contact Time	40 h
Exercises	30 h	Literature review	20 h
Sum	60 h	Sum	60 h

Total Workload: 120 h

Lecturers

M.U. Khudoyberganov – Professor at the Department of "Computational mathematics and information systems", Doctor of Physical and Mathematical Sciences.

Teaching Contents

Introduction. Numerical Methods for Solving Boundary Problems for Ordinary Differential Equations. Hyperbolic Systems. Transforming a Hyperbolic System with Two Independent Variables into Canonical Form Around a Point. Riemann Invariants. Formulation of the Mixed Problem for a Hyperbolic System. Finite Difference Schemes for the Linear Advection Equation. Analysis of Finite Difference Schemes. Monotonicity Properties of Finite Difference Schemes. Higher-Order Finite Difference Schemes. Methods for Solving Grid Equations. Quasi-Linear Hyperbolic System of Equations. Finite Difference Schemes for Gas Dynamics Problems. Classical Solution. Generalized Solution. Finite Difference Schemes for the Nonlinear Shallow Water Equation. Multi-Dimensional Schemes and Their Stability Conditions. Numerical Methods Based on the Exact Solution of the Riemann Problem.

Learning Outcomes:

To successfully complete this discipline, students:

- should understand boundary value problems and hyperbolic systems, including Riemann invariants and mixed problem formulations¹
- should be familiar with finite difference schemes, their properties, and higher-order methods¹
- should comprehend numerical approaches for gas dynamics, shallow water equations, and Riemann problems.¹
- Should be able to develop numerical solutions using finite difference methods for real-world applications²
- should be able to analyze and implement grid equations and multi-dimensional schemes²
- should use software tools like MATLAB, MathCad, or Python for computational modeling and testing.²

¹Knowledge; ²Skill.

Teaching and learning methods:

Lectures, Performing and summarizing practical tasks, Interactive case studies, Blitz surveys, Working in groups, Giving presentations, Teamwork and project defense.

Entrance requirements:

Mandatory: Completed secondary education Basic computer literacy

Recommended: Familiarity with logical thinking and problem-solving. Prior exposure to basic programming concepts (optional but helpful)

Reading list

1. Xudoyberganov M.O., Boltayev A.K., Sonli usullar. O'quv qo'llanma -T. 2023, 176 bet. (Xudoyberganov M.O., Boltayev A.K., Numerical methods. Textbook. -T. 2023, 176 pages)
2. Xudoyberganov M.O., Tulyaganova N.B., Sonli usullardan amaliy topshiriqlar to'plami. O'quv qo'llanma -T. 2023, 125 bet. (Xudoyberganov M.O., Tulyaganova N.B., Collection of practical exercises on numerical methods. Nexnbook. -T. 2023, 125 pages)
3. C.-W. Chu. Essentially Non-Oscillatory and Weighted Essentially Non-Oscillatory Schemes for Hyperbolic Conservation Laws. NASA/CR-97-206253, ICASE Report No. 97-65, 1997.
4. Peter Bastian. Numerical Solution of Hyperbolic Partial Differential Equations. Lecture notes. Interdisziplinäres Zentrum für Wissenschaftliches Rechnen Universität Heidelberg, Im Neuenheimer Feld 368, 69120 Heidelberg, 2017.
5. Eric Sonnendrücker. Numerical methods for hyperbolic systems. Lecture notes. Max-Planck-Institut für Plasmaphysik und Zentrum Mathematik, TU München, 2013.

Examination:

Assessment of students' knowledge is carried out in accordance with the Regulation on the system for monitoring and assessing students' knowledge in higher education institutions developed based on the credit-module system, Article 15

Type of assessment	Midterm	Final
Type of assessment	Midterm	Final
Time of assessment	Weeks 10-12	Weeks 19-20
Form of assessment	Written work	Written work

Midterm Assessment: The midterm assessment is conducted after approximately half of the discipline's lecture and practical sessions have been completed. A written assessment is administered, consisting of 2 theoretical questions and 1 practical task based on the topics covered up to that point. Each task is pre-prepared in different versions. Students who provide complete and correct answers receive a maximum of 5 points per correct answer. The final score for the midterm is calculated as the average of the points obtained for each task. The midterm assessment questions are announced at the beginning of the class sessions.

Final Assessment: The final assessment is conducted in written form based on the topics defined in the discipline syllabus, including both taught subjects and independent learning materials. Each version of the final assessment consists of 2 theoretical questions and 1 practical task.

Teaching materials and media

Projector; white/black board; hand-outs; flipchart; visualization aids for presentation; demonstration materials

Study Semester: 7 (full time)**ECTS:** 4**Workload**

Contact Time		Self-study	
Lectures	30 h	Preparation for Contact Time	40 h
Exercises	30 h	Literature review	20 h
Sum	60 h	Sum	60 h

Total Workload: 120 h**Lecturers**

M.U. Khudoyberganov – Professor at the Department of “Computational mathematics and information systems”, Doctor of Physical and Mathematical Sciences.

Teaching Contents

Introduction. Numerical Methods for Solving Boundary Problems for Ordinary Differential Equations. Hyperbolic Systems. Transforming a Hyperbolic System with Two Independent Variables into Canonical Form Around a Point. Finite Difference Schemes for Gas Dynamics Problems. Classical Solution. Generalized Solution. Finite Difference Schemes for the Nonlinear Shallow Water Equation. Riemann Invariants. Formulation of the Mixed Problem for a Hyperbolic System. Finite Difference Schemes for the Linear Advection Equation. Analysis of Finite Difference Schemes. Monotonicity Properties of Finite Difference Schemes. Higher-Order Finite Difference Schemes. Methods for Solving Grid Equations. Quasi-Linear Hyperbolic System of Equations. Multi-Dimensional Schemes and Their Stability Conditions. Numerical Methods Based on the Exact Solution of the Riemann Problem.

Learning Outcomes:

To successfully complete this discipline, students:

- should understand boundary value problems and hyperbolic systems, including Riemann invariants and mixed problem formulations¹
- should be familiar with finite difference schemes, their properties, and higher-order methods¹
- should comprehend numerical approaches for gas dynamics, shallow water equations, and Riemann problems¹
- should be able to develop numerical solutions using finite difference methods for real-world applications²
- should be able to analyze and implement grid equations and multi-dimensional schemes²
- should use software tools like MATLAB, MathCad, or Python for computational modeling and testing²

¹Knowledge; ²Skill.

Teaching and learning methods:

Lectures, Performing and summarizing practical tasks, Interactive case studies, Blitz surveys, Working in groups, Giving presentations, Teamwork and project defense.

Entrance requirements:

Mandatory: Completed secondary education Basic computer literacy

Recommended: Familiarity with logical thinking and problem-solving. Prior exposure to basic programming concepts (optional but helpful)

Reading list

1. Xudoyberganov M.O., Boltayev A.K., Sonli usullar. O'quv qo'llanma -T. 2023, 176 bet. (Xudoyberganov M.O., Boltayev A.K., Numerical methods. Textbook. -T. 2023, 176 pages)
2. Xudoyberganov M.O., Tulyaganova N.B., Sonli usullardan amaliy topshiriqlar to'plami. O'quv qo'llanma -T. 2023, 125 bet. (Xudoyberganov M.O., Tulyaganova N.B., Collection of practical exercises on numerical methods. Nexnbook. -T. 2023, 125 pages)
3. C.-W. Chu. Essentially Non-Oscillatory and Weighted Essentially Non-Oscillatory Schemes for Hyperbolic Conservation Laws. NASA/CR-97-206253, ICASE Report No. 97-65, 1997.
4. Peter Bastian. Numerical Solution of Hyperbolic Partial Differential Equations. Lecture notes. Interdisziplinäres Zentrum für Wissenschaftliches Rechnen Universität Heidelberg, Im Neuenheimer Feld 368, 69120 Heidelberg, 2017.
5. Eric Sonnendrücker. Numerical methods for hyperbolic systems. Lecture notes. Max-Planck-Institut für Plasmaphysik und Zentrum Mathematik, TU München, 2013.

Examination:

Assessment of students' knowledge is carried out in accordance with the Regulation on the system for monitoring and assessing students' knowledge in higher education institutions developed based on the credit-module system, Article 15

Type of assessment	Midterm	Final
Type of assessment	Midterm	Final
Time of assessment	Weeks 10-12	Weeks 19-20
Form of assessment	Written work	Written work

Midterm Assessment: The midterm assessment is conducted after approximately half of the discipline's lecture and practical sessions have been completed. A written assessment is administered, consisting of 2 theoretical questions and 1 practical task based on the topics covered up to that point. Each task is pre-prepared in different versions. Students who provide complete and correct answers receive a maximum of 5 points per correct answer. The final score for the midterm is calculated as the average of the points obtained for each task. The midterm assessment questions are announced at the beginning of the class sessions.

Final Assessment: The final assessment is conducted in written form based on the topics defined in the discipline syllabus, including both taught subjects and independent learning materials. Each version of the final assessment consists of 2 theoretical questions and 1 practical task.

Teaching materials and media

Projector; white/black board; hand-outs; flipchart; visualization aids for presentation; demonstration materials

AMAB1211 Qualification Internship I (Professional/Orientation Internship)			
Academic semester	2	ECTS	2
Academic workload			
Contact hours		Independent work	
		Professional Internship for 1st-Year Students of the Applied Mathematics Education Program	60 h
Total work-load	60 h		
Lecturers			
Khojiev T. – Senior Lecturer, Department of Applied Mathematics and Computer Analysis Tulaganov Z. – Senior Lecturer, Department of Applied Mathematics and Computer Analysis Ruzimatov J. – Trainee Lecturer, Department of Applied Mathematics and Computer Analysis			
Course content			
<ol style="list-style-type: none"> 1. Explain and distribute the students' internship assignments. 2. Review the knowledge gained in the subject Algorithmic Languages and Programming (ALP) and the process of constructing algorithms. 3. Revise algorithm construction techniques. 4. Create simple programs and practice executing them in the Visual Studio environment. 5. Study methods with and without parameters, including those that return and do not return values. 6. Work with ref and out modifiers in methods. 7. Handle arrays in methods — passing and receiving them as parameters. 8. Work with the params modifier in methods. Understand recursion and recursive methods. 9. Work with classes and their members. 10. Prepare and submit internship reports. 			
Learning objectives			
Upon successful completion of this course, students should:			
<ul style="list-style-type: none"> • Know the basic concepts and principles of algorithmic languages and programming; Understand the process of algorithm development and the logic of program execution; Have knowledge of methods and functions (with and without parameters), the use of ref, out, and params modifiers, recursion, and the structure and operation of classes and objects in object-oriented programming; Be familiar with the Visual Studio environment and its tools for program creation and debugging.¹ • Be able to design and implement algorithms to solve applied problems; Write, execute, and debug simple programs in the Visual Studio environment; Use parameterized and non-parameterized methods, return and non-return functions effectively; Apply ref, out, and params modifiers in practice; Work with arrays and pass them through methods; Develop and test recursive methods; Create classes, define their members, and use object-oriented principles in program construction.² • Be capable of integrating theoretical and practical programming knowledge to solve computational problems independently and in groups; Demonstrate responsibility and accuracy when developing and testing programs; Prepare and present internship reports clearly in written and oral form; Engage in analytical thinking, problem-solving, and continuous self-improvement in algorithmic thinking and programming.³ <p>¹ knowledge; ² skills; ³ abilities;</p>			
Teaching and learning methods			
Self-study; Group work;			
Admission requirements			
Mandatory: Algorithmic languages and programming I,II.			

Recommended: Possess basic computer literacy, including familiarity with file management, text editing, and operating system navigation.

Bibliography

1. Adambayev U.E., Yusupov Yu.S., Algoritmik tillar va dasturlash. C# tilida dasturlash asoslari. Darslik. – Toshkent: "Universitet", 2023. – 272 bet. (Adambayev U.E., Yusupov Yu.S., Algorithmic Languages and Programming. Fundamentals of Programming in C#. Textbook. – Tashkent: "Universitet", 2023. – 272 pages.)
2. Хоҗиёв Т.Қ., Хажийев И.О. Algoritmik tillar va dasturlash. О‘quv qo‘llanma. – Toshkent: "Ma'rifat", 2023. – 408 bet. (Khodjiyev T.Q., Khajiyev I.O. Algorithmic Languages and Programming. Study Guide. – Tashkent: "Ma'rifat", 2023. – 408 pages.)
3. Албахари Бен, Албахари Джозеф. C# 7.0. Справочник. Полное описание языка, 6 изд... Пер. с англ. – СПб: “Алфа-книга”, 2018. – 1024 с. (Ben Albahari, Joseph Albahari. C# 7.0. Pocket Reference. Complete Language Description, 6th ed. Translated from English. – St. Petersburg: “Alpha-kniga”, 2018. – 1024 pages.)
4. Василев А. Программирование на C# для начинающих. Основные сведения. – Москва: Эксмо, 2018. – 592 с.(A. Vasilev. Programming in C# for Beginners. Basic Information. – Moscow: Eksmo, 2018. – 592 pages.)
5. Герберт Шилдт. C# 4.0: полное руководство. Пер. с англ. – Москва: ООО "И.Д. Вилямс", 2011. – 1056 с. (Herbert Schildt. C# 4.0: The Complete Reference. Translated from English. – Moscow: ID Williams, 2011. – 1056 pages.)
6. Шарп Джон. Microsoft Visual C#. Подробное руководство. 8-е изд. – СПб.: Питер, 2017. – 848 с.(John Sharp. Microsoft Visual C#. Detailed Guide. 8th ed. – St. Petersburg: Piter, 2017. – 848 pages)

Assessments

Assessment of students’ knowledge is carried out in accordance with the Regulation on the system for monitoring and assessing students’ knowledge in higher education institutions developed based on the credit-module system.

Type of Assessment	FA
Timing	38-39 th week
Form of Assessment	Written report and oral exam

Final Assessment: Each student must prepare an individual report. During the report evaluation, the knowledge, professional skills, and competencies acquired by each student during the internship are assessed.

Educational Materials and Media Tools

Projector; white/black board; hand-outs; flipchart; visualization aids for presentation; demonstration materials

AMAB1212 Qualification Internship II (Professional/Orientation Internship)			
Academic semester	4	ECTS	2
Academic workload			
Contact hours		Independent work	
		Professional Internship for 2nd-Year Students of the Applied Mathematics Education Program	60 h
Total work-load	60 h		
Lecturers			
Khojiyev T. – Senior Lecturer, Department of Applied Mathematics and Computer Analysis Tulaganov Z. – Senior Lecturer, Department of Applied Mathematics and Computer Analysis Ruzimatov J. – Trainee Lecturer, Department of Applied Mathematics and Computer Analysis			
Course content			
<ol style="list-style-type: none"> 1. Explain and distribute the students' internship assignments. 2. Access modifiers: public, private, protected, and internal. 3. Static data, methods, and classes, and their usage. Nested classes and their declaration. 4. Working with namespaces. Overloading arithmetic and logical operators. 5. Base class and derived classes. Working with constructors, methods, and properties in inheritance. 6. Working with disks and directories. File and FileInfo classes. 7. Data streams. FileStream class. Writing data to and reading data from files. 8. StreamWriter and StreamReader classes. 9. Abstract classes. Abstract properties and methods. Redefining abstract methods in derived classes. 10. Preparing and submitting internship reports. 			
Learning objectives			
Upon successful completion of this course, students should:			
<ul style="list-style-type: none"> ● Know the concepts and applications of access modifiers (public, private, protected, internal); Understand the principles of static data, methods, and classes; Have knowledge of nested classes, namespaces, operator overloading, inheritance, file handling, data streams, and abstract classes in object-oriented programming.¹ ● Be able to apply access modifiers appropriately in program design; Create and use static members and nested classes; Implement inheritance with constructors, methods, and properties; Work with disks, directories, and files using File, FileInfo, FileStream, StreamWriter, and StreamReader classes; Perform file input/output operations; Redefine abstract methods in derived classes; Develop structured and efficient C# programs within the Visual Studio environment.² ● Be capable of integrating theoretical and practical programming knowledge to design, implement, and document software solutions; Work independently and collaboratively in programming projects; Demonstrate responsibility, accuracy, and adherence to coding standards; Analyze program functionality and optimize performance; Prepare and present internship reports effectively in written and oral form.³ <p>¹ knowledge; ² skills; ³ abilities;</p>			
Teaching and learning methods			
Self-study; Group work;			
Admission requirements			
Mandatory: Algorithmic languages and programming III, IV. Recommended: Possess basic knowledge of C# programming language or another high-level programming language. Understand fundamental object-oriented programming (OOP) concepts such as classes, objects, methods, and inheritance			

Bibliography	
7.	Adambayev U.E., Yusupov Yu.S., Algoritmik tillar va dasturlash. C# tilida dasturlash asoslari. Darslik. – Toshkent: "Universitet", 2023. – 272 bet. (Adambayev U.E., Yusupov Yu.S., Algorithmic Languages and Programming. Fundamentals of Programming in C#. Textbook. – Tashkent: "Universitet", 2023. – 272 pages.)
8.	Xoʻjayev T.Q., Xajiyev I.O. Algoritmik tillar va dasturlash. Oʻquv qoʻllanma. – Toshkent: "Maʼrifat", 2023. – 408 bet. (Khodjiyev T.Q., Khajiyev I.O. Algorithmic Languages and Programming. Study Guide. – Tashkent: "Maʼrifat", 2023. – 408 pages.)
9.	3. Албахари Бен, Албахари Джозеф. C# 7.0. Справочник. Полное описание языка, 6 изд... Пер. с англ. – СПб: "Алфа-книга", 2018. – 1024 с. (Ben Albahari, Joseph Albahari. C# 7.0. Pocket Reference. Complete Language Description, 6th ed. Translated from English. – St. Petersburg: "Alpha-kniga", 2018. – 1024 pages.)
10.	4. Василев А. Программирование на C# для начинающих. Основные сведения. – Москва: Эксмо, 2018. – 592 с. (A. Vasilev. Programming in C# for Beginners. Basic Information. – Moscow: Eksmo, 2018. – 592 pages.)
11.	5. Герберт Шилдт. C# 4.0: полное руководство. Пер. с англ. – Москва: ООО "И.Д. Вилямс", 2011. – 1056 с. (Herbert Schildt. C# 4.0: The Complete Reference. Translated from English. – Moscow: ID Williams, 2011. – 1056 pages.)
12.	6. Шарп Джон. Microsoft Visual C#. Подробное руководство. 8-е изд. – СПб.: Питер, 2017. – 848 с. (John Sharp. Microsoft Visual C#. Detailed Guide. 8th ed. – St. Petersburg: Piter, 2017. – 848 pages)
Assessments	
Assessment of students' knowledge is carried out in accordance with the Regulation on the system for monitoring and assessing students' knowledge in higher education institutions developed based on the credit-module system.	
Type of Assessment	FA
Timing	39-40 th week
Form of Assessment	Written report and oral exam
Final Assessment: Each student must prepare an individual report. During the report evaluation, the knowledge, professional skills, and competencies acquired by each student during the internship are assessed.	
Educational Materials and Media Tools	
Projector; white/black board; hand-outs; flipchart; visualization aids for presentation; demonstration materials	

AMAB1213 Qualification Internship III (Professional/Orientation Internship)			
Academic semester	6	ECTS	2
Academic workload			
Contact hours		Independent work	
		Professional Internship for 3rd-Year Students of the Applied Mathematics Education Program	60 h
Total work-load	60 h		
Lecturers			
Khojiyev T. – Senior Lecturer, Department of Applied Mathematics and Computer Analysis Tulaganov Z. – Senior Lecturer, Department of Applied Mathematics and Computer Analysis Ruzimatov J. – Trainee Lecturer, Department of Applied Mathematics and Computer Analysis A.S. Matyakubov – Associate Professor at the «Applied Mathematics and Computer Analysis» Doctor of Physical and Mathematical Sciences			
Course content			
<ol style="list-style-type: none"> 1. Meeting conducted by the university-appointed internship supervisor and the supervisor from the host organization. Introduction to the internship schedule and program. 2. Familiarization with safety regulations and internal labor rules as well as the requirements and conditions for completing the internship at the organization. 3. Explanation and distribution of tasks to students. 4. Solving problems in mathematical analysis using computer-based mathematical systems. Exercises on calculating limits. 5. Solving problems in mathematical analysis using computer-based mathematical systems. Exercises on calculating indefinite integrals. 6. Solving problems in mathematical analysis using computer-based mathematical systems. Exercises on calculating definite integrals. 7. Solving problems in mathematical analysis using computer-based mathematical systems. Exercises on calculating the sums and products of series and expanding functions into series. 8. Solving problems in mathematical analysis using computer-based mathematical systems. Exercises on evaluating improper integrals (first type). 9. Solving problems in mathematical analysis using computer-based mathematical systems. Exercises on evaluating improper integrals (second type). 10. Solving problems in mathematical analysis using computer-based mathematical systems. Exercises on calculating multiple integrals. 			
Learning objectives			
Upon successful completion of this course, students should: <ul style="list-style-type: none"> ● Upon completion of this internship, students should possess a solid understanding of the structure, objectives, and requirements of the professional internship program. They will have knowledge of occupational safety rules and internal labor regulations within the host organization. Students will also understand the theoretical foundations of mathematical analysis, including limits, integrals, series, and their computational applications, as well as be familiar with computer-based mathematical systems used to solve analytical problems.¹ ● During the internship, students will develop the ability to apply theoretical knowledge in solving mathematical analysis problems using modern computer software. They will acquire practical skills in calculating limits, definite and indefinite integrals, performing series expansions, and solving problems related to improper and multiple integrals through computer-based systems. Moreover, students will be able to record, process, and analyze mathematical data obtained during computational practice and prepare a comprehensive internship report that summarizes their tasks and outcomes.² ● As a result of the internship, students will demonstrate the ability to integrate theoretical and practical knowledge when addressing applied mathematical problems. They will work effectively both independently and in teams, showing responsibility, accuracy, and adherence to workplace safety standards. Furthermore, 			

<p>students will be able to communicate analytical results clearly in both written and oral forms and will show readiness for continuous self-improvement and professional development in the field of applied mathematics and computer analysis.³ ¹ knowledge; ² skills; ³ abilities;</p>						
Teaching and learning methods						
Self-study; Group work;						
Admission requirements						
Mandatory: Computer-based mathematical systems. Recommended:						
Bibliography						
<p>1. Y.K. Khudayberganov, Z.R. Rakhmonov. Computer-Based Mathematical Systems. Educational manual. “Ma’rifat” Publishing House, Tashkent, 2025. 204 pages. 2. O.G. Korolkov, A.S. Chebotarev, Yu.D. Sheglova. Maple in Examples and Problems. A university-level textbook. Voronezh, 2011. 82 pages. 3. V.P. Dyakonov. Maple 10/11/12/13/14 in Mathematical Calculations. Moscow: DMK Press, 2014. 800 pages. 4. M.N. Kirsanov. Practical Programming in the Maple System. Moscow: Publishing House MEI, 2011. 208 pages.</p>						
Assessments						
<p>Assessment of students’ knowledge is carried out in accordance with the Regulation on the system for monitoring and assessing students’ knowledge in higher education institutions developed based on the credit-module system.</p> <table style="width: 100%; border: none;"> <tr> <td style="text-align: center;">Type of Assessment</td> <td style="text-align: center;">FA</td> </tr> <tr> <td style="text-align: center;">Timing</td> <td style="text-align: center;">39-40 th week</td> </tr> <tr> <td style="text-align: center;">Form of Assessment</td> <td style="text-align: center;">Written report and oral exam</td> </tr> </table> <p>Final Assessment: Each student must prepare an individual report. During the report evaluation, the knowledge, professional skills, and competencies acquired by each student during the internship are assessed.</p>	Type of Assessment	FA	Timing	39-40 th week	Form of Assessment	Written report and oral exam
Type of Assessment	FA					
Timing	39-40 th week					
Form of Assessment	Written report and oral exam					
Educational Materials and Media Tools						
Projector; white/black board; hand-outs; flipchart; visualization aids for presentation; demonstration materials						

AMAB1214.1 Qualification Internship III (Teaching internship)			
Academic semester	8	ECTS	8
Academic workload			
Contact hours		Independent work	
		Teaching internship for 4th-Year Students of the Applied Mathematics Education Program	240 h
Total work-load	240 h		
Lecturers			
Senior Lecturer Q. Akhmedova; Senior Lecturer Z. Tulaganov			
Course content			
<p>1. Orientation Phase (1 week)</p> <p>Meeting with school and academic lyceum administration: Conversation between the internship students and the school or academic lyceum leadership (deputy principal for academic affairs). Familiarization with the official documents of the school and academic lyceum, the general plans of the principal and mathematics, algebra, geometry, and informatics teachers (time should be specified).</p> <p>Distribution of students by classes and groups: Assignment of students to specific classes and groups; familiarization with the class and group supervisors and their work plans. Preparation of individual calendar plans for students' educational and instructional activities.</p> <p>Passive observation phase: Attendance of mathematics, algebra, geometry, and informatics lessons conducted by teachers; observation and analysis of their teaching methods and lesson structures.</p> <p>Study of teaching methods and resources: Examination of the scientific and theoretical level and pedagogical mastery of mathematics, algebra, geometry, and informatics teachers, as well as their use of additional literature, instructional materials, technical teaching aids, and demonstration activities.</p> <p>Preparation of the general plan of the pedagogical internship: Development of a comprehensive internship plan for students at the assigned schools and academic lyceums.</p> <p>II. Active Phase (7 weeks)</p> <p>Lesson schedule and distribution methods: Preparation of a timetable for active teaching practice; methods for assigning classes and lessons; procedures for peer review and preparation of analytical reports. Determination of the number of lessons conducted by each trainee (maximum and minimum), as well as analysis of trial and observed lessons.</p> <p>Teaching load and analysis by groups: Summarizing the total number of teaching hours conducted by trainees in schools and academic lyceums (separately for Uzbek- and Russian-language groups) and analyzing them by classes.</p> <p>Evaluation of lesson quality: Analysis of the scientific and theoretical level of the lessons conducted by the trainees, including their use of supplementary literature, methodological materials, technical teaching aids, visual materials and ICT tools related to mathematics, algebra, geometry, and informatics.</p> <p>Study of students' attitudes toward mathematics, algebra, geometry, and informatics: Investigation of the attitudes of school and academic lyceum students toward these subjects, as well as their opinions about the lessons conducted by trainee teachers.</p> <p>Monitoring and assessment of trainee performance:</p> <p>a) Evaluation of trainees who delivered lessons of a high scientific and theoretical level;</p>			

- b) Evaluation of trainees who were unable to deliver lessons of sufficient quality;
- c) Analysis of trainees who, despite having potential, demonstrated indifference toward their teaching duties;
- d) Encouragement and recognition of active students who made significant contributions to the effective organization of the educational process in schools and academic lyceums.

III. Extracurricular Activities

- Decorating mathematics and informatics classrooms in schools and academic lyceums (providing detailed information about exhibits, posters, wall newspapers, and albums — including their quantity, titles, and the students responsible for them).
 - Preparing necessary teaching aids, computer equipment, and laboratory materials for mathematics and informatics lessons.
 - Repairing and adjusting computers, software, and educational technical tools.
 - Creating wall newspapers, infographics, and photo collages related to mathematics and informatics, and organizing classroom bulletin boards.
 - Developing instructional and methodological materials, exercise collections, tests, electronic resources, and interactive tasks for mathematics and informatics.
 - Organizing excursions and field trips related to mathematics and informatics (including visits to the relevant faculties of the National University of Uzbekistan).
 - Working individually with underachieving students; conducting engaging question-and-answer sessions, logical games, problem-solving, and coding activities.
 - Conducting educational (advisory) class hours dedicated to mathematics and informatics subjects in classrooms or groups.
 - Collaborating with class or group leaders and active students to improve the educational process.
 - Guiding students in career orientation toward information technology and programming through discussions, meetings, and practical activities.
 - Visiting students' homes and providing recommendations to increase their learning motivation.
 - Participating in parent–teacher meetings and presenting information about achievements in mathematics and informatics.
 - Organizing meetings between students and prominent mathematicians, programmers, and IT specialists.
-
- Holding evening events, quizzes, and competitions dedicated to important dates and figures in mathematics and computer science.
 - Compiling a list of active trainee students who made significant contributions to organizing educational and extracurricular activities in schools and academic lyceums..

IV. Final Phase (1 week)

- Conducting a final conference on teaching practice with the participation of trainee students, school and academic lyceum teachers, and administration.
- Compiling a general list of trainee students and recording their final evaluation grades.
- Preparing a list of students who did not complete the internship program or received unsatisfactory evaluations.
- Preparing a list of students who violated the internal regulations of schools or academic lyceums
- Compiling a list of active students who made significant contributions to both educational and extracurricular activities in schools and academic lyceums (for recognition by the university and faculty administration).
- Identifying and summarizing the main difficulties that hindered the successful completion of the internship (e.g., insufficient preparation of trainees, lack of methodological support from mathematics and informatics teachers, insufficient number of classrooms, etc.).
- Developing recommendations and proposals for improving the pedagogical internship for the following academic year.

Learning objectives

Upon successful completion of this course, students should:

- understand the principles and methods of teaching **mathematics and informatics** in secondary schools and academic lyceums, know lesson planning, curriculum design, and assessment methods, be aware of modern

<p>pedagogical concepts, advanced teaching technologies, and ICT in education, understand how to organize spiritual-enlightenment and educational activities, and know the responsibilities and documentation of a class (group) leader, including preparation of semester and annual plans and journals¹</p> <ul style="list-style-type: none"> ● be able to prepare and deliver mathematics and informatics lessons using effective teaching methods and technologies, assess students' knowledge, skills, and competencies through various forms of evaluation, analyze and reflect on lessons conducted by experienced teachers and peers to improve teaching performance, design and implement lesson plans and materials aligned with curriculum goals, and integrate digital and information technologies into the learning process to enhance outcomes.² ● effectively apply pedagogical and communication skills in classroom and group management, independently organize and conduct high-quality mathematics and informatics lessons and extracurricular activities, adopt innovative teaching methods and continuously improve professional competence, collaborate with colleagues, students, and school administration to achieve educational goals, and demonstrate responsibility, initiative, and ethical behavior during pedagogical practice³ <p>¹ knowledge; ² skills; ³ abilities;</p>						
Teaching and learning methods						
Self-study; Group work;						
Admission requirements						
<p>Requirements for Students' Knowledge and Competence during the Pedagogical Practice. During the pedagogical practice, students are expected to demonstrate knowledge and competence in the following areas: Lesson preparation and delivery: ability to prepare for lessons, present educational topics in mathematics and informatics clearly, and assess students' knowledge, skills, and performance. Conducting various types of lessons: ability to organize and conduct different lesson formats while developing professional knowledge, skills, and teaching competencies relevant to mathematics and informatics education. Organizing educational and moral–spiritual activities: ability to plan and conduct extracurricular and educational events that promote students' personal, ethical, and intellectual development. Implementation of modern pedagogical technologies: competence in integrating innovative teaching methods and educational technologies into mathematics and informatics lessons. Lesson observation and analysis: ability to attend and critically analyze lessons delivered by school and academic lyceum teachers—especially mathematics and informatics teachers—and fellow trainees. Use of information technologies in education: proficiency in applying digital and information tools to enhance the teaching and learning of mathematics and informatics. Class management: ability to perform the duties of a class (group) supervisor, including maintaining class journals and student records. Curriculum and planning: ability to develop semester and annual teaching plans in mathematics and informatics. Lesson planning documentation: ability to design and prepare detailed lesson plan outlines (lesson plan–conspectus) for mathematics and informatics lessons</p>						
Bibliography						
<ol style="list-style-type: none"> 1. Mukhammadiyev J.O., Rakhmonov Z.R. "Methodology of Teaching Mathematics and Computer Science." Educational-methodical manual. Tashkent, National University of Uzbekistan, 2021. – 200 pages. 2. Mukhammadiyev J.O. "Methodology of Teaching Mathematics and Computer Science." Educational-methodical manual. Tashkent, National University of Uzbekistan, 2019. – 172 pages. 						
Assessments						
<p>Assessment of students' knowledge is carried out in accordance with the Regulation on the system for monitoring and assessing students' knowledge in higher education institutions developed based on the credit-module system.</p> <table border="0" style="width: 100%;"> <tr> <td style="text-align: center;">Type of Assessment</td> <td style="text-align: center;">FA</td> </tr> <tr> <td style="text-align: center;">Timing</td> <td style="text-align: center;">28-29 th week</td> </tr> <tr> <td style="text-align: center;">Form of Assessment</td> <td style="text-align: center;">Written report and oral exam</td> </tr> </table> <p>Final Assessment Criteria:</p>	Type of Assessment	FA	Timing	28-29 th week	Form of Assessment	Written report and oral exam
Type of Assessment	FA					
Timing	28-29 th week					
Form of Assessment	Written report and oral exam					

Grade “5” (Excellent) – The student has successfully completed all the tasks specified in the program at the required level. Their knowledge, skills, and teaching methodology fully meet the established standards. The lesson plan notebook is complete and accurate. The student is also able to organize and conduct educational and spiritual-enlightenment activities; implement advanced pedagogical technologies in the learning process; analyze lessons conducted by mathematics and informatics teachers and peers; use information and communication technologies in education; work as a group leader and maintain group journals; prepare semester and annual teaching plans in mathematics and informatics; prepare detailed lesson plans; and conduct independent lessons at a high professional level.

Grade “4” (Good) – The student has correctly completed all assigned tasks with one or two significant methodological errors. The student is able to organize and conduct educational and spiritual-enlightenment activities; apply modern pedagogical technologies in the learning process; analyze lessons of mathematics and informatics teachers and peers; use digital and information technologies in education; work as a group leader and maintain group journals; prepare semester and annual teaching plans in mathematics and informatics; prepare lesson plans; and conduct lessons independently.

Grade “3” (Satisfactory) – The student has correctly completed about two-thirds of the assigned work or, in the case of completing all assignments, has made one or two significant errors or several minor shortcomings. The student is able to organize and conduct educational and spiritual-enlightenment activities; apply pedagogical technologies in the learning process; analyze lessons of mathematics and informatics teachers and peers; use information technologies in teaching; work as a group leader and maintain group journals; prepare lesson plans and conduct classes independently.

Grade “2” (Unsatisfactory) – The student is unable to organize and conduct educational and spiritual-enlightenment activities; fails to apply pedagogical technologies in the learning process; cannot analyze lessons of mathematics and informatics teachers and peers; cannot perform group leadership duties or maintain journals; fails to prepare lesson plans; and has excessive absences during the practice period.

Educational Materials and Media Tools

White/blackboard, printed handouts, measuring instruments and devices, demonstration equipment and materials, visual aids, multimedia presentations, computers, projectors, and educational software.

AMAB1214.2 Qualification Internship IV (Pre-graduation internship)			
Academic semester	8	ECTS	7
Academic workload			
Contact hours		Independent work	
		Professional Internship for 4th Year Students of the Applied Mathematics Education Program	210 h
Total work-load	210 h		
Lecturers			
Associate Prof. Dr. M.Matyakubov			
Course content			
<p>The pre-graduation internship of university students represents a consistent continuation of the educational process conducted at higher education institutions. It provides an opportunity for students to collect materials related to the topics of their bachelor's thesis, analyze relevant literature, and consolidate theoretical knowledge and research methods acquired during their studies within the chosen department. The internship also contributes to the development of professional competencies and practical skills.</p> <p>During this internship, students expand and deepen the knowledge gained in their bachelor's program, strengthen and improve their academic and professional skills.</p> <p>The main tasks of the pre-graduation internship include:</p> <ul style="list-style-type: none"> • Developing professional competencies and practical skills related to the topic of the bachelor's thesis. • Strengthening theoretical understanding by studying literature and research methods relevant to the chosen topic, as well as acquiring knowledge about the necessary instruments and equipment. • Analyzing the physical process related to the bachelor's thesis topic and providing suggestions for its improvement. <p>After completing the assigned work, the student discusses the results in detail under the supervision of the academic advisor and takes a final assessment. The outcomes of the internship are presented in a written report. The topics of bachelor's theses are determined by each department according to their specialization and are assigned to students by the internship supervisor.</p>			
Learning objectives			
<ul style="list-style-type: none"> ● Understand the fundamental mathematical and informatics principles, laws, and processes related to the chosen topic of the bachelor's thesis; possess theoretical knowledge of mathematical modeling and numerical solution methods; be familiar with scientific literature and modern computational approaches relevant to the selected research area; understand the meaning, parameters, and interrelations of measurable quantities; have knowledge of software tools, algorithmic analysis methods, as well as the structure, methodology, and ethical standards of scientific research and reporting.¹ ● Apply theoretical knowledge to construct, solve, and analyze mathematical models using numerical methods; develop and implement algorithms and computational programs; collect data, process it using computer software, and analyze the results; effectively use programming languages (such as Python, MATLAB, C#, etc.) and computational technologies in research; work independently on the bachelor's thesis, preparing a scientifically grounded written report and presenting visual results (graphs, tables, diagrams).² ● Independently plan, conduct, and complete a small-scale scientific or applied research project in mathematics or informatics focused on constructing and analyzing mathematical models using numerical methods; critically evaluate research results, identify sources of computational error, and propose methods for improvement; present and defend research findings logically and scientifically in written and oral forms; integrate theoretical 			

<p>and practical knowledge to solve specific mathematical or computational problems; demonstrate responsibility, initiative, and adherence to professional ethics throughout the research process.³</p> <p>¹ knowledge; ² skills; ³ abilities;</p>						
Teaching and learning methods						
Self-study; Group work;						
Admission requirements						
<p>Mandatory: Mathematical Modeling; Numerical Methods; Algorithms and Data Structures; Programming; Computer Systems and Networks; Information Technologies; Applied Mathematics.</p> <p>Recommended: All other subjects in Mathematics and Informatics.</p>						
Bibliography						
Recommended by the internship supervisor based on the chosen field of specialization.						
Assessments						
<p>Assessment of students' knowledge is carried out in accordance with the Regulation on the system for monitoring and assessing students' knowledge in higher education institutions developed based on the credit-module system.</p> <table border="0" style="width: 100%;"> <tr> <td style="text-align: center;">Type of Assessment</td> <td style="text-align: center;">FA</td> </tr> <tr> <td style="text-align: center;">Timing</td> <td style="text-align: center;">36-38 th week</td> </tr> <tr> <td style="text-align: center;">Form of Assessment</td> <td style="text-align: center;">Written report and oral exam</td> </tr> </table> <p>Final Assessment Criteria:</p> <p>Grade “3” The student knows the main mathematical and informatics laws, principles, and processes related to the chosen thesis topic. They can correctly write and explain basic mathematical formulas and algorithms, understand the subject of the bachelor's thesis, and describe it accurately. The student knows the meaning, symbols, and units of measurable parameters and can describe computational relationships correctly, though without derivations.</p> <p>Grade “4” – The student knows the main theoretical principles and computational methods related to the chosen topic. They can correctly write and explain the fundamental mathematical formulas and algorithms, understand and describe the topic of the bachelor's thesis appropriately, and know the meaning and interrelations of measurable quantities and parameters. The student can correctly apply numerical methods or algorithms (without full proof), perform the thesis work independently, and analyze the obtained results using appropriate software or programming tools.</p> <p>Grade “5” – The student demonstrates deep knowledge of mathematical modeling, algorithms, and numerical computation methods related to the chosen thesis topic. They can correctly write, explain, and apply mathematical formulas, algorithms, and numerical techniques to model and solve the relevant problems. The student fully understands the meaning, symbols, and units of measurable quantities, and can describe or implement computational formulas and models accurately. They can independently complete the bachelor's thesis, analyze results critically, and scientifically justify both theoretical and practical aspects using logical reasoning and mathematical argumentation. The student is able to provide a coherent, comprehensive, and well-grounded theoretical explanation of all issues related to their thesis in both written and oral forms.</p>	Type of Assessment	FA	Timing	36-38 th week	Form of Assessment	Written report and oral exam
Type of Assessment	FA					
Timing	36-38 th week					
Form of Assessment	Written report and oral exam					
Educational Materials and Media Tools						
white/black board; printed handouts; demonstration equipment and materials						

YDAB415 Final State Attestation (Including Defense of the Bachelor Thesis)			
Academic semester	8	ECTS	15
Academic workload			
Contact hours		Independent work	
		Professional Internship for 4th Year Students of the Applied Mathematics Education Program	450 h
Total work-load	450 h		
Lecturers			
Academic Staff of the Department of Applied Mathematics and Computer Analysis			
Course content			
<p>Algorithmic Languages and Programming (C#): Syntax and structure of the C# programming language, algorithmic and object-oriented programming principles, data types and operators, control statements, arrays and strings, classes and objects, methods and constructors, file operations, recursion, and the use of standard libraries in application development within the Visual Studio environment.</p> <p>Mathematical Analysis: Sets and real numbers, limits and continuity of functions and sequences, derivatives and differentials, applications of differential calculus, indefinite and definite integrals, improper integrals and their convergence, functions of several variables, partial derivatives, multiple integrals, line and surface integrals, infinite numerical and functional series, power series, Fourier series, Gamma and Beta functions, and applications of integral and differential calculus in geometry, physics, and mechanics.</p> <p>Mathematical Modeling: Concepts of model and modeling, types and methods of constructing mathematical models, adequacy and validation of models, use of conservation laws and variational principles, demographic and biological models, competition and predator-prey systems, models of economic and financial processes, and computational experiments in modeling complex systems.</p> <p>Numerical Methods: Theory of errors and their sources, approximate methods in linear algebra, iterative techniques for solving algebraic and transcendental equations, interpolation and function approximation, eigenvalue problems, numerical integration using Newton–Cotes and Gaussian quadrature formulas, numerical solutions of ordinary differential equations (Euler, Runge–Kutta, Adams methods), variational and Galerkin approaches, and finite difference methods for solving mathematical physics problems.</p>			
Learning objectives			
<ul style="list-style-type: none"> ● Understand the fundamental mathematical principles, theories, and methods related to applied mathematics, mathematical modeling, and numerical analysis. Know the main concepts of mathematical analysis, differential and integral calculus, and series. Understand the principles of constructing mathematical models for real-world processes and phenomena. Know the theoretical foundations of numerical methods, error theory, and computational algorithms. Be familiar with the structure, methodology, and ethical principles of scientific and applied research in mathematics and computer analysis.¹ ● Apply theoretical knowledge to solve analytical, modeling, and computational problems. Use mathematical and numerical methods to analyze, approximate, and simulate real-world processes. Develop and apply mathematical models using appropriate algorithms and software tools. Independently perform numerical calculations, analyze errors, and ensure computational accuracy. Use modern information and programming technologies (such as C#, MATLAB, Python, etc.) for data processing, visualization, and simulation. Prepare a coherent and scientifically grounded bachelor's thesis in the field of applied mathematics and computer analysis.² ● Independently plan and conduct research or practical projects in mathematical modeling and numerical computation. Critically analyze results, identify sources of computational errors, and suggest improvements. 			

<p>Integrate mathematical theory with numerical and computational methods to solve complex interdisciplinary problems. Present and justify research outcomes both in written and oral forms using scientific reasoning. Demonstrate responsibility, initiative, and professional ethics in analytical and computational research activities..³</p> <p>¹ knowledge; ² skills; ³ abilities;</p>							
Teaching and learning methods							
Self-study; Group work;							
Admission requirements							
<p>Mandatory: Mathematical Analysis; Mathematical Modeling; Numerical Methods; Probability Theory and Mathematical Statistics; Programming and Algorithms</p> <p>Recommended: All other subjects in Applied Mathematics and Computer Analysis</p>							
Bibliography							
<ol style="list-style-type: none"> 1. Adambayev U.E., Yusupov Yu.S., Algoritmik tillar va dasturlash. C# tilida dasturlash asoslari. Darslik. – T.: “Universitet”, 2023. -272 b. 2. Xojiyev T.Q., Xajiyev I.O. Algoritmik tillar va dasturlash. O‘quv qo‘llanma. –T: “Ma’rifat”, 2023. -408 b. 3. Албахари Бен, Албахари Джозеф. C# 7.0. Справочник. Полное описание языка, 6 изд.: Пер. с англ. -СПб: “Алфа-книга”, 2018. -1024 с. 4. Василев А. Программирование на C# для начинающих. Основные сведения. – М.: Эксмо, 2018.-592 с. 5. Alimov Sh.O., Ashurov R.R. Matematik analiz. 1, 2, 3 q. -T.: “Mumtoz so‘z”, 2018. 6. Xudayberganov G., Vorisov A. K., Mansurov X. T., Shoimqulov B. A. Matematik analizdan ma’ruzalar, I, II q. -T.: “Voris-nashriyot”, 2010. 7. Фихтенгольц Г.М. Курс дифференциального и интегрального исчисления 1,2,3 т.-М.: «Физматлит», 2007. 8. Хайдаров А., Кабилжанова Ф.А., Матякубов А.С. Математик моделлаштириш асослари. Ўқув кўлланма. -Т.: 2023. 172 б. 9. Хайдаров А.Т., Жумаев Ж., Шафиев Т.Р. Основы математического моделирования. Учебник.- Бухара: «Садриддин Салим Бухорий». Дурдона, 2022. -216 с. 10. Самарский А.А., Михайлов А.П., Математическое моделирование.-М.: Физматлит, 2005. 11. Normurodov Ch. Ayirmali sxemalar nazariyasi. Darslik.–Termiz.: 2021.-236 b. 12. Исроилов М.И. Ҳисоблаш методлари. I, II қисм. -Т.: Ўқитувчи, 2003, 2008. 13. Алоев Р.Д., Худойберганоў М.Ў. Ҳисоблаш усуллари курсидан лаборатория машғулотлари тўплами.-Т.:ЎзМУ.Ўқув кўлланма. 2008.-110 б 							
Assessments							
<p>Assessment of students’ knowledge is carried out in accordance with the Regulation on the system for monitoring and assessing students’ knowledge in higher education institutions developed based on the credit-module system.</p> <table border="0" style="width: 100%;"> <tr> <td style="text-align: center; width: 50%;">Type of Assessment</td> <td style="text-align: center; width: 50%;">FA</td> </tr> <tr> <td style="text-align: center;">Timing</td> <td style="text-align: center;">36-38 th week</td> </tr> <tr> <td style="text-align: center;">Form of Assessment</td> <td style="text-align: center;">Written report and oral exam</td> </tr> </table> <p>The State Attestation is conducted in written form and is assessed according to a five-point grading system. Each student is given a test paper consisting of four questions, and each answer is evaluated with a maximum score of five points. The final grade is determined as the average of the scores obtained for the individual questions. Students’ written work is evaluated based on the following assessment criteria:</p> <p>Grade “5” –</p> <ul style="list-style-type: none"> ● the student is able to draw independent conclusions and make decisions; ● demonstrates creative thinking; ● shows independent judgment; ● can apply the acquired knowledge in practice; ● understands the essence of the discipline (topic); ● possesses solid knowledge of the subject; 		Type of Assessment	FA	Timing	36-38 th week	Form of Assessment	Written report and oral exam
Type of Assessment	FA						
Timing	36-38 th week						
Form of Assessment	Written report and oral exam						

- can clearly express and explain the content;
- demonstrates a comprehensive understanding of the discipline (topic).

Grade “4” –

- the student shows independent judgment;
- can apply the acquired knowledge in practice;
- understands the essence of the discipline (topic);
- possesses sufficient knowledge of the subject;
- can express and explain the content;
- demonstrates understanding of the discipline (topic).

Grade “3”

- the student can apply the acquired knowledge in practice;
- understands the main idea of the discipline (topic);
- possesses basic knowledge of the subject;
- can express and explain the content;
- demonstrates partial understanding of the discipline (topic).

Grade “2”

- the student has not mastered the course program;
- does not understand the essence of the discipline (topic) and demonstrates no understanding of the subject matter.

Educational Materials and Media Tools

Laboratory setups; white/black board; printed handouts; measuring instruments and equipment; demonstration equipment and materials