National University of Uzbekistan
named after Mirzo Ulugbek
Faculty of Mathematics

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

September 2025

valid for all students enrolled
from WS 2023/24 onwards

# The most important details

| | |
|---|---|
| **Duration:** | 8 semesters full-time |
| **Location:** | Tashkent |
| **Qualification**: | Bachelor of Mathematics, B.A. |
| **Course start:** | Annually in the Autumn term |
| **Language**: | Uzbek |
| **Preparatory internship:** | During the 8th semester, students of the mathematics program are expected to complete an 8-week pedagogical internship at secondary schools or academic lyceums. This internship is designed to provide hands-on teaching experience and to strengthen the students' practical skills in mathematics education. |
| **Internship/ study abroad:** | no |
| **Bachelor thesis:** | During the 7th and 8th semesters, final-year students of the 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"[1], 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. |

[1] https://lex.uz/uz/docs/3916793

CONTENT

# Curriculum BD-60540100 “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 | Modern history of Uzbekistan | **120** | **60** | 30 | | | 30 | 60 | 4 | 4 |
| 1.04 | XJTB104 | Foreign language | **120** | **60** | | 60 | | | 60 | 4 | 4 |
| 1.07 | ANGB112 | Analytical geometry 1 | **180** | **60** | 30 | 30 | | | 120 | 4 | 6 |
| 1.08 | DASB108 | Fundamentals of programming 1 | **120** | **60** | 30 | 30 | | | 60 | 4 | 4 |
| 1.09 | ALGB118 | Algebra 1 | **180** | **60** | 30 | 30 | | | 120 | 4 | 6 |
| 1.10 | MANB122 | Mathematical analysis 1 | **180** | **90** | 54 | 36 | | | 90 | 6 | 6 |
| | | **Total per semester** | **900** | **390** | **174** | **186** | | **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 | | | |
| 1.02 | FALB104 | Philosophy | **120** | 60 | 30 | | | 30 | 60 | 4 | 4 |
| 1.03 | URTB104 | Uzbek (Russian) language | **120** | 60 | | 60 | | | 60 | 4 | 4 |
| 1.07 | ANGB112 | Analytical geometry 2 | **150** | 60 | **30** | **30** | | | **90** | **4** | **5** |
| 1.07 | ANGB112 | Analytical geometry 2 (Course paper) | **30** | | | | | | **30** | | **1** |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1.08 | DASB108 | Fundamentals of programming 2 | **120** | **60** | **30** | **30** | | | **60** | **4** | **4** |
| 1.09 | ALGB118 | Algebra 2 | **180** | **60** | **30** | **30** | | | **120** | **4** | **6** |
| 1.10 | MANB122 | Mathematical analysis 2 | **180** | **90** | **36** | **54** | | | **90** | **6** | **6** |
| | | **Total per semester** | **900** | **390** | **156** | **204** | | **30** | **510** | **26** | **30** |
| **Total Academic Load per Year** | | | **1800** | **780** | **330** | **390** | | **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 | | | |
| 1.09 | ALGB118 | Algebra 3 | **180** | **60** | 30 | 30 | | | 120 | 4 | 6 |
| 1.10 | MANB122 | Mathematical analysis 3 | **180** | **90** | 40 | 50 | | | 90 | 6 | 6 |
| 1.11 | UFZB204 | General physics | **120** | **60** | 20 | 20 | 20 | | 60 | 4 | 4 |
| 1.12 | DFGB204 | Differential geometry | **120** | **60** | 30 | 30 | | | 60 | 4 | 4 |
| 1.13 | DMMB206 | Discrete mathematics and mathematical logic | **180** | **60** | 30 | 30 | | | 120 | 4 | 6 |
| 1.14 | DFTB208 | Differential equations 1 | **120** | **60** | 30 | 30 | | | 60 | 4 | 4 |
| **Total per semester** | | | **900** | **390** | **180** | **190** | **20** | | **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) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | In-class sessions (hours) | | | | | | | |
| | | | **Total workload** | **Total** | **Lectures** | **Problem-solving sessions** | **Laboratory work** | **Seminars** | **Independent study** | | |
| 1.05 | DINB104 | Religious studies | **120** | **60** | 30 | | | 30 | 60 | 4 | 4 |
| 1.10 | MANB122 | Mathematical analysis 4 | **90** | **60** | 36 | 24 | | | 30 | 4 | 3 |
| 1.10 | MANB122 | Mathematical analysis (Course paper) | **30** | | | | | | 30 | | 1 |
| 1.14 | DFTB208 | Differential equations 2 | **120** | **60** | 30 | 30 | | | 60 | 4 | 4 |
| 1.15 | NZMB204 | Theoretical mechanics | **120** | **60** | 30 | 30 | | | 60 | 4 | 4 |
| 1.16 | EHNB204 | Probability theory | **120** | **60** | 30 | 30 | | | 60 | 4 | 4 |
| *2.01* | | *Elective subject 1* | ***180*** | ***90*** | *44* | *46* | | | *90* | *6* | *6* |
| | TPD2061 | Topology and selected topics of differential geometry | | | | | | | | | |
| | MMAB204 | Professional internship 1 | **120** | | | | | | 120 | | 4 |
| | | **Total per semester** | **900** | **390** | **200** | **160** | | **30** | **510** | **26** | **30** |
| | | **Total Academic Load per Year** | **1800** | **780** | **380** | **350** | **20** | **30** | **1020** | **52** | **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 | MSTB304 | Mathematical statistics | **90** | **60** | 30 | 30 | | | 30 | | 4 | 3 |
| 1.17 | MSTB304 | Mathematical statistics (Course paper) | **30** | | | | | | 30 | | | 1 |
| 1.18 | MFTB308 | Equations of mathematical physics 1 | **120** | **60** | 30 | 30 | | | 60 | | 4 | 4 |
| 1.19 | KUFB310 | Theory of functions of a complex variable 1 | **180** | **60** | 30 | 30 | | | 120 | | 4 | 6 |
| *2.02* | | *Elective subject 2* | ***120*** | ***60*** | *30* | *30* | | | *60* | | *4* | *4* |
| | SMMB3041 | Models in insurance and financial mathematics | | | | | | | | | | |
| | ASTB3041 | Applied statistics | | | | | | | | | | |
| *2.03* | | *Elective subject 3* | ***120*** | ***60*** | *30* | *30* | | | *60* | | *4* | *4* |
| | TMMB3041 | Continuum mechanics | | | | | | | | | | |
| | DQJB3041 | Mechanics of deformable solids | | | | | | | | | | |
| *2.04* | | *Elective Subject 4* | ***120*** | ***30*** | *16* | *14* | | | *90* | | *2* | *4* |
| | DTPB3041 | Differential topology 1 | | | | | | | | | | |
| | PRGB3041 | Projective geometry 1 | | | | | | | | | | |
| | | **Total per semester** | **900** | **390** | **196** | **164** | | **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 |
| 1.18 | MFTB308 | Equations of mathematical physics 2 | **90** | **60** | 30 | 30 | | | 30 | 4 | 3 |
| 1.18 | MFTB300 | Equations of mathematical physics (Course paper) | **30** | | | | | | 30 | | 1 |
| 1.19 | KUFB310 | Theory of functions of a complex variable 2 | **120** | **60** | 30 | 30 | | | 60 | 4 | 4 |
| 1.20 | FANB310 | Functional analysis 1 | **120** | **60** | 30 | 30 | | | 60 | 4 | 4 |
| *2.04* | | *Elective Subject 4* | ***60*** | ***30*** | *14* | *16* | | | *30* | *2* | *2* |
| | DTPB3041 | Differential topology 2 | | | | | | | | | |
| | PRGB3041 | Projective geometry 2 | | | | | | | | | |
| *2.05* | | *Elective Subject 5* | ***120*** | ***60*** | *30* | *30* | | | *60* | *4* | *4* |
| | YFGB3041 | Age physiology and hygiene | | | | | | | | | |
| | HFXB304 | Life safety | | | | | | | | | |
| *2.06* | | *Elective Subject 6* | ***120*** | ***60*** | *30* | *30* | | | *60* | *4* | *4* |
| | UNB3041 | Measure theory | | | | | | | | | |
| | SNB3041 | Number theory | | | | | | | | | |
| | MMAB304 | Professional internship 2 | **120** | | | | | | 120 | | 4 |
| | | **Total in the semester** | **900** | **390** | **194** | **166** | | **30** | **510** | **26** | **30** |
| | | **Total in the academic year** | **1800** | **780** | **390** | **330** | | **60** | **1020** | **52** | **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** | | | | |
| 1.20 | FANB310 | Functional analysis 2 | **180** | **60** | 30 | 30 | | | 120 | | 4 | 6 |
| 1.21 | MUMB404 | Methods of teaching mathematics | **120** | **60** | 30 | | | 30 | 60 | | 4 | 4 |
| 1.22 | VHOB404 | Variational calculus and optimization methods | **120** | **60** | 30 | 30 | | | 60 | | 4 | 4 |
| 1.23 | HUSB404 | Computational methods | **120** | **60** | 30 | 30 | | | 60 | | 4 | 4 |
| *2.07* | | *Elective subject 7* | ***180*** | ***90*** | *46* | *44* | | | *90* | | *6* | *6* |
| | AQBB4041 | Advanced topics in analysis | | | | | | | | | | |
| | KAQB4041 | Advanced topics in complex analysis | | | | | | | | | | |
| *2.08* | | *Elective Subject 8* | ***180*** | ***60*** | *30* | *30* | | | *120* | | *4* | *6* |
| | MGQB4041 | Additional chapters of mathematical physics | | | | | | | | | | |
| | INTB4041 | Integral equations | | | | | | | | | | |
| | | **Total in the semester** | **900** | **390** | **196** | **164** | | **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) | | | | | Independent study | | |
| | | | | Total | Lectures | Problem-solving sessions | Laboratory work | Seminars | | | |
| | MMAB407 | Professional internship | **210** | | | | | | 210 | | 7 |
| | MMAB408 | Pedagogical internship | **240** | | | | | | 240 | | 8 |
| | YDAB415 | Final State Attestation (Including bachelor thesis) | **450** | | | | | | 450 | | 15 |
| | | **Total per semester** | **900** | | | | | | **900** | | **30** |
| **Total Academic Load per Year** | | | **1800** | **390** | **196** | **164** | | **30** | **1410** | | **60** |
| **Total** | | | **7200** | **2730** | **1296** | **1234** | **20** | **180** | **4470** | | **240** |

## UYTB104 Modern history of Uzbekistan

| | | | | |
|---|---|---|---|---|
| **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 Karakalpakistan 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 facts[1];
- 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 view[2];
- 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 independence[3].

[1]Knowledge; [2]Skill; [3]Competence.

**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. O‘zbekistonning eng yangi tarixi. R.H.Murtazayeva, A.A.Yermetov, A.A.Odilov va boshq. - Toshkent, 2024.
3. O‘zbekiston tarixi. A.S.Sagdullayev umumiy tahriri ositida. 1-jild. Darslik. – Toshkent: NIF MSH. 2024.
4. B.J.Eshov, A.A.Odilov. O‘zbekiston tarixi. 2-jild. Darslik. – Toshkent: NIF MSH, 2024.
5. К.Д.Саипова. Новейшая история Узбекистана (учебное пособие). –Ташкент: NIF MSH, 2024.

**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 |
| --- | --- | --- |
| 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; visualization aids for presentation; demonstration materials.

## XJTB104 Foreign language

| | | | |
|---|---|---|---|
| **Study semester** | **1** (full time) | **ECTS:** | **4** |

### Workload

| Contact time | | Self-study hours | |
|---|---|---|---|
| Practical course | 60 h | Preparation for contact time | 30 h |
| | | Literature review | 30 h |
| Sum | 60 h | Sum | 60 h |
| **Total workload** | **120 h** | | |

### 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[1];
- 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[2];
- 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[3].

[1]Knowledge; [2]Skill; [3]Competence.

## 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.

| 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; visualization aids for presentation; demonstration materials.

# ANGB112 Analytical geometry 1

| Study semester | 1 (full time) | ECTS: | 6 |
|---|---|---|---|

## Workload

| Contact Time | | Self-study | |
|---|---|---|---|
| Lectures | 30 h | Preparation for Contact Time | 80 h |
| Exercises | 30 h | Literature review | 40 h |
| Sum | 60 h | Sum | 120 h |
| **Total workload** | **180 h** | | |

## Lecturers

A.Y.Narmanov – Professor at the Department of "Geometry and topology",
A.M.Bayturaev – Associate Professor at the Department of "Geometry and topology".

## Teaching contents

An overview of analytical geometry. Subject and methods of analytical geometry. Vectors. Linear operations on vectors. Sets of linearly independent and dependent vectors and their properties. Conditions of collinearity and coplanarity of vectors. Basis. Coordinates of a vector relative to a given basis. Projection of a vector onto an axis. Scalar (dot) product of vectors. Operations with vectors given by coordinates. Magnitude and direction cosines of a vector. Left- and right-handed coordinate systems. Vector (cross) product of vectors. Mixed (triple scalar) product. Scalar, vector, and mixed products of vectors with given coordinates. Basic problems of analytical geometry. Transformation of Cartesian coordinate systems in the plane and in space. Polar, cylindrical, and spherical coordinate systems. Equations of a line in the plane. Various equations of a plane in space. Mutual positions of planes in space. Distance from a point to a plane. Equations of a line in space. Mutual positions of lines in space. Relative positions of a plane and a line. Distance from a point to a line in space and the distance between skew lines.

## Learning outcomes

To successfully complete this discipline, students:

- understand the concept of analytical geometry and types of problems solved in this subject, able to use geometric objects defined by first- and second-degree equations, understand algebraic functions and know how to work with them[1];
- be able to model processes using mathematical notation and structured systems, interpret mathematical symbols, capable of modeling processes using simple mathematical systems[2];
- analyze and construct models of specific economic processes, understand the properties of geometric objects such as lines and surfaces, generalize and apply concepts defined by algebraic functions[3].

[1]Knowledge; [2]Skill; [3]Competence.

## 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: 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 1.

## Reading list


1. Narmanov A.Y. Analitik geometriya. Toshkent, “Innovatsiya-Ziyo”, 154 bet, 2021-yil. Darslik.
2. Fayziyev Y.E., Buvayev Q.T., Qo‘chqorov E.I., Analitik geometriya va chiziqli algebra, “Turon-iqbol”, 112 bet, 2022-yil. Uslubiy qo‘llanma.
3. Sharipov A.S. Analitik geometriya. Toshkent, “Tilsim” nashriyoti, 304 bet, 2023 y. 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.

| 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.<br>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 tasks. | | |

**Teaching materials and media**

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

# DASB108 Fundamentals of programming 1

| Study semester: | 1 (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. Polatov – Professor at the Department of "Software Engineering and Artificial Intelligence",
U. Adambayev – Associate Professor at the Department of "Software Engineering and Artificial Intelligence",
A. Ikromov – Associate Professor at Department of “Software Engineering and Artificial Intelligence".

## Teaching contents

Introduction. Installing the C++ Programming Environment. Configuring and using the C++ Programming Environment. Studying Linear Algorithms in the C++ Environment. Branching Algorithms. Arrays and Related Algorithms. Methods. Classes and Objects. Dynamic Creation of Objects. Solving Mathematical Equations in the C++ Environment. Working with Arrays of Random Numbers. Solving Function Plotting Problems. Numerical Solution of Ordinary Differential Equations. Random Processes. Fourier Transform Using a computer.

## Learning outcomes

To successfully complete this discipline, students:

- Identify and explain the role of programming languages in physics and scientific research, outline the stages involved in the development of computer models and their relevance in scientific investigations, mastering the mathematical principles and software components of computing systems[1];
- Development of an algorithm for solving applied problems, explain modeling as a method of scientific inquiry and discuss its importance in physics, interpret the relationship between physical phenomena, their mathematical representations, and corresponding computer implementations, create applications using generalized programming paradigms, apply programming languages (C++) to develop simple models of physical processes, implement numerical methods and algorithms to solve physics-related problems in a programming environment, use software tools to visualize and analyze the results of computational modeling[2];
- Analyze the outcomes of numerical experiments to detect errors and evaluate model stability, modular analysis and the basics of modular programming, promotion of methods for developing efficient programs and software systems[3].

[1]Knowledge; [2]Skill; [3]Competence.

## 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:
Introductory knowledge of any programming language (C++, C#, or others), Basic understanding of computer science and information technologies.

## Reading list


1. Глушаков С.В., Коваль А.В. Язык программирования C++. Издательство АСТ, 2017 г. 728 с.
2. Мадрахимов Ш.Ф., Гайназаров С.М. С++ тилида дастурлаш асослари// Тошкент, ЎзМУ, 2009, 196 бет.
3. Polatov A.M. Algoritmlar va C++ tilida dasturlash asoslari. O‘quv qo’llanma // Toshkent, O‘zbekiston Milliy Universiteti, “Universitet” nashriyoti, 2017. - 100 bet.
4. Madraximov Sh.F., Ikramov A.M., Babajanov M.R. C++ tilida programmalash bo’yicha masalalar to‘plami. O‘quv qo‘llanma // Toshkent, O‘zbekiston Milliy Universiteti, “Universitet” nashriyoti, 2014. - 160 bet.


## 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 |
|---|---|---|
| Time of assessment | Weeks 13-14 | Weeks 19-20 |
| Form of assessment | Written work | Written and oral work |

Midterm Assessment: It is conducted after completing the sections related to lectures and problem solving, covering approximately half of the total course content. The material will be distributed across several variants, each containing 2 theoretical questions and 2 problems. Answers must be provided in written form. A student can receive a maximum of 5 points for each correct answer.

Final Assessment: Variants covering all topics studied conducted based on exam throughout the semester. Each student will receive a variant containing 2 theoretical questions and 2 problems. Answers are submitted in written form. A student can receive up to 5 points for each answer. The final grade is calculated as the arithmetic average of all points earned.

## Teaching materials and media

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

# ALGB118 Algebra 1

| Study semester | 1 (full time) | ECTS: | 6 |
| --- | --- | --- | --- |

## Workload

| Contact Time | | Self-study | |
| --- | --- | --- | --- |
| Lectures | 30 h | Preparation for Contact Time | 80 h |
| Exercises | 30 h | Literature review | 40 h |
| Sum | 60 h | Sum | 120 h |

**Total workload** **180 h**

## Lecturers

B.A.Omirov – Professor at the Department of "Algebra and Functional Analysis".

## Teaching contents

Methods for Solving Systems of Linear Algebraic Equations. Elementary transformations of systems of linear algebraic equations. Matrix algebra. Determinants of the second and third order and methods for computing them. Triangle and parallelogram methods. Arrangements and permutations. Determinants of the *n*-th order and their properties. Computation of determinants. Laplace's Theorem. Minors and algebraic complements and their properties. Methods for calculating determinants and additional properties of matrices. Proper and improper matrices. Methods for finding the inverse matrix. Properties of the inverse matrix. Solving systems of linear equations using Cramer's method. Solving systems using the inverse matrix method. Vector spaces. Linear dependence and independence. Dimension and basis. Subspaces. Sum and intersection of subspaces. Euclidean spaces. Orthonormal systems. The orthogonalization process. Unitary spaces. The Kronecker–Capelli Theorem. Matrix rank. The relationship between linear dependence, independence, and matrix rank. Homogeneous systems and methods for solving them. Fundamental system of solutions. Complex numbers and arithmetic operations with them. Trigonometric form of a complex number. De Moivre's formula. Extracting roots. Roots of unity and their properties. Euler's formulas. Polynomials and operations on them. Polynomial divisibility theory. Horner's scheme. Bezout's Theorem. Vieta's formulas. Root location of a polynomial. Greatest common divisor. Euclidean algorithm. Divisibility theory of integers. Division with remainder. Irreducible polynomials. The Fundamental Theorem of Algebra and its corollaries. Rational fractions and their decomposition into partial fractions. Root bounds. Descartes' Rule of Signs and Sturm's Theorem.

## Learning outcomes

To successfully complete this discipline, students:

- should understand elementary transformations of systems of linear algebraic equations, know matrix algebra, including the concept of proper and improper matrices, be familiar with determinants of the 2nd, 3rd, and *n*-th order and methods for calculating them (including Laplace's Theorem, minors, and algebraic complements), understand the theoretical foundations of vector spaces, subspaces, basis, dimension, and Euclidean/unitary spaces, know the fundamentals of complex numbers, including arithmetic operations, trigonometric form, De Moivre's formula, know polynomial theory, including divisibility, the Fundamental Theorem of Algebra, Vieta's and Bezout's theorems[1];
- should be able to solve systems of linear equations using various analytical methods (e.g., Gaussian elimination, Cramer's method, inverse matrix method), able to calculate determinants correctly using different methods, including Laplace expansion, able to apply matrix-based methods for solving linear systems and determining matrix rank, able to find inverse matrices and apply their properties, able to perform algebraic operations on complex numbers and extract roots using De Moivre's formula, able to manipulate polynomials, perform division with remainder, apply Horner's scheme, and factor using divisibility theorems[2];
- should demonstrate the ability to model and solve applied mathematical problems using systems of linear equations, capable of conducting independent analysis of algebraic structures such as vector spaces, subspaces, and polynomial equations, develop mathematical reasoning skills in analyzing the properties and structure of complex numbers and polynomials, competent in interpreting the relationship between linear dependence, matrix rank, and solution sets of linear systems[3].

[1]Knowledge; [2]Skill; [3]Competence.

## 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: 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 1.

## Reading list

1. Ayupov A.Sh., Omirov B.A., Xudoyberdiyev 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.

## 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 |
|---|---|---|
| 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 subjects and independent learning materials. Each version of the final assessment consists of 2 theoretical questions and 3 practical tasks.

## Teaching materials and media

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

# MANB122 Mathematical analysis 1

| | | | |
|---|---|---|---|
| **Study semester** | **1** (full time) | **ECTS:** | **6** |

## Workload

| Contact Time | | Self-study | |
|---|---|---|---|
| Lectures | 54 h | Preparation for Contact Time | 60 h |
| Exercises | 36 h | Literature review | 30 h |
| Sum | 90 h | Sum | 90 h |

**Total workload** **180 h**

## Lecturers

J.K.Tishabaev – Professor at the Department of "Mathematical Analysis".

## Teaching contents

Set. Operations on sets. Mapping and its types. Real numbers. Bounds of real number sets. Limit of a numerical sequence. Properties of convergent sequences. Monotonic sequences and their limits. Subsequences and fundamental sequences. Lower and upper limits of a sequence. Limit of a function. Properties of functions possessing a limit. Limits of monotonic functions. Existence of a function's limit. Cauchy criterion for functions. Comparison of functions. Continuity of a function. Local properties of continuous functions. Global properties of continuous functions. Uniform continuity. Cantor's theorem. Derivative of a function. Rules for computing derivatives. Differential of a function. Higher-order derivatives and differentials. Fundamental theorems of calculus. Consequences of fundamental theorems. Cauchy's mean value theorem. Taylor's formula. L'Hôpital's rule. Monotonicity of a function. Extrema of a function. Convexity and inflection points of a function. Asymptotes.

## Learning outcomes

To successfully complete this discipline, students:

- should understand the fundamental concepts of sets, set operations, and mappings, including their classification and basic properties, have knowledge of the real number system, including bounds, supremum and infimum and completeness properties, understand the definitions and properties of sequences, including convergence, divergence and limits, know the criteria for the existence of a limit of a function, including the Cauchy criterion, understand local and global properties of continuous functions and be familiar with the Cantor theorem, use the fundamental theorems of calculus and their consequences (including Cauchy's theorem)[1];
- should be able to compute derivatives using standard techniques and apply them to function analysis, apply Taylor's formula and L'Hôpital's rule to evaluate limits and approximate functions and to analyze the monotonicity, extrema, convexity, and inflection points of functions[2];
- should demonstrate the ability to apply theoretical knowledge to analyze the behavior of real function, able to solve mathematical problems involving limits, continuity, differentiation, and asymptotic behavior, to develop critical mathematical thinking and reasoning based on rigorous definitions and logical argumentation, be competent in interpreting relationships between function properties and their graphical and analytical behavior[3].

[1]Knowledge; [2]Skill; [3]Competence.

## 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: Proficiency in high-school level algebra: manipulating polynomials, rational expressions, linear/quadratic equations and inequalities. Firm command of real numbers: order relations, exponents, roots, absolute value. Competent with graphing and analyzing functions: domain, range, inverse, compositions. Strong understanding of trigonometry: trigonometric ratios, identities, graph behavior. basic ideas of sequences, limits, and continuity. Mathematical reasoning: pattern recognition, structured step‑by‑step solving, basic proof strategies. Ability to study independently using textbooks and online resources. Basic English and Russian proficiency for understanding mathematical terminology and literature, Pre-calculus / Elementary mathematics.

## Reading list

1. Tao T. Analysis 1, 2. Hindustan Book Agency, India, 2014. Darslik.
2. Alimov SH, O., Ashurov R.R. Matematik analiz 1,2,3 q.T. "Mumtoz so`z", 2018. 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.

| Type of assessment | Midterm | Final |
|---|---|---|
| Time of assessment | Weeks 9, 15 | Weeks 19-20 |
| Form of assessment | Written and oral examination | 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 3 practical tasks 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 tasks.

## Teaching materials and media

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

# FALB104 Philosophy

| Study semester | 2 (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 time[1];
- 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 perspectives[2];
- 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 progress[3].

[1]Knowledge; [2]Skill; [3]Competence.

## 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, Sultonova A. Falsafa. – Toshkent: TMU, 2019.
2. Madaeva Sh.Shermuhamedova N.va boshqalar. Falsafa-oʻquv qoʻllanma. 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 Academik 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.

| 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; visualization aids for presentation; demonstration materials.

# URTB104 Uzbek (Russian) language

| | | | |
|---|---|---|---|
| **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, 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 and to be able to construct a monologic statement in Russian on professional topics[1];
- 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].

[1]Knowledge; [2]Skill; [3]Competence.

## Teaching and learning methods

Practical classes, Independent work, 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 guruhlari 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.

| 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; visualization aids for presentation; demonstration materials.

# ANGB112 Analytical geometry 2

| Study semester | 2 (full time) | ECTS: | 6 |
|---|---|---|---|

## Workload

| Contact Time | | Self-study | |
|---|---|---|---|
| Lectures | 30 h | Preparation for Contact Time | 80 h |
| Exercises | 30 h | Literature review | 40 h |
| Sum | 60 h | Sum | 120 h |
| **Total workload** | **180 h** | | |

## Lecturers

A.S.Sharipov – Professor at the Department of "Geometry and topology",
J.O.Aslonov – Associate Professor at the Department of "Geometry and topology".

## Teaching contents

Second-order curves in the plane. The ellipse and its canonical equation. Canonical equations of the hyperbola and the parabola. Equations of the ellipse, hyperbola, and parabola in the polar coordinate system. Equations of tangents to the ellipse, parabola, and hyperbola. Optical properties of second-order curves. General equation of second-order curves. The center of a second-order curve. Central and non-central curves. Reduction of second-order curve equations (without a center) to canonical form. Intersection of a second-order curve with a line. Asymptotic, non-asymptotic, and special directions. Tangent to a second-order curve, conjugate directions, and diameters. Principal directions. Conic, cylindrical, and ruled (linear) surfaces. Canonical equations of the sphere, ellipsoid, hyperboloid, and paraboloid. Generating lines of the one-sheeted hyperboloid and the hyperbolic paraboloid. Second-order surfaces, their centers, tangent planes, and diametral planes.

## Learning outcomes

To successfully complete this discipline, students:

- understand the concept of analytical geometry and types of problems solved in this subject, able to use geometric objects defined by first- and second-degree equations, understand algebraic functions and know how to work with them[1];
- be able to model processes using mathematical notation and structured systems, able to interpret mathematical symbols, capable of modeling processes using simple mathematical systems[2];
- analyze and construct models of specific economic processes, understand the properties of geometric objects such as lines and surfaces, generalize and apply concepts defined by algebraic functions[3].

[1]Knowledge; [2]Skill; [3]Competence.

## 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: 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 1, analytical geometry 1.

## Reading list


1. Narmanov A.Y. Analitik geometriya. Toshkent, “Innovatsiya-Ziyo”, 154 bet, 2021-yil. Darslik.
2. Fayziyev Y.E., Buvayev Q.T., Qo‘chqorov E.I., Analitik geometriya va chiziqli algebra, “Turon-iqbol”, 112 bet, 2022-yil. Uslubiy qo‘llanma.
3. Sharipov A.S. Analitik geometriya. Toshkent, “Tilsim” nashriyoti, 304 bet, 2023 y. 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.

| 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.<br>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 tasks. | | |
| **Teaching materials and media** | | | |
| | Projector; white/black board; hand-outs; flipchart; visualization aids for presentation; demonstration materials. | | |

# DASB108 Fundamentals of programming 2

| 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

A. Polatov – Professor at the Department of "Software Engineering and Artificial Intelligence",
U. Adambayev – Associate Professor at the Department of "Software Engineering and Artificial Intelligence",
A. Ikromov – Associate Professor at Department of “Software Engineering and Artificial Intelligence".

## Teaching contents

One-dimensional static arrays. Multidimensional static arrays. Declaration and definition of functions. Recursive functions. Standard library functions. Working with pointers. Working with dynamic arrays. Working with functions that return arrays. Structures. Standard streams. Creating text files. Generating binary files. Text and binary files. Arrays and Related Algorithms. Methods. Fundamentals of Object-Oriented Programming (OOP). Solving Mathematical Equations in the C++ Environment. Working with Arrays of Random Numbers.

## Learning outcomes

To successfully complete this discipline, students:

- Understand information within the scope of applied problems, including its storage methods, processing and transmission techniques, the mathematical and software support of computing systems, and their applications in scientific fields, industry, and education, types and characteristics of software, principles of structured programming, program optimization and generalization, and the use of modular programming paradigms[1];
- Recognize the achievements of computer technologies and their application in the mathematical and software support of modern computing systems, as well as the traditions in the development of programming, develop algorithms for solving applied problems, construct mathematical (computer) models, and create appropriate software, apply structured and generalized programming paradigms to develop applications, use computational tools and software efficiently during programming and be able to evaluate developed applications[2];
- Demonstrate proficiency in high-level programming languages, software development, and programming technologies, promote methods for solving applied and computational mathematics problems, modular analysis, modular programming principles, and techniques for developing efficient programs and software complexes[3].

[1]Knowledge; [2]Skill; [3]Competence.

## 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:
Introductory knowledge of any programming language (C++, C#, or others), Basic understanding of computer science and information technologies.

## Reading list


1. Глушаков С.В., Коваль А.В. Язык программирования C++. Издательство АСТ, 2017 г. 728 с.
2. Мадрахимов Ш.Ф., Гайназаров С.М. C++ тилида дастурлаш асослари// Тошкент, ЎзМУ, 2009, 196 бет.
3. Polatov A.M. Algoritmlar va C++ tilida dasturlash asoslari. O’quv qo’llanma // Toshkent, O’zbekiston Milliy Universiteti, “Universitet” nashriyoti, 2017. - 100 bet.
4. Madraximov Sh.F., Ikramov A.M., Babajanov M.R. C++ tilida programmalash bo’yicha masalalar to’plami. O’quv qo’llanma // Toshkent, O’zbekiston Milliy Universiteti, “Universitet” nashriyoti, 2014. - 160 bet.

## 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 |
|---|---|---|
| Time of assessment | Weeks 28-29 | Weeks 36-37 |
| Form of assessment | Written work | Written and oral work |

Midterm Assessment: It is conducted after completing the sections related to lectures and problem solving, covering approximately half of the total course content. The material will be distributed across several variants, each containing 2 theoretical questions and 2 problems. Answers must be provided in written form. A student can receive a maximum of 5 points for each correct answer.

Final Assessment: Variants covering all topics studied conducted based on exam throughout the semester. Each student will receive a variant containing 2 theoretical questions and 2 problems. Answers are submitted in written form, followed by an oral defense of the answers. A student can receive up to 5 points for each answer. The final grade is calculated as the arithmetic average of all points earned.

## Teaching materials and media

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

# ALGB118 Algebra 2

| | | | |
|---|---|---|---|
| **Study semester** | **2** (full time) | **ECTS:** | **6** |

## Workload

| Contact Time | | Self-study | |
|---|---|---|---|
| Lectures | 30 h | Preparation for Contact Time | 80 h |
| Exercises | 30 h | Literature review | 40 h |
| Sum | 60 h | Sum | 120 h |
| **Total workload** | **180 h** | | |

## Lecturers

B.A.Omirov – Professor at the Department of "Algebra and Functional Analysis".

## Teaching contents

Vector spaces. Linear subspace. Sum and intersection of subspaces. Euclidean space. Cauchy–Bunyakovsky inequality. The orthogonalization process. Orthogonal complement and orthogonal projection. Linear, bilinear, and quadratic forms. Change of the matrix of a bilinear form under a change of basis. Methods for reducing a quadratic form to canonical form. Positive definite quadratic forms. Law of inertia. Complex Euclidean spaces. Quadratic forms in complex space and their canonical forms. Linear transformations and their matrices. Image and kernel of a linear transformation. Inverse transformation. Relation between matrices of a linear transformation in different bases. Invariant subspaces. Eigenvalues and eigenvectors. Adjoint transformation. Self-adjoint transformations and their canonical form. Unitary transformations, their eigenvalues and canonical form. Commutative permutations. Normal substitutions and their canonical form. Reduction of the matrix of a linear transformation to Jordan normal form.

## Learning outcomes

To successfully complete this discipline, students:

- should understand the structure and properties of vector spaces and linear subspaces, be familiar with the concepts of the sum and intersection of subspaces, understand the definitions and properties of linear, bilinear, and quadratic forms, be familiar with orthogonal complements, orthogonal projections, and the orthogonalization process, know the process of reducing quadratic forms (real and complex) to canonical form and the Law of Inertia, understand the concept of complex Euclidean spaces and quadratic forms in such spaces, know the theory of linear transformations, including their image, kernel, and inverse[1];
- should be able to apply orthogonalization methods to construct orthonormal systems, compute and analyze orthogonal projections and complements in Euclidean space, able to represent bilinear and quadratic forms as matrices and transform them under a change of basis, bring quadratic forms to canonical form using reduction techniques, determine whether a quadratic form is positive definite and apply the Law of Inertia, compute the image and kernel of a linear transformation and find its matrix in different bases, find eigenvalues and eigenvectors of linear transformations and apply them in solving problems, compute and interpret self-adjoint and unitary transformations and bring them to canonical form, bring matrices of linear transformations to Jordan normal form and interpret the result[2];
- should demonstrate the ability to use orthogonalization and projection techniques in applied and theoretical settings, capable of performing analysis of bilinear and quadratic forms in both real and complex vector spaces, apply the theory of linear transformations to model, analyze, and solve mathematical problems involving vector spaces, develop a solid understanding of the relationships between eigenvalues, eigenvectors, and canonical forms, synthesize knowledge of matrix transformations and coordinate changes in solving high-dimensional algebraic problems[3].

[1]Knowledge; [2]Skill; [3]Competence.

## 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: 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, Algebra 1.

## Reading list

1. Ayupov A.Sh., Omirov B.A., Xudoyberdiyev A.X. Chiziqli algebra, Toshkent, “Muxr-Press”, 392

| | |
|---|---|
| | bet, 2023-yil. Darslik.<br>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. |
| **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 |
|---|---|---|
| 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 3 practical tasks.

**Teaching materials and media**

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

# MANB122 Mathematical analysis 2

| | | | |
|---|---|---|---|
| **Study semester** | **2** (full time) | **ECTS:** | **6** |

## Workload

| Contact Time | | Self-study | |
|---|---|---|---|
| Lectures | 36 h | Preparation for Contact Time | 60 h |
| Exercises | 54 h | Literature review | 30 h |
| Sum | 90 h | Sum | 90 h |
| **Total workload** | **180 h** | | |

## Lecturer

J.K.Tishabaev – Professor at the Department of "Mathematical Analysis".

## Teaching contents

Concepts of the antiderivative and the indefinite integral. Techniques of integration. Integration of rational functions using partial fractions. Integration of general rational functions. Integration of certain irrational functions. Integration of trigonometric functions. Concept of the definite integral. Darboux sums. Criterion for Riemann integrability. Class of Riemann integrable functions. Properties of definite integrals. Definite integrals with variable limits and their evaluation. Area of a plane figure and its computation. Arc length and its computation. Applications of the definite integral. Improper integrals of the first and second kind. Improper integrals of non-negative functions. Absolutely and conditionally convergent improper integrals. Dirichlet's test. Improper integrals of unbounded functions. Cauchy principal value of an improper integral. The Euclidean space $\mathbb{R}^n$. Open and closed sets in $\mathbb{R}^n$. Sequences in $\mathbb{R}^n$ and their limits. Functions of several variables and their limits. Continuity of functions of several variables. Properties of continuous functions. Uniform continuity. Cantor's theorem.

## Learning outcomes

To successfully complete this discipline, students:

- should understand the concepts of antiderivatives and indefinite integrals, and the foundational principles of integral calculus, be familiar with various integration techniques, including substitution, integration by parts, trigonometric substitutions, and partial fractions, know how to integrate rational, irrational, and trigonometric functions using standard methods, understand the concept of the definite integral, including its formal definition through Darboux sums, know the conditions under which a function is Riemann integrable and be familiar with the class of Riemann integrable functions, be familiar with the theory and convergence criteria of improper integrals, including the comparison test, Dirichlet's test, and the notion of principal value, understand the structure of Euclidean space $\mathbb{R}^n$, including open and closed sets, understand the concept of functions of several variables, their limits, and continuity, to examine properties of multivariable continuous functions, including uniform continuity and the implications of Cantor's theorem[1];
- should be able to apply properties of definite integrals and compute definite integrals with constant or variable limits, calculate areas of plane regions and arc lengths using definite integrals, understand and apply definite integrals in solving applied mathematical problems, evaluate improper integrals and determine whether they converge absolutely or conditionally, analyze sequences in $\mathbb{R}^n$ and evaluate their convergence[2];
- should be able to apply theoretical knowledge to compute integrals and analyze real-valued functions of one and several variables, demonstrate skills in solving problems involving integration, limits, continuity, and convergence in single and multivariable contexts, develop the ability to reason mathematically, interpret results, and communicate conclusions using precise mathematical language, competent in linking graphical representations with analytical results and applying concepts to theoretical and practical problems[3].

[1]Knowledge; [2]Skill; [3]Competence.

## 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: Solid foundation in topics covered by the following prerequisite or parallel courses:

- Mathematical analysis 1:
  Understanding of sequences and their limits, convergence and divergence criteria, monotonic sequences, subsequences, the concepts of limit and continuity of functions of one variable, and

basic theorems related to continuous functions (e.g., Intermediate Value Theorem, Extreme Value Theorem). Familiarity with the concept and properties of the derivative, rules of differentiation, and elementary applications such as monotonicity, extrema, and convexity of functions.

- Algebra 1:
  Proficiency in operations with polynomials and rational expressions. Knowledge of the structure of number systems, properties of real and complex numbers. Understanding of linear and quadratic equations and inequalities. Familiarity with algebraic identities, factorization techniques, and the Fundamental Theorem of Algebra. Ability to work with elementary functions and their compositions.
  Analytic geometry 1:
- Understanding of coordinate systems, equations of lines and conic sections. Ability to analyze and graph geometric figures in the Cartesian plane. Knowledge of basic vector operations, dot product, and geometric interpretations. Familiarity with the geometric meaning of derivatives and tangents. Ability to compute distances, angles, and projections in $\mathbb{R}^2$ and $\mathbb{R}^3$ and should develop the ability to reason mathematically, interpret results, and communicate conclusions using precise mathematical language.

## Reading list


1. Tao T. Analysis 1, 2. Hindustan Book Agency, India, 2014. Darslik.
2. Alimov SH, O., Ashurov R.R.  Matematik analiz 1,2,3 q.T. “Mumtoz so`z”, 2018. 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.

| Type of assessment | Midterm | Final |
|---|---|---|
| Time of assessment | Weeks 28, 35 | Weeks 36-37 |
| Form of assessment | Written and oral examination | 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 3 practical tasks 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 tasks.

## Teaching materials and media

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

## ALGB118 Algebra 3

| Study semester | 3 (full time) | ECTS: | 6 |
|---|---|---|---|

### Workload

| Contact Time | | Self-study | |
|---|---|---|---|
| Lectures | 30 h | Preparation for Contact Time | 80 h |
| Exercises | 30 h | Literature review | 40 h |
| Sum | 60 h | Sum | 120 h |
| **Total workload** | **180 h** | | |

### Lecturers

F.N. Ibragimov – Associate Professor at the Department of "Algebra and Functional Analysis".

### Teaching contents

Relations. Binary relation. Semigroups. Monoids. Groups. Abelian group. Symmetric and alternating groups. Subgroups. Generating element. Cyclic groups. Subgroup of a cyclic group. Left and right cosets and their properties. Concepts of finite groups and indices. Lagrange's Theorem. Normal subgroup and its properties. Binary relation between cosets. Factor groups. Group homomorphisms. Kernel of a homomorphism. Basic concepts of epimorphisms, monomorphisms, and isomorphisms. Properties of homomorphisms and isomorphisms. Cayley's Theorem. Fundamental Homomorphism Theorem. First, second, and third isomorphism theorems. Automorphisms of a group and the group defined by them. Inner automorphisms and their properties. Group action on a set. Orbit. Stabilizer subgroups. Coincidence of orbit length with the index of the stabilizer subgroup. Rings and their types, integral domains, fields. Subrings and subfields, and related theorems. Residue rings. Characteristic of a ring and the associated theorem. Finite fields. Characteristic of a field. Right, left, and two-sided ideals of a ring. Factor rings. Primary, prime, and maximal ideals. Principal ideal ring. Ring homomorphisms and their properties. Concepts of epimorphisms, monomorphisms, and isomorphisms of rings and their properties. The Fundamental Theorem of Ring Homomorphisms. First, second, and third isomorphism theorems for rings. Boolean and regular rings and their characteristics. Relations between Boolean and regular rings.

### Learning outcomes

To successfully complete this discipline, students:

- should understand the basic concepts of relations and binary relations, know the definitions and properties of semigroups, monoids, and groups, including Abelian, symmetric, and alternating groups, be familiar with subgroups, cyclic groups, generating elements, and cosets (left and right), understand key group-theoretical theorems such as Lagrange's Theorem and the properties of normal subgroups, know the structure and properties of factor groups and the binary relation between cosets, understand group homomorphisms, their kernels, and the basic concepts of epimorphisms, monomorphisms, and isomorphisms, be familiar with Cayley's Theorem and the Fundamental Homomorphism Theorem, know the first, second, and third isomorphism theorems for groups, know the properties of ideals (left, right, two-sided) and the structure of factor rings, understand the classification of ideals (primary, prime, maximal) and principal ideal rings, understand ring homomorphisms and the Fundamental Theorem of Ring Homomorphisms, know the first, second, and third isomorphism theorems for rings[1];
- should be able to identify and verify algebraic structures such as groups, subgroups, rings, and fields, able to construct and analyze cosets and apply Lagrange's Theorem to determine subgroup properties and to determine whether a group is cyclic and find generators and to compute and analyze group homomorphisms, their kernels, and apply isomorphism theorems, able to describe and compute the orbit and stabilizer of a group action, and apply the orbit-stabilizer formula and to construct quotient (factor) groups and rings, able to classify ideals and verify whether an ideal is prime, maximal, or primary, able to perform calculations and verify properties in Boolean and regular rings, able to construct and analyze ring homomorphisms and apply related theorems[2];
- should demonstrate the ability to abstract and generalize mathematical structures from concrete examples, able to independently construct and analyze algebraic proofs using homomorphisms and isomorphism theorems, able to evaluate and classify algebraic systems (groups, rings, fields) based on their properties and structure, develop theoretical reasoning in analyzing relationships between elements, substructures (e.g., subgroups or ideals), and quotient structures, be capable of comparing and interpreting the roles of automorphisms, homomorphisms, and group/ring actions in abstract algebra[3].

[1]Knowledge; [2]Skill; [3]Competence.

### 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: 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, Algebra 1, Algebra 2.

## Reading list


1. Ayupov A.SH., Omirov B.A., Xudoyberdiyev A.X. Abstrakt algebra, Toshkent, “Fan”, 296 bet, 2022 y.


## 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 |
|---|---|---|
| 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 subjects and independent learning materials. Each version of the final assessment consists of 2 theoretical questions and 3 practical tasks.

## Teaching materials and media

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

# MANB122 Mathematical analysis 3

| | | | |
|---|---|---|---|
| **Study semester** | **3** (full time) | **ECTS:** | **6** |

## Workload

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

**Total workload** **180 h**

## Lecturers

J.K.Tishabaev – Professor at the Department of "Mathematical Analysis".

## Teaching contents

Partial derivatives of multivariable functions. Differentiability of functions of several variables. Differentiability of composite functions. Directional derivatives and the gradient. Higher-order partial derivatives and differentials. Taylor's formula for multivariable functions. Extrema of multivariable functions. Implicit functions. Constrained extrema and the method of Lagrange multipliers. Infinite numerical series and properties of convergent series. Series with positive terms and their convergence tests. Integral test, Raabe's test, and Gauss's test. General term series and convergence criteria: Leibniz's test, Dirichlet's test, and Abel's test. Properties of absolutely convergent series. Sequences and series of functions. Uniform convergence and the Cauchy criterion. Tests for uniform convergence: Weierstrass M-test, Dirichlet–Abel test, and Dini's test. Functional properties of uniformly convergent sequences and series: term-by-term limit, continuity of the sum function. Functional properties under term-by-term integration and differentiation. Power series and Abel's theorem. Radius of convergence of a power series and the Cauchy–Hadamard formula. Uniform convergence of power series. Second Abel's theorem. Properties of power series. Taylor series. Expansion of elementary functions into Taylor series.

## Learning outcomes

To successfully complete this discipline, students:

- should understand partial derivatives, total differentials, and differentiability of multivariable functions, know the gradient, directional derivatives, and the chain rule, understand Taylor's formula and criteria for extrema in several variables, be familiar with implicit functions and the method of Lagrange multipliers, understand convergence of numerical series and tests for convergence, know the definition and properties of function series and uniform convergence, be familiar with power series, radius of convergence, and Taylor expansions[1];
- should be able to compute partial derivatives, directional derivatives, and gradients, determine differentiability and compute total differentials of multivariable functions, find and classify local extrema of multivariable functions, including using Lagrange multipliers, analyze and determine convergence of numerical series using standard tests and to determine uniform convergence of function sequences and series using various criteria, perform term-by-term integration and differentiation when conditions are satisfied, work with power series: find their radius of convergence, expand functions into power series, and analyze convergence behavior[2];
- should be able to apply multivariable calculus to solve real-world problems involving optimization, rates of change, and approximation, demonstrate the ability to reason rigorously and systematically when analyzing convergence of series and properties of functional sequences, connect theoretical concepts with computational techniques and graphical behavior of multivariable and infinite series-based functions, develop mathematical maturity in handling abstract definitions and proofs related to convergence, continuity, and differentiability[3].

[1]Knowledge; [2]Skill; [3]Competence.

## 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: Familiarity with the concepts of antiderivatives and indefinite integrals. Understanding of basic integration techniques, including substitution, integration by parts, rational and trigonometric function integration, and partial fractions. Knowledge of definite integrals and their formal definition via Darboux sums. Ability to determine integrability conditions (Riemann criterion) and apply properties of definite integrals. Proficiency in evaluating definite integrals with variable limits and in applying them to compute areas and arc lengths.

Understanding of improper integrals, their convergence (absolute and conditional), and evaluation methods, including the comparison test, Dirichlet's test, and the concept of principal value.
Basic knowledge of Euclidean space $\mathbb{R}^n$, including open and closed sets, sequences and their limits in $\mathbb{R}^n$. Understanding of functions of several variables, their limits, and continuity. Familiarity with the properties of continuous functions in multivariable settings, including uniform continuity and Cantor's theorem, Mathematical analysis 1, Mathematical analysis 2.

## Reading list


1. Tao T. Analysis 1, 2. Hindustan Book Agency, India, 2014. Darslik.
2. Alimov SH, O., Ashurov R.R. Matematik analiz 1,2,3 q.T. “Mumtoz so`z”, 2018. 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.

| Type of assessment | Midterm | Final |
|---|---|---|
| Time of assessment | Weeks 9, 15 | Weeks 19-20 |
| Form of assessment | Written and oral examination | 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 2 theoretical questions and 3 practical tasks 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 tasks.

## Teaching materials and media

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

## UFZB204 General physics

| Study semester | 3 (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 fields, know the main physical laws such as Gauss's theorem, Coulomb's law, Ohm's law, Kirchhoff's rules, Faraday's law, and their applications, be familiar with the behavior of conductors, dielectrics, and semiconductors in electric and magnetic fields, understand the classical electron theory of conductivity and the nature of electrical current in metals, semiconductors, and vacuum, know about electromagnetic induction, electromagnetic waves, and energy transformations in electric and magnetic fields[1];
- 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 physics, apply theoretical laws (Ohm's law, Kirchhoff's rules, Gauss's theorem, etc.) to analyze and calculate parameters of electric and magnetic circuits, assemble electrical circuits in the laboratory and conduct measurements of voltage, current, and resistance, carry out calculations of work and power of electric current, resonance frequency, reactive power, and other related quantities, process experimental data, present results, and calculate absolute and relative errors[2];
- Should be able to analyze and explain mechanical and molecular physics phenomena based on fundamental physical laws, graphs, and data, analyze and explain electric and magnetic phenomena using fundamental physical laws, graphs, and data, demonstrate independence in conducting experiments, using measuring equipment, and applying research methods to solve practical problems, explain physical processes such as induction, current generation, resonance, and electromagnetic wave propagation, capable of synthesizing knowledge of electric and magnetic fields to solve both standard and non-standard problems in general physics[3].

[1]Knowledge; [2]Skill; [3]Competence.

### 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 Hallidey., 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.

| 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; visualization aids for presentation; demonstration materials.

# DFGB204 Differential geometry

| 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.Y.Narmanov – Professor at the Department of "Geometry and topology",
A.M.Bayturaev – Associate Professor at the Department of "Geometry and topology".

## Teaching contents

Vector functions and operations on them. Rules of differentiation for vector functions. Elementary, simple, and general smooth curves; methods of curve representation and parameterization. Simple and singular points of a curve. Definition and properties of the tangent to a curve. Equation of the normal plane to a curve. Equation of the osculating plane and its properties. Equations of the normal and binormal. Arc length of a curve and methods of computation. Rectifying curve. Natural parameter of a curve. Curvature of a curve and its calculation. Torsion of a curve and its calculation. Frenet formulas. Natural equations of a line. Concept of a curvilinear coordinate system. Arc length of a line in a curvilinear coordinate system. Concept of the Riemannian metric.
Elementary, simple, and general smooth surfaces; methods of surface representation and parameterization. Curves lying on a surface. Equations of the tangent plane and the normal to a surface. Basis of the tangent plane. Tangent vector and its coordinates. Transformation of tangent vector coordinates when changing basis. First fundamental form of a surface. Calculating the length of curves on a surface, and the angle between two curve lines. Second fundamental form of a surface. Meusnier’s theorem. Normal curvature of a surface. Principal curvatures and principal directions. Euler’s formula. Classification of surface points. Dupin's indicatrix. Gauss and Weingarten derivative formulas. Christoffel symbols. Relationship between the first and second fundamental forms. Bonnet’s theorem. Intrinsic geometry of surfaces. Geodesic curves. Semi-geodesic coordinate system. Parallel transport of vectors. Vector fields in Euclidean space. Line integrals of vector fields. Vector fields defined on surfaces and their integral curves. Covariant differential of a vector field and its properties. Parallel transport of a tangent vector.

## Learning outcomes

To successfully complete this discipline, students:

- know the methods of representing curves, surfaces, and curves on surfaces, know about principal curvatures and directions, understand and apply derivative theorems, gauss-bonnet theorem, and parallel vector transport[1];
- understand how to model processes using mathematical notation and structured systems, construct and analyze models with topological and/or geometric structure for specific economic and social processes; perform computations based on available models, apply the obtained results from theoretical or practical experiments in relevant branches of production or industry[2];
- analyze the application of results obtained from theoretical or practical experiments in the educational process, be knowledgeable about the methods of representing curves, surfaces, and curves on surfaces, generalize knowledge of principal curvatures and directions, Dupin’s indicatrix, and parallel transport of vectors on surfaces[3].

[1]Knowledge; [2]Skill; [3]Competence.

## 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: 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 1.

## Reading list

1. Narmanov A.Y. Differensial geometriya. T. Turon-Iqbol, 2016. 225 bet.

2. Narmanov A.Y., Sharipov A.S., Aslonov J.O. Differensial geometriya va topologiya kursidan masalalar to'plami, T.: Universitet, 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.

| 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 subjects and independent learning materials. Each version of the final assessment consists of 2 theoretical questions and 3 practical tasks.

## Teaching materials and media

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

# DMMB206 Discrete mathematics and mathematical logic

| | | | |
|---|---|---|---|
| **Study semester** | **3** (full time) | **ECTS:** | **6** |

**Workload**

| Contact Time | | Self-study | |
|---|---|---|---|
| Lectures | 30 h | Preparation for Contact Time | 80 h |
| Exercises | 30 h | Literature review | 40 h |
| Sum | 60 h | Sum | 120 h |
| **Total workload** | **180 h** | | |

**Lecturers**

N. Kasimov – Professor at the Department of “Information security”.

**Teaching contents**

Set, relation, function. Equivalence relations and partial order. Ordinals and cardinals. Cantor's theorem. Transfinite induction. Maximum principle. Boolean algebras. Filters, ultrafilters. Algebra of statements. Concept of a formula. Equivalent formulas and tautologies. Theorems about tautologies. Dual formulas. Normal forms. Full CNF and DNF. Boolean functions. Zhegalkin polynomial. Complete and closed classes of functions. Post's theorem. The propositional calculus. Deduction theorem. Lemma on compatible inductions. Completeness theorem. Predicate algebra and its formulas. Logical and proper axioms. Algebraic systems. Homomorphisms. Products. Filtered products. Łoś's theorem. Compactness theorem. Basics of combinatorics. Pigeonhole principle. Permutations and combinations. Recurrence relations. Input-output formula. Graphs, isomorphisms, types, connectivity. Eulerian and Hamiltonian graphs. Trees and their applications. Spanning trees. Concept of an algorithm. Computability. Turing machine. Primitive recursive functions. Partial recursive and recursive functions. Recursive and recursive enumerable sets. Non-recursive enumerable sets. Halting problem. Algorithmically unsolvable problems.

**Learning outcomes**

After successfully completing this module, students should be able to:

- have knowledge and understanding of set theory, relations, relational algebra, special binary relations, propositional algebra, formal axiomatic theory, propositional calculus[1];
- perform operations on sets and relations, construct truth tables, find normal forms, prove theorems, determine the completeness of Boolean function systems, perform operations on predicates, and solve combinatorial problems, have skills in applying combinatorics principles to practical problems, know graph coloring algorithms, use algorithms in trees, and apply methods of discrete mathematics and mathematical logic to practical tasks[2];
- be able to apply methods of discrete mathematics, approach practical problems logically, and use acquired knowledge of discrete mathematics, Turing machines, and primitive recursive functions, be knowledgeable about Boolean functions, Post’s theorem, predicate algebra, formulas and their implementations, predicate calculus, Turing machines, and primitive recursive functions[3].

[1]Knowledge; [2]Skill; [3]Competence.

**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: 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.

**Reading list**


1. N.Kh.Kasymov, R.N.Dadajanov, F.N.Ibragimov, Diskret matematika va matematik mantiq asoslari, Toshkent 2021. 135 bet.
2. N.Kh.Kasymov, R.N.Dadajanov, F.N.Ibragimov, Diskret matematika va matematik mantiq asoslari, Toshkent 2019. 115 bet.
3. E.Mendelson, Introduction to Mathematical Logic, Sixth Edition, 2017.
4. Игошин В.И. Математическая логика и теория алгоритмов. – М.: Академия, 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.

| Type of assessment | Midterm | Final |
|---|---|---|
| Time of assessment | Weeks 11-12 | Weeks 19-20 |
| Form of assessment | Written work | Written and oral work |

Midterm Assessment: It is conducted after completing the sections related to lectures and problem-solving covering approximately half of the total course content. The covered material will be divided into different variants, each containing 1 theoretical question and 3 problems. Answers will be submitted in written form. A student can receive a maximum of 5 points for each correct answer.

Final Assessment: It is conducted based on prepared variants covering all topics studied during the semester. Each student receives a variant consisting of 1 theoretical question and 3 problems related to the semester's topics. Answers are submitted in written form. After submitting the written response, the student answers the questions orally and can earn up to 5 points for each answer. The final grade is calculated as the arithmetic average of all scores.

## Teaching materials and media

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

# DFTB208 Differential equations 1

| | | | |
|---|---|---|---|
| **Study semester** | **3** (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

B. Islomov – Professor at the Department of "Differential equations and mathematical physics",
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

Basic concepts in the theory of ordinary differential equations. The field of directions on a plane and in space. Isocline. Integral curves. A vector field. The trajectory. Some physical and geometric problems are depicted using ordinary differential equations. Integrable types of first-order equations solved with respect to the derivative. Equations with separable variables and those resulting from them. Homogeneous and generalized homogeneous equations with respect to variables. Linear equations and the Bernoulli equation. The Jacobi equation. The Riccati equation. Equations in complete differentials and leading to them. The Cauchy problem for first-order equations. The theorem of existence and uniqueness. The method of successive approximations. Eulerian polylines. Special points. First-order equations that are not resolved with respect to the derivative. Equations of the first order of the nth degree. The general method is parameter introduction. The Lagrange and Clerault equations. Special solutions. The trajectory problem. Higher-order differential equations. Initial conditions. The theorem of existence and uniqueness. Types of n–th order equations that can be solved in quadratures. Intermediate integrals. Equations that allow lowering the order. Integration of homogeneous and generalized homogeneous higher-order equations with respect to variables. Higher-order linear differential equations. Linear homogeneous differential equations of the nth order. General properties of solutions. Linear independence of functions. The fundamental decision system. The Ostrogradsky-Liouville formula. Linear inhomogeneous equations. The method of variation of arbitrary constants. The Euler equation. Inhomogeneous linear differential equations with constant coefficients and their methods of finding partial solutions.

## Learning outcomes

To successfully complete this discipline, students:

- know the basic concepts: general and particular solution, order and degree of equation, initial conditions, integral curve, know the classification of differential equations by type, order, linearity, and the presence of variable coefficients, know analytical methods of solving: separation of variables, reduction to a homogeneous form, integrating factor, variation of an arbitrary constant, know formulas and rules for solving linear equations of the first and second order, as well as systems of linear equations with constant coefficients[1];
- understand the relationship between the type of equation and the method of solving it, understand the geometric and physical interpretation of solutions to differential equations, understand the features and behavior of solutions to equations with variable coefficients and equations that are not resolved with respect to the derivation, understand the role of differential equations in describing physical processes, apply various methods of solving equations and systems in practice, apply knowledge to derive equations of motion in physics problems, use methods of differential equations in solving problems from mechanics, electricity, vibrations, and heat transfer, able to solve first-order partial differential equations that arise in physics[2];
- analyze the structure and features of various types of equations and systems, identify symmetries and invariants in linear equations with constant coefficients, analyze the stability and behavior of solutions when the initial conditions or model parameters change, compare the effectiveness of different solution methods for different classes of equations, interpret mathematical solutions in the context of physical phenomena, develop stable skills in mathematical modeling of processes described by differential equations[3].

[1]Knowledge; [2]Skill; [3]Competence.

## 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: 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 1, Algebra 1, Analytical geometry 1.

## 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. Эльсгольц Л.Э. Диференциальные уравнения и вариационное исчисление. Классические учебники МГУ. 2024. 312 с.
6. Понтрягин Л.С. Обыкновенные дифференциальные уравнения. М., "Наука", 2023. 336 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.

| 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 2 practical tasks 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 tasks.

## Teaching materials and media

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

# DINB104 Religious studies

| 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 interactions[1];
- 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 arguments[2];
- 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 interaction[3].

[1]Knowledge; [2]Skill; [3]Competence.

## 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 |
|---|---|---|
| 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.

# MANB122 Mathematical analysis 4

| | | | |
|---|---|---|---|
| **Study semester** | **4** (full time) | **ECTS:** | **4** |

## Workload

| Contact Time | | Self-study | |
|---|---|---|---|
| Lectures | 36 h | Preparation for Contact Time | 20 h |
| Exercises | 24 h | Literature review | 10 h |
| Sum | 60 h | Sum | 30 h |
| **Total workload** | **90 h** | | |

## Lecturers

J.K.Tishabaev – Professor at the Department of "Mathematical Analysis".

## Teaching contents

Partial derivatives of multivariable functions. Differentiability of functions of several variables. Differentiability of composite functions. Directional derivatives and the gradient. Higher-order partial derivatives and differentials. Taylor's formula for multivariable functions. Extrema of multivariable functions. Implicit functions. Constrained extrema and the method of Lagrange multipliers. Infinite numerical series and properties of convergent series. Series with positive terms and their convergence tests. Integral test, Raabe's test, and Gauss's test. General term series and convergence criteria: Leibniz's test, Dirichlet's test, and Abel's test. Properties of absolutely convergent series. Sequences and series of functions. Uniform convergence and the Cauchy criterion. Tests for uniform convergence: Weierstrass M-test, Dirichlet–Abel test, and Dini's test. Functional properties of uniformly convergent sequences and series: term-by-term limit, continuity of the sum function. Functional properties under term-by-term integration and differentiation. Power series and Abel's theorem. Radius of convergence of a power series and the Cauchy–Hadamard formula. Uniform convergence of power series. Second Abel's theorem. Properties of power series. Taylor series. Expansion of elementary functions into Taylor series.

## Learning outcomes

To successfully complete this discipline, students:

- should understand the theory and convergence criteria of improper integrals, including parameter-dependent cases and principal value, know special improper integrals such as Dirichlet and Euler–Poisson integrals, and understand Euler integrals and should be familiar with coordinate transformations in multiple integrals, including spherical and cylindrical systems, know the definitions and properties of line integrals of the first and second kind, and be familiar with Green's theorem, understand the concept of Fourier series, periodic extensions, be familiar with the Riemann–Lebesgue theorem and the principle of localization in Fourier analysis[1];
- should be able to evaluate improper integrals, including parameter-dependent and conditionally convergent integrals, compute double and triple integrals, including those requiring change of variables and to apply multiple integrals to calculate area, volume, and other geometric quantities, evaluate line integrals and apply Green's theorem to solve vector field problems, expand functions into Fourier series and determine convergence properties, use kernel properties to analyze the convergence behavior of Fourier series, apply integration techniques and series expansions to solve applied problems[2];
- should be able to model real-world problems using improper or multiple integrals and analyze the results, demonstrate the ability to reason about integrability, convergence, and functional properties in both analytical and applied contexts, connect theoretical ideas with graphical interpretations and computational tools in the context of integration and series, develop mathematical maturity and independence in working with abstract integral concepts and infinite series[3].

[1]Knowledge; [2]Skill; [3]Competence.

## 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: Familiarity with the fundamental concepts of multivariable calculus, particularly partial derivatives, total differentials, and the differentiability of functions of several variables. Understanding of the gradient, directional derivatives, the chain rule for composite functions, and the computation and interpretation of higher-order partial derivatives. Awareness of Taylor's theorem for functions of several variables and the criteria for identifying local extrema, including

constrained optimization using the method of Lagrange multipliers.
Solid grasp of the theory of infinite numerical series, including convergence and divergence behavior. Proficiency in applying classical convergence tests such as the integral test, Raabe's test, Gauss's test, Leibniz's test, Dirichlet's test, and Abel's test.
Understanding of uniform convergence of sequences and series of functions, including the Cauchy criterion and major uniform convergence tests (Weierstrass M-test, Dirichlet–Abel test, and Dini's test). Familiarity with the functional implications of uniform convergence, including term-by-term limit operations, continuity, integration, and differentiation.
Basic knowledge of power series, their radius of convergence using the Cauchy–Hadamard formula, and convergence properties in light of Abel's theorems. Experience in expanding elementary functions into Taylor series and analyzing their convergence behavior.
Mathematical analysis 1, Mathematical analysis 2, Mathematical analysis 3.

## Reading list

1. Tao T. Analysis 1, 2. Hindustan Book Agency, India, 2014. Darslik.
2. Alimov SH, O., Ashurov R.R. Matematik analiz 1,2,3 q.T. "Mumtoz so`z", 2018. 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.

| Type of assessment | Midterm | Final |
|---|---|---|
| Time of assessment | Weeks 29, 35 | Weeks 40-41 |
| Form of assessment | Written and oral examination | 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 2 theoretical questions and 3 practical tasks 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 tasks.

## Teaching materials and media

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

# DFTB208 Differential equations 2

| 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**

B. Islomov – Professor at the Department of "Differential equations and mathematical physics",
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**

Systems of differential equations. Reduction of a system of differential equations to normal form. Existence and uniqueness theorem for a normal system of differential equations. Systems of linear differential equations. Properties of solutions to systems of linear homogeneous equations. Ostrogradskii-Liouville formula. Theorem on the general solution of a system of linear homogeneous equations. Systems of linear inhomogeneous differential equations. Existence and uniqueness theorem. A system of equations with linear constant coefficients, the right-hand side of which has a special form. A system of linear equations in the form of a matrix. Cauchy integral formula. Theorem on continuous dependence of solution on initial values and parameters. Theorem on differentiability of solutions with respect to initial value and parameter. Autonomous systems. Singular points of linear autonomous system. Concept of asymptotic stability of periodic motions. Differentiability of solution with respect to initial condition and parameter. First integrals of system of differential equations. Existence of system of first integrals. Stability theory. Lyapunov stability. Theorems on asymptotic stability. Lyapunov theorem on stability in first approximation. Boundary value problems for linear equations. Reduction to simple form of linear differential equations of second order. Boundary value problems. On existence and uniqueness of Green's function. Concept of eigenvalues and eigenfunctions. Integration of differential equations of second order using power series. Linear homogeneous partial differential equation of the first order. Linear inhomogeneous partial differential equation of the first order. System of two simultaneous equations of the first order. Pfaff equation. Complete, general and special integrals of a partial differential equation of the first order. Lagrange-Charpy method for finding a complete integral. Cauchy method for n independent variables. Characteristic and integral surfaces.

**Learning outcomes**

To successfully complete this discipline, students:

- know the basic concepts: general and particular solution, order and degree of the equation, initial conditions, integral curve, know the classification of differential equations by type, order, linearity, presence of variable coefficients, know analytical methods of solution: separation of variables, reduction to homogeneous form, integrating factor, variation of an arbitrary constant, know formulas and rules for solving linear equations of the first and second order, as well as systems of linear equations with constant coefficients[1];
- understand the relationship between the type of equation and the method of its solution, understand the geometric and physical interpretation of solutions of differential equations, apply various methods of solving equations and systems in practice, apply knowledge to deriving equations of motion in physical problems, use methods of differential equations when solving problems in mechanics, electricity, vibrations, heat transfer, solve first-order partial differential equations arising in physics[2];
- analyze the structure and features of various types of equations and systems, identify symmetries and invariants in linear equations with constant coefficients, analyze the stability and behavior of solutions when changing initial conditions or model parameters, compare the efficiency of various solution methods for different classes of equations, develop sustainable skills in mathematical modeling of processes described by differential equations[3].

[1]Knowledge; [2]Skill; [3]Competence.

**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: 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 1, Algebra 1, Analytic geometry 1.

## 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. Эльсгольц Л.Э. Диференциальные уравнения и вариационное исчисление. Классические учебники МГУ. 2024. 312 с.
6. Понтрягин Л.С. Обыкновенные дифференциальные уравнения. М., “Наука”, 2023. 336 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.

| 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 2 practical tasks 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 tasks.

## Teaching materials and media

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

## NZMB204 Theoretical mechanics

| 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.Kh.Zakirov – Associate Professor at the Department of "Mechanics and Mathematical Modeling", M.I.Ruzmatov – 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. Simple cases of rigid body motion. Parallel plane motion of a rigid body. Motion of a rigid body around a fixed point. Complex motion of a point. Dynamics: basic definitions. Point dynamics. Motion of a material point under the influence of a central force. Mechanical system. Moments of inertia of a rigid body. Basic dynamic quantities. Basic theorems of dynamics. Analytical statics: real and virtual displacements. Lagrange's equations of motion of the 2nd kind. Canonical equations. Variational principles of mechanics.

### Learning outcomes

To successfully complete this discipline, students:

- should know basic physical quantities and laws and axioms of mechanics, general theorems of dynamics and the basic principles of mechanics, the main types of equations of motion of mechanical systems, and how to determine the first integrals of the equations of motion of mechanical systems[1];
- should be able to use basic theorems of system dynamics to solve problems, determine the kinematic and dynamic characteristics of mechanical systems, how to formulate the equations of motion of a mechanical system and obtain their first integrals[2];
- should demonstrate the ability to perform mechanical analysis of the obtained results, support the methods of theoretical mechanics and use in solving inverse problems, be have the ability to apply theoretical knowledge to solve specific mechanical problems[3].

[1]Knowledge; [2]Skill; [3]Competence.

### 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: Ability to perform operations with vectors. Ability to perform calculations on differentiation and integration. Ability to think mathematically and find solutions to problematic tasks. Knowledge of Russian and English, ability to observe discipline and order, ability to use the necessary literature and Internet resources.
Mathematical analysis 1, Algebra 1, Analytical geometry 1, Differential equations 1.

### Reading list


1. Бухгольц Н.Н. Основной курс теоретической механики. Ч.1,2. Спб: Лань, 2021, 2023. – 448 с. – 336 с.
2. Rashidov T.R. va bosh. Nazariy mexanika. T.: VNESHINVESTPROM, 2020.
3. Мещерский И. В. Задачи по теоретической механике: учебное пособие для вузов. Санкт-Петербург : Лань, 2023. — 448 с. — ISBN 978-5-507-46953-6.


### 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 |
|---|---|---|
| Time of assessment | Weeks 30-31 | Weeks 35-36 |

| | | | |
|---|---|---|---|
| | 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 question and 2 practical tasks 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.<br>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 1 theoretical question and 2 practical tasks. | | |
| **Teaching materials and media** | | | |
| | Projector; white/black board; hand-outs; flipchart; visualization aids for presentation; demonstration materials. | | |

# EHNB204 Probability theory

| 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 |
| Sum | 60 h | Sum | 60 h |
| **Total workload** | **120 h** | | |

## Lecturers

O.Sh.Sharipov - Professor at Department of "Probability theory and mathematical statistics", A.S.Begmatov - Associate Professor at 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, Total probability formula and Bayes' theorem.
Sequences of independent experiments. Bernoulli formula, Binomial distribution and its properties, local and integral limit theorems of Moivre–Laplace, Poisson's theorem and their applications.
Random variable and its distribution, Properties of the distribution function, Discrete and continuous random variables, Random vector and its distribution, Some important distributions: binomial distribution, Poisson distribution, geometric distribution, uniform distribution, exponential distribution, normal distribution. 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, Characteristic function and its properties, characteristic functions of some important distributions.
Types of convergence of sequences of random variables and distributions, Criteria for weak convergence, Chebyshev's inequality, Law of large numbers and its applications, Strong law of large numbers and its applications. Central limit theorem for sequences of independent and identically distributed random variables, Lindeberg's central limit theorem, Lyapunov's central limit theorem, Applications of the central limit theorem.

## Learning outcomes

To successfully complete this discipline, students:

- should have understand the fundamental concepts of probability theory, including sample space and probability axioms, describe and differentiate between discrete, classical, and geometric probability models, understand and state key probability theorems such as the law of total probability and Bayes' theorem, explain the concept of random variables, distribution functions, and common probability distributions (binomial, Poisson, normal, etc.), recognize different types of convergence of sequences of random variables and understand the statements of major limit theorems such as the Law of Large Numbers and Central Limit Theorem[1];
- should be able to apply axiomatic and combinatorial methods to compute probabilities in discrete and continuous settings, solve problems involving conditional probability and independence of events, solve problems involving sequences of independent experiments using Bernoulli trials and binomial distribution, apply limit theorems (De Moivre–Laplace, Poisson approximation) to approximate probabilities in complex problems, compute expectation, variance, higher-order moments, and correlation coefficients for discrete and continuous random variables, use convergence criteria and inequalities (e.g., Chebyshev's inequality) to analyze sequences of random variables, apply the Law of Large Numbers and Central Limit Theorems to practical problems in probability and statistics[2];
- should be able to develop rigorous probabilistic models for real-world random phenomena in fields such as engineering, computer science, finance, and natural sciences, critically analyze probabilistic arguments, communicate probability concepts and results effectively in written and oral forms, using proper mathematical notation, integrate foundational probability theory with statistical inference techniques in further studies or applied projects[3].

[1]Knowledge; [2]Skill; [3]Competence.

## 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 Algebra 1, Mathematical analysis 1, Differential equations 1),
Recommended: Prior completion of a course in Algebra 1, Mathematical analysis 1, Algebra 2, Mathematical analysis 2, Algebra 3, Analytical thinking and problem-solving skills.

**Reading list**

1. Sh.Q. Formanov, Ehtimolliklar nazariyasi, Toshkent, “Universitet”, 2014 y.
2. M.U. Gafurov, Y.M. Xusanboyev, M.M. Toshmatova. Ehtimolliklar nazariyasi va matematik statistika. Darslik, 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 |
|---|---|---|
| Time of assessment | Weeks 8-9 | Weeks 16-17 |
| Form of assessment | Written work | Written work |

Midterm Assessment: The midterm assessment (MA) 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 in written form based on the topics defined in the module 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.

# TPD2061 Topology and selected topics of differential geometry

| Study semester | 4 (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

R.B.Beshimov – Professor at the Department of "Geometry and topology",
S.S.Saitova – Associate Professor at the Department of "Geometry and topology".

## Teaching contents

Euclidean topology and spaces. Metric spaces. Metric topology. Topological spaces. Basic properties of open and closed subsets. Interior, boundary, and limit points in topological spaces. Methods of introducing topology: bases, closure operator, product topology. Induced topology, quotient topology, compact-open topology. Separation axioms (Kolmogorov, Hausdorff, regular, normal spaces). Urysohn's lemma. Continuous maps. Theorems on continuity. Connected and path-connected spaces. Compactness and compactifications. Homeomorphisms. Stereographic projection. Homotopy, homotopy classes, topological groups. Local coordinates. Smooth manifolds and maps. Tangent vectors, tangent spaces. Immersions, submersions, diffeomorphisms. Vector fields and integral curves. Lie bracket. Covariant differentiation. Christoffel symbols. Levi-Civita connection. Differentiation along a path. Parallel vector fields and transport. Geodesics, exponential maps. Curvature tensor. Sectional, Ricci, scalar curvature. Local isometries. Riemannian submersion. O'Neill's formula.

## Learning outcomes

To successfully complete this discipline, students:

- understand topological and metric spaces, methods of introducing topologies, factor topologies and spaces, topological manifolds, local coordinate systems, elements of riemannian geometry, compute homotopy classes of spaces, geometric characteristics of riemannian manifolds[1];
- determine connected components of topological spaces, jacobians, ranks of differentiable manifolds, integral curves, covariant derivatives of vector fields, apply theorems on separability, parallel transport, and exponential maps, model processes using mathematical notations and systems with mathematical structures, construct and analyze models with topological or geometric structures for certain socio-economic processes, perform computations based on these models[2];
- apply obtained data from practical or theoretical experiments in industrial or production methodologies, use data in educational processes[3].

[1]Knowledge; [2]Skill; [3]Competence.

## 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: 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 1.

## Reading list


1. Садовничий Ю.В., Бешимов Р.Б., Жураев Т.Ф., Топология. Учебное пособие. -Т.: "Университет", 2021. -200 стр.
2. Федорчук В.В., Введение в топологию: Учебное пособие. М.: Издательство Московского университета, 2014. 144 стр.
3. J.M.Lee Introduction to Riemannian Manifolds, Department of Math, University of Washington, seattle, WA. USA, 2018.
4. Сборник задач по дифференциальной геометрии и топологии, Мищенко А.С., Соловьев Ю.П., Фоменко А.Т., 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.

| 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 subjects and independent learning materials. Each version of the final assessment consists of 2 theoretical questions and 3 practical tasks.

## Teaching materials and media

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

| MMAB204, MMAB304, MMAB407, MMAB408 | **Professional and Pedagogical internship** |
|---|---|

| | | | |
|---|---|---|---|
| **Study semesters** | **4** (full time) | **ECTS:** | **4** |
| | **6** (full time) | | **4** |
| | **8** (full time) | | **7** |
| | **8** (full time) | | **8** |

**Workload**

| Contact Time | | Independent work | |
|---|---|---|---|
| | | Preparation for Professional Internship for fourth, sixth and eighth semesters | 450 h |
| | | Preparation for Pedagogical Internship for eighth semester | 240 h |
| | | Sum | 690 h |

| | |
|---|---|
| **Total workload:** | **690 h** |

**Lecturers**

Associate Prof. Narzillaev Nurbek

**Teaching contents**

Developing students' skills and competencies in applying mathematical knowledge to solve theoretical and practical problems across major branches of mathematics. The internship covers the following subject areas: Algebra, Analytic Geometry, Mathematical Analysis, Differential Geometry and Topology, Probability Theory, and Differential Equations. Students review relevant theoretical concepts, study academic literature, and perform independent and guided tasks aimed at deepening their understanding of fundamental mathematical ideas and methods. The internship emphasizes problem-solving, mathematical modeling, analytical reasoning, and result interpretation.

*Algebra:* Studying algebraic structures such as groups, rings, and fields, and exploring their properties through examples and proofs. Applying concepts of linear algebra, including vector spaces, subspaces, linear independence, basis, and dimension. Performing operations with matrices and determinants, solving systems of linear equations, and using eigenvalues and eigenvectors to analyze linear transformations. Developing computational and theoretical understanding of algebraic and linear systems as foundations for advanced mathematics and applied modeling.

*Analytic Geometry:* Constructing and interpreting equations of lines, planes, conic sections, and surfaces; analyzing geometric figures in coordinate systems; solving geometric problems using analytic methods and graphical representations.

*Mathematical Analysis:* Applying the concepts of limits, derivatives, and integrals to practical problems; investigating function behavior, extrema, and curvature; working with sequences, series, and functional relationships.

*Differential Geometry and Topology:*
Studying curves and surfaces, their curvature, and geodesic properties; exploring the topological properties of geometric objects; understanding the connection between geometry and topology in mathematical modeling.

*Probability Theory:*
Developing probabilistic models for real-world phenomena; calculating probabilities and expectations for random variables; studying probability distributions and elements of mathematical statistics.

*Differential Equations:*
Solving ordinary and partial differential equations analytically and numerically; modeling physical, biological, or economic processes using differential equations; performing qualitative analysis of solutions.

Throughout the internship, students record their results accurately, evaluate errors, and discuss the efficiency of applied mathematical methods. Each completed topic is reviewed and discussed under the supervision of the instructor, followed by an assessment (test, report, or presentation). All outcomes of the internship are summarized in a written report.

## Learning outcomes

To successfully complete this discipline, students:

- Demonstrate a solid understanding of fundamental mathematical disciplines, including *algebra, linear algebra, analytic geometry, mathematical analysis, differential geometry and topology, probability theory,* and *differential equations*[1].
- Apply theoretical concepts to solve a wide range of mathematical and applied problems using analytical, numerical, and graphical methods[2].
- Analyze algebraic and linear structures such as groups, rings, fields, matrices, vector spaces, and linear transformations, and use them in modeling and computation[1,2].
- Construct and interpret equations and geometric representations of lines, planes, conic sections, and surfaces in coordinate systems[2]
- Utilize the main tools of mathematical analysis-limits, derivatives, integrals, sequences, and series-to investigate the behavior of functions and to model continuous processes[1,2].
- Understand and apply concepts of curvature, continuity, connectedness, and compactness in differential geometry and topology[1].
- Develop and interpret probabilistic and statistical models, calculate probabilities and expected values, and analyze random phenomena[1,2].
- Formulate, solve, and interpret ordinary and partial differential equations in connection with physical, biological, and engineering applications[2].
- Integrate mathematical theory with practice through computation, experimentation, and modeling activities[2,3].
- Critically evaluate results, identify potential errors or limitations, and suggest improvements in applied methods[3].
- Communicate mathematical reasoning clearly and effectively through written reports, presentations, and discussions[3].
- Work independently and collaboratively, demonstrating responsibility, analytical thinking, and a commitment to continuous learning and professional development[3].

[1] Knowledge; [2] Skills; [3] Abilities.

## Teaching and learning methods

Self-study; Group work

## Entrance requirements

Students admitted to this internship must be second-year undergraduate students majoring in Mathematics or related disciplines. They should have successfully completed the core mathematical courses of the first and second semesters and possess sufficient theoretical knowledge and practical skills in basic mathematical concepts.

## Reading list


1. Tao T. Analysis 1, 2. Hindust n Book Ageocy, India, 2014.
2. Xudayberganov G., vorisov A. L, Mansuov x. T., Shoimqulov B. A. Matcmatik analizdan ma'ruzalar, I, II q. T. "Voris-nashriyot", 2010.
3. Alimov SH, O., Ashurov R.R. Matematik analiz 1,2,3 q.T. “Mumtoz so`z”, 2018. Darslik.
4. Ayupov A.Sh., Omirov B.A., Xudoyberdiyev A.X. Chiziqli algebra, Toshkent, «Muxr-Press», 392 bet, 2023-yil. Darslik.
5. 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.
6. Narmanov A.Y. Analitik geometriya. Toshkent, “Innovatsiya-Ziyo”, 154 bet, 2021-yil. Darslik.
7. Fayziyev Y.E., Buvayev Q.T., Qo‘chqorov E.I., Analitik geometriya va chiziqli algebra, “Turon-iqbol”, 112 bet, 2022-yil. Uslubiy qo‘llanma.
8. Sharipov A.S. Analitik geometriya. Toshkent, “Tilsim” nashriyoti, 304 bet, 2023 y. Darslik.
9. Narmanov A.Y. Differensial geometriya. T. Turon-Iqbol, 2016. 225 bet.
10. Narmanov A.Y., Sharipov A.S., Aslonov J.O. Differensial geometriya va topologiya kursidan masalalar to’plami, T.: Universitet, 2014.
11. Степанов В.В. Курс дифференциальных уравнений: Учебник. Изд. 11-е, исправ. М.: Издательство ЛЕНАНД, 2024. 512 с.
12. Арнольд В.И. Обыкновенные дифференциальные уравнения. 2-е изд. М. МЦНМО, 2018.-344 с.
13. Abdulla A’zam. Differensial tenglamalar. Oliy o‘quv yurtlari uchun darslik. Toshkent. “Turon-iqbol” nashriyoti. 2024. 408 b.
14. Филиппов А.Ф. Сборник задач по дифференциальным уравнениям. Учебное пособие. Изд. М.: ЛЕНАНД. 2024. 240 с.
15. Эльсгольц Л.Э. Диференциальные уравнения и вариационное исчисление. Классические учебники МГУ. 2024. 312 с.
16. Понтрягин Л.С. Обыкновенные дифференциальные уравнения. М., “Наука”, 2023. 336 с.
17. Sh.Q. Formanov, Ehtimolliklar nazariyasi, Toshkent, “Universitet”, 2014 y.

18. M.U. Gafurov, Y.M. Xusanboyev, M.M. Toshmatova. Ehtimolliklar nazariyasi va matematik statistika. Darslik, 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 |
|---|---|---|
| Time of assessment | | Weeks 39-40 |
| Form of assessment | | Written report and oral exam |

**Final Assessment:** To successfully complete the orientation internship, students are required to submit a written report and provide oral answers to the supervisor's control questions.

## Teaching materials and media

For the effective implementation of the internship, the following educational materials and media tools will be used:

- Whiteboard and/or blackboard for explanations and discussions;
- Printed handouts and instructional materials for individual and group activities;
- Measuring instruments and equipment for experimental and practical tasks;
- Demonstration equipment and materials for illustrating mathematical and physical concepts;
- Standard textbooks, lecture notes, and reference literature related to the course topics;
- Computer and multimedia resources for modeling, visualization, and report preparation.

## UPPB308 General pedagogy. Psychology 1

| 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 institutions[1];
- 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 environment[2];
- 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 education[3].

[1]Knowledge; [2]Skill; [3]Competence.

### Teaching and learning methods

Lecture; Seminars; Self-study; Group work.

### Entrance requirements

Mandatory: None
Recommended: None.

### Reading list


1. Axrarova Z., Sodikov U., Allayarova S., Sadikova Sh., Shodmonov Sh. –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.

| 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; visualization aids for presentation; demonstration materials.

# MSTB304 Mathematical statistics

| | |
|---|---|
| **Study semester** | **5** (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.Sh.Sharipov - Professor at Department of "Probability theory and mathematical statistics", A.S.Begmatov - Associate Professor at Department of " Probability theory and mathematical statistics".

## Teaching contents

Population and sample sets, Polygon and histogram, Empirical distribution function and its properties, Sample mean and variance, Statistical estimation and its properties, Fisher information, Rao-Cramer inequality, Exponential family, Efficient estimators for the exponential family, Point estimators and methods for constructing estimators: method of moments, method of substitution, Maximum likelihood estimation, Bayes estimation method, minimax estimation; Distributions related to the normal distribution: chi-square, Student's T and Fisher distributions, Confidence interval method for estimating unknown parameters, Constructing confidence intervals, Statistical hypotheses and their types, Principles for selecting criteria to test statistical hypotheses, Parametric criteria, Goodness-of-fit criteria, Nonparametric criteria for testing the homogeneity of samples.

## Learning outcomes

To successfully complete this discipline, students:

- should have understand the concepts of population and sample sets, polygons, histograms, and their construction, the empirical distribution function and its properties, know definitions and properties of sample mean and variance, understand the basic concept of statistical estimation and its key properties (unbiasedness, consistency, efficiency), explain Fisher information and the Rao-Cramer inequality, define the exponential family of distributions and the idea of efficient estimators, understand the principles behind point estimators, including the method of moments and method of substitution, describe the ideas behind maximum likelihood estimation, Bayesian estimation, and minimax estimation, know the main distributions related to the normal distribution: chi-square, Student's t, and Fisher's F-distribution, understand the concepts of confidence intervals and parameter estimation, identify types of statistical hypotheses and common parametric, goodness-of-fit, and nonparametric tests, understand two-dimensional sampling, the least squares method, and the linear regression equation[1];
- should be able to construct frequency polygons and histograms from grouped data, calculate and interpret the empirical distribution function, compute sample mean, variance, and empirical indicators from raw data, apply the method of moments and substitution method to estimate parameters, Implement maximum likelihood estimation (MLE) and Bayesian estimation in typical problems, use confidence intervals to estimate unknown parameters, apply chi-square, Student's t, and F-distributions in hypothesis testing, formulate and test statistical hypotheses using appropriate parametric or nonparametric criteria, analyze homogeneity of samples using nonparametric tests, apply the least squares method to estimate parameters in simple linear regression models, derive and interpret the linear regression equation from bivariate data[2];
- should be able choose and justify appropriate estimation methods (MLE, Bayesian, minimax) based on the nature of the statistical problem, evaluate and compare the efficiency of different estimators, particularly within the exponential family, Interpret results from confidence intervals and hypothesis tests in practical research contexts, Design and conduct complete statistical analyses, including parameter estimation, hypothesis testing, and regression modeling, Adapt statistical criteria to complex or real-world datasets, balancing precision, reliability, and computational feasibility, Make informed decisions based on statistical inference, demonstrating responsibility in the interpretation of sampling and estimation results[3].

[1]Knowledge; [2]Skill; [3]Competence.

## 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: Algebra 1, Mathematical analysis 1, Algebra 2, Mathematical analysis 2, Algebra 3, Probability theory;
Recommended: Prior completion of a course in Advanced calculus, Introductory statistics, Differential equations 1**,** Analytical thinking and problem-solving skills.

**Reading list**

1. M.U. Gafurov, Y.M. Xusanboyev, M.M. Toshmatova. Ehtimolliklar nazariyasi va matematik statistika. Darslik, Toshkent, 2023.
2. Боровков А.А. Математическая статистика, Москва, “Лань”, 2010. -704 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.

| 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 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 in written form based on the topics defined in the module 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.

## MFTB308 Equations of mathematical physics 1

| Study semester | 5(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

B.Islomov – Professor at the Department of "Differential equations and mathematical physics", Sh.Kasimov – Professor at the Department of "Differential equations and mathematical physics", E.Kuchkorov – Associate professor at the Department of "Differential equations and mathematical physics".

### Teaching contents

Concepts of partial differential equations and their solutions. Concept of characteristic form and classification of second-order linear equations. Classification of higher-order equations. Systems of partial differential equations. Reduction to canonical form of second-order linear partial differential equations with two independent variables. Reduction to canonical form of second-order linear partial differential equations with many independent variables. Derivation of the main equations of mathematical physics: string oscillation equation; heat equation; stationary equations. Statement of the main problems for the equations of mathematical physics: Cauchy problem. Boundary value and mixed problem. The role of characteristics in the formulation of the Cauchy problem. Statement of problems (Goursat, Darboux, nonlocal) for two-dimensional second-order linear partial differential equations. Method of propagating waves. D'Alembert's formula for a homogeneous equation of string oscillations. D'Alembert's formula for an inhomogeneous equation of string oscillations. Stability of solutions. Semi-bounded line and continuation method. Problems for a bounded segment. Correctness of statements of problems in mathematical physics. Correct and incorrect problems. Hadamard example. Problem with data on characteristics. Eisgerson principle. Goursat and Darboux problem for the equation of string vibrations. Cauchy problem for three-dimensional wave equation. Kirchhoff formula. Huygens principle. Cauchy problem for two-dimensional wave equation. Descent method. Poisson formula. Energy inequality. Continuous dependence of solution. Uniqueness of solution.

General second-order linear equation of hyperbolic type with two independent variables. Conjugate differential operators. Green's formula. Riemann function. Riemann method. Fourier method. Application of Fourier method to hyperbolic and parabolic equations. First and third boundary value problem. Oscillations of rectangular membrane. Oscillations of circular membrane.

### Learning outcomes

To successfully complete this discipline, students:

- know the partial differential equation and its solutions, as well as their properties, classification of second-order differential equations: hyperbolic, parabolic, elliptic and their canonical forms, formulation of basic problems for equations of mathematical physics and the methods for solving equations of mathematical physics: the method of separation of variables, the Fourier method, the d'Alembert method, the Green's function method[1];
- understand the physical meaning of mathematical models describing wave, thermal and scattering processes and Eisgerson principle, the Riemann function, the Riemann method for a hyperbolic equation, able to formulate and solve problems of mathematical physics with given initial and boundary conditions, methods of mathematical analysis in constructing and solving models of physical processes and Fourier method to hyperbolic and parabolic equations, as well as use it to solve applied problems[2];
- master methods for constructing fundamental solutions and study the properties of solutions, the correctness of problem formulation, and the stability of solutions, able to generalize the methods of mathematical physics to new types of equations and complex physical models and critically evaluate the applicability of various analytical methods to specific problems of mathematical physics[3].

[1]Knowledge; [2]Skill; [3]Competence.

### 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: 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 1, Mathematical analysis 2, Mathematical analysis 3, General physics, Analytical geometry 1, Analytical geometry 2, Differential equations 1, Differential equations 2.

## Reading list


1. Zikirov O. S. Matmatik fizika tenglamalari. Toshkent. Fan va texnologiya. 2017. 320 b.
2. Salohiddinov M., Islomov B. Matmatik fizika tenglamalari fanidan masalalar to'plami. Toshkent. Universitet. 2017. 370 b.
3. Kasimov Sh.G. Matematik fizika tenglamalari. I tom. Toshkent. "Ma'rifat". 2024 y. 912 b.
4. Kasimov Sh.G. Matematik fizika tenglamalari. II tom. Toshkent. "Ma'rifat". 2025 y. 928 b.
5. 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.

| 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 subjects and independent learning materials. Each version of the final assessment consists of 2 theoretical questions and 2 practical tasks.

## Teaching materials and media

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

# KUFB310 Theory of functions of a complex variable 1

| Study semester | 5 (full time) | ECTS: | 6 |
|---|---|---|---|

## Workload

| Contact Time | | Self-study | |
|---|---|---|---|
| Lectures | 30 h | Preparation for Contact Time | 80 h |
| Exercises | 30 h | Literature review | 40 h |
| Sum | 60 h | Sum | 120 h |

**Total workload** **180 h**

## Lecturers

G. Kh. Khudaiberganov– Professor at the Department of "Mathematical Analysis",
M.R. Eshimbetov – Associate Professor at the Department of "Mathematical Analysis".

## Teaching contents

Complex numbers, forms of complex numbers, complex plane. Stereographic projection. Riemann sphere. Lines and regions in the complex plane. Functions of a complex variable. Limit and continuity of a function. Differentiability of a function of a complex variable. Cauchy–Riemann conditions. The concept of a holomorphic function. Harmonic functions and their properties. Geometric meaning of the modulus and argument of the derivative. Conformal mappings. Fractional-linear (Möbius) functions and their properties. Fractional-linear isomorphisms and automorphisms. Power functions and their properties. The Joukowsky function and its properties. Exponential function. Trigonometric and hyperbolic functions. Integral of complex-valued functions. Cauchy's theorem. The concept of a primitive (antiderivative) function. Cauchy's integral formula.

## Learning outcomes

To successfully complete this discipline, students:

- Should possess knowledge of the theory of functions of a complex variable, conformal mappings, the integral of a function of a complex variable, the properties of holomorphic functions, Laurent series and residue theory[1];
- Should know how to check the differentiability of a function of a complex variable, conformal mappings performed using elementary functions, convergence of series, to compute the integral of a function of a complex variable, to expand functions into power series, to expand Laurent series in an annulus, to use residues to evaluate integrals[2];
- Should know how to check the differentiability of a function of a complex variable, how to evaluate integrals of functions of a complex variable, how to solve examples related to the zeros of holomorphic function, how to expand a function into a Laurent series[3].

[1]Knowledge; [2]Skill; [3]Competence.

## 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: Mathematical analysis 1, Mathematical analysis 2, Mathematical analysis 3, Mathematical analysis 4, Analytical geometry 1, Analytical geometry 2, Algebra 1, Algebra 2, Algebra 3.

## Reading list


1. Xudoyberganov G., Shoimqulov B.A. Kompleks oʻzgaruvchili funksiyalar nazariyasi. Oʻquv qoʻllanma. Toshkent. Marifat nashriyoti. 2024.
2. Туйчиев Т.Т., Тишабаев Ж.К., Джумабаев Д.Х., Китманов А.М., Комплекс ўзгарувчили функциялар назарияси фанидан мустақил ишлар, Oʻquv qoʻllanma. Т. “Мумтоз сўз”, 2018.(Лотин алифбосида) .
3. Садуллаев А., Худойберганов Г., Мансуров Х. Т., Ворисов А. К., Туйчиев Т. Т. Математитк анализ курсидан мисол ва масалалар тўплами (комплекс анализ) 3 қисм. Oʻquv qoʻllanma. Т. “Ўзбекистон”, 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.

| Type of assessment | Midterm | Final |
|---|---|---|

| | | | |
|---|---|---|---|
| | Time of assessment | Weeks 9, 15 | Weeks 19-20 |
| | Form of assessment | Mixed (oral and written) | Mixed (oral and written) |
| | 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 question and 3 practical tasks 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.<br>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 question and 3 practical tasks. | | |
| **Teaching materials and media** | | | |
| | Projector; white/black board; hand-outs; flipchart; visualization aids for presentation; demonstration materials. | | |

# SMMB3041 Models in insurance and financial mathematics

| | | | |
|---|---|---|---|
| **Study semester** | **5** (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.K.Mukhamedov- Associate Professor at Department of "Probability theory and mathematical statistics",
H.B.Khudaykulova- Senior teacher of Department of "Probability theory and mathematical statistics".

## Teaching contents

Credit operations, Debt repayment schemes, Evaluation of investment projects, Net Present Value (NPV), Internal Rate of Return (IRR). The (B, S) model of the derivatives market, Investor activity in the (B, S) market, Payoff models for options, European-type options in discrete time, Key indicators of a complete market, Cox-Ross-Rubinstein model of the securities market, One-step model of the (B, S) market, Stochastic dynamic model of the securities market, Black–Scholes model. The essence and necessity of insurance, The role of actuarial mathematics in insurance, Basic concepts and terminology, Risk and its characteristics, risk management, Types of insurance and their classification, Tariff rates, general principles, and the pricing policy of insurance companies, Methods for calculating tariff rates for mass-risk types of insurance, Insurance methods, Deductibles (franchise) and their types, Calculations for early termination or modification of contracts, Reinsurance: its economic essence, features, main types and forms, Actuarial calculations in forming insurance reserves, Methods for calculating insurance reserves, Financial stability of insurance companies, Dynamic models of insurance company insolvency.

## Learning outcomes

To successfully complete this module, students:

- should have understand  the principles of credit operations and debt repayment schemes, Know how to evaluate investment projects using Net Present Value (NPV) and Internal Rate of Return (IRR), Explain the (B, S) model of the derivatives market and the role of investor behavior in that model, Describe option payoff models, including European-type options in discrete time, Understand key properties of a complete financial market, and the Cox-Ross-Rubinstein, one-step, and Black–Scholes models, Understand the essence of insurance, types of insurance, and the importance of actuarial mathematics, Define risk, its characteristics, and its role in insurance modeling, Recognize the financial stability indicators and dynamic insolvency models of insurance companies[1];
- should be able to perform calculations for loan repayment plans, and apply NPV and IRR methods to assess investment projects, Model simple financial scenarios using the (B, S) and Cox-Ross-Rubinstein models, Calculate option payoffs, and apply the one-step and discrete-time European option models, Analyze market completeness and simulate asset pricing using the Black–Scholes model, Apply basic actuarial techniques to compute insurance premiums, tariff rates, and insurance reserves, Perform risk assessment, classify risk types, and determine appropriate insurance methods, Use formulas to calculate contract adjustments, early terminations, and reinsurance arrangements, Assess the financial health of an insurance company using dynamic models and key ratios[2];
- should be able to Integrating financial and insurance models to evaluate and optimize decisions in banking, insurance, and investment contexts, Selecting appropriate financial and actuarial models to analyze real-world data and make informed decisions, Designing and justifying insurance products, including pricing, risk control, and reinsurance strategies, Communicating and defending financial recommendations, risk assessments, and investment appraisals using analytical tools, Applying regulatory, ethical, and practical considerations in the management of financial instruments and insurance contracts[3].

[1]Knowledge; [2]Skill; [3]Competence.

## 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: Algebra 1, Algebra 2, Algebra 3, Mathematical analysis 1, Mathematical analysis 2, Mathematical analysis 3, Mathematical analysis 4, Probability theory, Mathematical statistics.

Recommended: Prior completion of a course in Ordinary Differential Equations (ODEs), Stochastic Calculus**,** Statistical Software (MATLAB, Excel)**,** Introductory Economics or Finance, Analytical thinking and problem-solving skills.

## Reading list


1. Muxamedov A.K., Sharipov O.Sh. Sug'urta matematikasi.Toshkent,"Marifat", 2023. 196 b.
2. Бакоев М.Т.,Муҳамедов А.Қ. Молиявий математика.Ўқув Қўлланма.ЖИДУ.2013.194 б.


## 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 |
|---|---|---|
| Time of assessment | Weeks 7-8 | 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 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 in written form based on the topics defined in the module 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.

# ASTB3041 Applied statistics

| Study semester | 5 (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.K.Mukhamedov - Associate Professor at Department of "Probability theory and mathematical statistics",
H.B.Khudaykulova - Senior teacher of Department of "Probability theory and mathematical statistics".

## Teaching contents

Population and sample, statistical distribution of the sample, polygon and histogram, cumulative total, Lorenz curve, Lorenz and Gini coefficients, sample mean and variance, method of least squares, linear and non-linear regressions, correlation and regression analysis based on grouped data, applications of regression models, Cobb-Douglas and gravity models.
Analysis of two sample data, two-dimensional sample, constructing a regression equation for two-dimensional sample data, multiple regression models, statistical analysis of qualitative (non-quantitative) variables, statistical analysis of qualitative variables, index method in socio-economic analysis, individual indexes, general indexes, aggregate indexes, price index, forecasting models.
Time series, simple forecasting methods, moving average method, simple exponential smoothing method, modeling trend in time series, Holt's method for smoothing trend series, modeling seasonal and cyclical fluctuations, Holt-Winters method for time series with seasonality.

## Learning outcomes

To successfully complete this module, students:

- should have understand key statistical concepts: population, sample, sampling distribution, and descriptive statistics, explain graphical and analytical tools: histogram, frequency polygon, cumulative totals, Lorenz curve, describe inequality measurement: Lorenz and Gini coefficients, understand methods of estimating central tendency and dispersion (mean, variance), explain the method of least squares and its role in regression, describe linear, non-linear, and multiple regression models, understand correlation and regression analysis for grouped and multidimensional data, explain economic models like Cobb-Douglas and gravity models, understand the principles of qualitative data analysis and index number systems, describe time series components and forecasting methods, including Holt and Holt-Winters smoothing[1];
- should be able to construct and interpret histograms, frequency polygons, and cumulative curves, calculate and interpret statistical measures: mean, variance, Gini coefficient, apply least squares method to develop linear and non-linear regression models, perform correlation and regression analysis using grouped and two-dimensional data, build multiple regression models, including those with qualitative variables, use and apply Cobb-Douglas and gravity models with real data, compute individual, general, aggregate, and price indexes for socio-economic analysis, analyze time series using moving average, exponential smoothing, and trend modelling, apply Holt and Holt-Winters methods to forecast seasonal and cyclic time series[2];
- should be able to choose and justify appropriate statistical methods for analyzing real-world datasets, interpret and critically assess the results of regression, index, and forecasting models, apply statistical tools to solve problems in economics, business, and social sciences, work independently with statistical software for analysis, modeling, and forecasting, present statistical findings effectively in both written and oral formats, demonstrate responsibility and ethical conduct in using and interpreting statistical data[3].

[1]Knowledge; [2]Skill; [3]Competence.

## 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 (general mathematics or Algebra 1, algebra 2, Introductory statistics or mathematical statistics).
Recommended: Prior completion of a course in Introductory Economics, Basic Computer Literacy.

| | |
|---|---|
| | Analytical thinking and problem-solving skills. |

**Reading list**

1. N.M. Soatov, X. Nabiyev, A.H. Ayubjonov. Amaliy statatistika. Darslik. Toshkent- “Iqtisodiyot”, 2020-yil. 593-bet.
2. А.А. Мицель. Прикладная математическая статистика. Учебное пособие. Томск: Томский государственный университет систем управления и радиоэлектроники. 2022 г. 118 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.

| Type of assessment | Midterm | Final |
|---|---|---|
| Time of assessment | Weeks 7-8 | 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 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 in written form based on the topics defined in the module 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.

# TMMB3041 Continuum mechanics

| Study semester | 5(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.B. Akhmedov – Head of the Department of “Mechanics and Mathematical Modeling”,
A.A. Khaldjigitov – Professor of the Department of “Mechanics and Mathematical Modeling".

## Teaching contents

Introduction to the mechanics of the continuum. Principal values and eigenvectors of a tensor. Kinematics of a Deformable Medium. Theory of Deformations. Mechanics of continuous media - mass and density. Dynamic equations of continuum mechanics. Equations of motion of a continuous medium. Classical models of a continuous medium. Thermodynamic Basis of the Continuous Medium. Wave propagation in continuous media.

## Learning outcomes

To successfully complete this discipline, students:

- should be able to perform operations involving basis vectors and tensors, have a fundamental understanding of the theory of deformation and stress and able to compute the components of the deformation tensor, determine the principal values of the stress tensor, and identify the principal directions[1];
- should be able to perform various operations with vectors and tensors using index notation and apply derived equations and formulas to determine the deformation state of a medium[2];
- should be familiar with modern application software packages for solving engineering problems and solve practical problems and analyze the obtained results effectively[3].

[1]Knowledge; [2]Skill; [3]Competence.

## 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 theoretical mechanics. Familiarity with calculus (limits, derivatives, integrals, differential equations). Understanding of mathematical analysis and mathematical physics equations. Knowledge of linear algebra or Algebra 1, Algebra 2 (vectors, matrices, tensor operations). Introductory exposure to continuum mechanics concepts.

## Reading list


1. Mamatqulov Sh. Tutash muhitlar mexanikasi. Oʻquv qoʻllanma. -T:. “Maʼrifat”. 2024. 296 bet.
2. Механика сплошных сред в задачах: классический учебник МГУ / под ред. М.Э. Эглит. -М.: Московский лицей, 2017. -640 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.

| Type of assessment | Midterm | Final |
|---|---|---|
| Time of assessment | Weeks 32-33 | 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 1 theoretical question and 3 practical tasks 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 1 theoretical question and 3 practical tasks.

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

## DQJB3041 Mechanics of deformable solids

| Study semester | 5 (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

N.T.Mamatova – Associate Professor at the Department of "Mechanics and Mathematical Modeling"

## Teaching contents

Introduction. Subject and purpose of deformable solid mechanics. Stress tensor.
Equations of state of linear elasticity theory. Differential equations and basic relations of linear elasticity theory. Boundary conditions.
Differential equations of elasticity theory through displacements.
Expression of elasticity theory problems in terms of stresses. Beltrami relations.
The problem of bending straight rods. Torsion (distortion) function.
Saint-Venant's semi-inverse method for bending. Bredt's theorem
The problem of bending straight rods. The rigidity of beams. Components of the displacement vector and the deformation tensor. Cross-sectional deformation.
Center of bending. Problems of elastic theory
Basic theorems of elasticity theory.
Plane deformation state. Plane deformation problems. Basic relations.
Solving plane problems through stresses. Stress function.
Problems of bending of elastic beams and cantilevers. Calculation of beam-wall and triangular wall. Application of Fourier's method to plane problems.
Basic relations. The problem of a wedge loaded at the apex by a concentrated force or moment. Application of stress function to plane problems. Mitchell's general solution.
Dynamic equations of elasticity theory. Wave propagation equations. Longitudinal and transverse waves.
The problem of longitudinal wave propagation in elastic rods. On waves propagating on the surface of an elastic medium.

## Learning outcomes

To successfully complete this discipline, students:

- Identify types of deformations and stresses in structural elements and apply the laws of the mechanics of deformable solids to calculate strength and stiffness of structures[1];
- Able to use various methods for solving problems in the mechanics of deformable solids and apply the basic theorems of solid mechanics, solve some classical problems, select a coordinate system suitable for setting problems in the theory of elasticity and plasticity and methods for setting and solving problems; have the skills to analyze the results obtained[2];
- Have to know various models of deformable solids and able to formulate basic differential equations based on the thermodynamic principles of elasticity theory and skills in modeling applied problems, analyze the results of calculations and draw conclusions about the operability of the structure[3].

[1]Knowledge; [2]Skill; [3]Competence.

## 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 continuum mechanics, resistance of materials. Familiarity with calculus (differentiation, integration). Understanding of linear algebra (vector spaces, linear transformations, matrix operations). Basic skills in working with programming languages, such as MAPLE.

## Reading list

1. M.M.Mirsaidov, K.Ismailov. Elastiklik nazariyasi. –Toshkent, MASHHUR-PRESS, 2023, -296 p.
2. Савельев Л.М. Теория упругости. – Самара: Изд-во Самарского ун-та, 2021.

## 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 |
|---|---|---|
| Time of assessment | Weeks 32-33 | 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 1 theoretical question and 2 practical tasks 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 1 theoretical question and 2 practical tasks.

## Teaching materials and media

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

# DTPB3041 Differential topology 1

| Study semester | 5 (full time) | ECTS: | 4 |
|---|---|---|---|

## Workload

| Contact Time | | Self-study | |
|---|---|---|---|
| Lectures | 16 h | Preparation for Contact Time | 60 h |
| Exercises | 14 h | Literature review | 30 h |
| Sum | 30 h | Sum | 90 h |
| **Total workload** | **120 h** | | |

## Lecturers

R.B.Beshimov – Professor at the Department of "Geometry and topology",
S.S.Saitova – Associate Professor at the Department of "Geometry and topology".

## Teaching contents

Various ways of introducing topology: quotient set, quotient topology, quotient space. Countability axioms. Separable spaces. Tikhonov topology. Differentiable (smooth) mappings in Euclidean spaces, the rank of a differential mapping, the differential of a differentiable mapping in Euclidean space. The maximal rank of a differentiable mapping, immersions and embeddings, submersions. The theorem on regular values. Topological manifolds, topological atlases, local charts, local coordinate systems. Differentiable manifolds, smoothly compatible atlases, maximal atlases, and differential structures.

## Learning outcomes

To successfully complete this discipline, students:

- have an understanding of analytic geometry, higher and linear algebra, differential geometry, and topology[1];
- possess skills in solving algebraic equations and systems of equations both analytically and numerically[2];
- be able to mathematically model processes using mathematical symbols and simple systems, construct models for specific economic processes, perform calculations within the framework of the constructed model, and apply this knowledge by utilizing the main methods and guidelines for processing experimental data[3].

[1]Knowledge; [2]Skill; [3]Competence.

## 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: 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 1, Mathematical analysis 2, Analytical geometry 1, Analytical geometry 2, Differential geometry.

## Reading list


1. Садовничий Ю.В., Бешимов Р.Б., Жураев Т.Ф., Топология. Учебное пособие. -Т.: “Университет”, 2021. -200 стр.
2. J.M.Lee Introduction to Riemannian Manifolds, Department of Math, University of Washington, seattle, WA. USA, 2018.
3. Сборник задач по дифференциальной геометрии и топологии, Мищенко А.С., Соловьев Ю.П., Фоменко А.Т., 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.

| 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.<br>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 tasks. |
| **Teaching materials and media** | |
| | Projector; white/black board; hand-outs; flipchart; visualization aids for presentation; demonstration materials. |

# PRGB3041 Projective geometry 1

| **Study semester** | **5** (full time) | **ECTS:** | **4** |
|---|---|---|---|

## Workload

| Contact Time | | Self-study | |
|---|---|---|---|
| Lectures | 16 h | Preparation for Contact Time | 60 h |
| Exercises | 14 h | Literature review | 30 h |
| Sum | 30 h | Sum | 90 h |
| **Total workload** | **120 h** | | |

## Lecturers

A.S.Sharipov – Professor at the Department of "Geometry and topology",
A.M.Bayturaev – Associate Professor at the Department of "Geometry and topology".

## Teaching contents

On projective geometry and projective space. Projective plane. Projective space. Axioms of projective space. Basic facts of projective geometry. Projective coordinates. Duality principle. Desargues' theorem. Compound relation of four points lying on the same line. Projective permutations and their groups.

## Learning outcomes

To successfully complete this discipline, students:

- within the framework of the tasks implemented in the process of mastering the subject "Projective Geometry", the bachelor must know analytical geometry, higher and linear algebra[1];
- possess skills in solving algebraic equations and systems of equations both analytically and numerically[2];
- must have the skills to apply analytical and numerical solutions of algebraic equations, analytical and numerical solutions of systems of equations[3].

[1]Knowledge; [2]Skill; [3]Competence.

## 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: 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 1, Mathematical analysis 2, Analytical geometry 1, Analytical geometry 2, Differential geometry.

## Reading list

1. A.Y. Narmanov. Differentsial geometriya. Toshkent. «Universitet». 2016 y.
2. J. Israilov, Z.Pashayev. Geomtriya, 1 gism T. 2004 y.

## 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** |
|---|---|---|
| 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 subjects and independent learning materials. Each version of the final assessment consists of 2 theoretical questions and 3 practical tasks.

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

## UPPB308 General pedagogy. Psychology 2

| **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 manifestations[1];
- 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 traits[2];
- 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 research[3].

[1]Knowledge; [2]Skill; [3]Competence.

### 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. Ivanov P.I., Zufarova M. Umumiy psixologiya T.: O‘zbekiston faylasuflar milliy jamiyati, 2008.
3. A.Shamshetova, R.N.Melibaeva, X.Usmanova, I.Haydarov. Umumiy psixologiya. T. 2018.
4. 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.

| 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.<br>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. |

## MFTB308 Equations of mathematical physics 2

| Study semester | 6 (full time) | ECTS: | 3 |
|---|---|---|---|

### Workload

| Contact Time | | Self-study | |
|---|---|---|---|
| Lectures | 30 h | Preparation for Contact Time | 20 h |
| Exercises | 30 h | Literature review | 10 h |
| Sum | 60 h | Sum | 30 h |

**Total workload:** **90 h**

### Lecturers

B.Islomov – Professor at the Department of "Differential equations and mathematical physics", Sh.Kasimov – Professor at the Department of "Differential equations and mathematical physics", E.Kuchkorov – Associate professor at the Department of "Differential equations and mathematical physics".

### Teaching contents

Extremum principle for parabolic equations. Existence, uniqueness and stability of the solution of the Cauchy problem for the heat equation. Fundamental solutions. Poisson's formula. Basic properties of harmonic functions. Formulas for the connection of the real and imaginary parts of an analytic function with the Cauchy-Riemann system. Class $C^2$ functions and integral representation of harmonic functions. Formulas for the arithmetic mean. Extremum principle. Some important consequences of Poisson's formula. Liouville's and Harnack's theorems. Potential of bulk masses. Potentials of double and simple layers. Poisson's equation.
Dirichlet and Neumann problem. Uniqueness of the solution of the Dirichlet and Neumann problem for the Laplace equation. Solution of the Dirichlet problem for a sphere and a half-space. Poisson's formula. Concept of the Green's function. Solution of the Dirichlet and Neumann problem using the Green's function. Solution of the Dirichlet and Neumann problem by the Fourier method in a rectangular domain. Construction of the solution of the Dirichlet problem for the Laplace equation in a circle and a semicircle. Construction of the solution of the Dirichlet problem for the Laplace equation in a sphere and a hemisphere.

### Learning outcomes

To successfully complete this discipline, students:

- Have to know the extremum principle for parabolic equations, the correctness of the solution of the Cauchy problem for the heat equation, the basic properties of harmonic functions, the mean value theorems and the Extremum Principle[1];
- Understand the Cauchy-Riemann systems and the representation of harmonic functions, able to prove the uniqueness of the solution to the Dirichlet and Neumann problem for the Laplace equation, able to apply Green's functions when solving the Dirichlet and Neumann problem and the Fourier method to elliptic equations, as well as use it to solve applied problems[2];
- Develop skills in constructing mathematical models of physical processes and correctly interpreting the results and master the methods of constructing fundamental solutions and study the properties of these solutions, able to generalize the methods of mathematical physics to new types of equations and complex physical models and to critically evaluate the applicability of various analytical methods to specific problems of mathematical physics[3].

[1]Knowledge; [2]Skill; [3]Competence.

### 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: Mathematical analysis 1, Mathematical analysis 2, Mathematical analysis 3, Mathematical analysis 4, Analytic geometry 1, Analytic geometry 2, Differential equations 1, Differential equations 2.
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.

### Reading list


1. Salohiddinov M., Islomov B. Matmatik fizika tenglamalari fanidan masalalar to'plami. Toshkent. Universitet. 2017. 370 b.

2. Kasimov Sh.G. Matematik fizika tenglamalari. I tom. Toshkent. “Ma’rifat”. 2024 y. 912 b.
3. Kasimov Sh.G. Matematik fizika tenglamalari. II tom. Toshkent. “Ma’rifat”. 2025 y. 928 b.
4. Попов А.И., Попов И.Ю. Основные уравнения математической физики. Учебное пособие. – СПб: Университет ИТМО. 2020. 200 с.
5. Sobolev S. L. Partial differential equations of mathematical physics. ЛОНДОН - НЬЮ-ЙОРК-ПАРИЖ. 2022. 427 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.

| 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 2 practical tasks.

## Teaching materials and media

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

| KUFB310 Theory of functions of a complex variable 2 | | | |
|---|---|---|---|
| **Study semester** | **6** (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

G. Kh. Khudaiberganov – Professor at the Department of "Mathematical Analysis",
M.R. Eshimbetov – Associate Professor at the Department of "Mathematical Analysis".

## Teaching contents

Taylor series. Power series. Abel's theorem. Cauchy–Hadamard formula. Properties of holomorphic functions. Morera's theorem. Weierstrass's theorem. Zeros of holomorphic functions. Uniqueness theorem. Laurent series. Singular points and their types. Sokhotski's theorem. Entire and meromorphic functions. Residues and their computation. Applications of residue theory. Jordan's lemma. Multivalued functions. The function $w=\sqrt[n]{z}$. The logarithmic function $w=\mathrm{Ln}\,z$. Inverse trigonometric functions. The function $w=z^a$. Argument principle. Domain mapping principle. Maximum modulus principle. Schwarz's lemma. Symmetry principle. Conformal isomorphisms and automorphisms.

## Learning outcomes

To successfully complete this discipline, students:

- Have to possess knowledge of the theory of functions of a complex variable, conformal mappings, integral of a function of a complex variable, properties of holomorphic functions, Laurent series and residue theory[1];
- Understand to check the differentiability of a function of a complex variable, conformal mappings performed using elementary functions, to check the convergence of series, compute the integral of a function of a complex variable, expand functions into power series, expand Laurent series in an annulus and use residues to evaluate integrals[2];
- Know how to check the differentiability of a function of a complex variable, evaluate integrals of functions of a complex variable, solve examples related to the zeros of holomorphic functions and expand a function into a Laurent series[3].

[1]Knowledge; [2]Skill; [3]Competence.

## 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: Mathematical analysis 1, Mathematical analysis 2, Mathematical analysis 3, Mathematical analysis 4, Analytical geometry 1, Analytical geometry 2, Algebra 1, Algebra 2, Algebra 3, Theory of functions of a complex variable 1.

## Reading list


1. Xudoyberganov G., Shoimqulov B.A. Kompleks oʻzgaruvchili funksiyalar nazariyasi. Oʻquv qoʻllanma. Toshkent. Maʼrifat nashriyoti. 2024.
2. Туйчиев Т.Т., Тишабаев Ж.К., Джумабаев Д.Х., Китманов А.М., Комплекс ўзгарувчили функциялар назарияси фанидан мустақил ишлар, Oʻquv qoʻllanma. T. “Мумтоз сўз”, 2018.(Лотин алифбосида).
3. Садуллаев А., Худойберганов Г., Мансуров Х. Т., Ворисов А. К., Туйчиев Т. Т. Математитк анализ курсидан мисол ва масалалар тўплами (комплекс анализ) 3 қисм. Oʻquv qoʻllanma. T. “Ўзбекистон”, 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.

| Type of assessment | Midterm | Final |
|---|---|---|

| | | | |
|---|---|---|---|
| | Time of assessment | Weeks 29, 35 | Weeks 40-41 |
| | Form of assessment | Mixed (oral and written) | Mixed (oral and written) |
| | 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 question and 3 practical tasks 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.<br>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 question and 3 practical tasks. | | |
| **Teaching materials and media** | | | |
| | Projector; white/black board; hand-outs; flipchart; visualization aids for presentation; demonstration materials. | | |

# FANB310 Functional analysis 1

| | | | |
|---|---|---|---|
| **Study semester** | **6** (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

R.N. Ganikhodzhaev – Professor at the Department of "Algebra and Functional Analysis",
A.A. Rakhimov – Professor at the Department of "Algebra and Functional Analysis".

## Teaching contents

Linear spaces. Normed spaces. Banach and Hilbert spaces. Metric spaces. Open and closed sets. Compact sets. Compactness criteria on classical metric spaces. Complete and separable metric spaces. Contraction mapping principle. Linear bounded functionals. Dual spaces.

## Learning outcomes

To successfully complete this discipline, students:

- should understand the definitions and basic properties of linear spaces, normed spaces, Banach spaces, and Hilbert spaces, recall fundamental concepts of metric spaces, including open and closed sets, compact sets, and separability, know compactness criteria in classical metric spaces (e.g., Heine-Borel theorem), explain the contraction mapping principle and its implications and know the definition and properties of linear bounded functionals and dual spaces[1];
- should be able to identify and verify whether a given space is a normed space, Banach space, or Hilbert space, determine whether a subset of a metric space is open, closed, compact, complete, or separable, apply the contraction mapping principle to prove the existence and uniqueness of fixed points, calculate the norm and inner product in specific examples of function spaces and work with linear functionals and verify their boundedness[2];
- should be apply abstract concepts such as completeness, compactness, and separability to solve problems in functional analysis and its applications, formulate and prove results involving metric space properties and mappings, use the theory of Banach and Hilbert spaces in further mathematical analysis and applied mathematics and analyze and interpret the structure of dual spaces in both theoretical and applied contexts[3].

[1]Knowledge; [2]Skill; [3]Competence.

## 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 1, Mathematical analysis 2, Mathematical analysis 3, Mathematical analysis 4, Algebra 1, Algebra 2, Algebra 3.

## Reading list


1. J.Muscat, Functional analysis, Springer, 2024.
2. Abdullayev J.I., G‘anixo‘jayev R.N., Shermatov M.H., Egamberdiyev O.I., Funksional analiz va integral tenglamalar, Toshkent, Turon-Iqbol-2022.
3. Abdullayev J.I., Eshqobilov Y.X., G‘anixo‘jayev R.N. Funksional analiz (misol va masalalar yechish) I, II qismlar, Toshkent, Turon-Iqbol-2022.


## 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 |
|---|---|---|
| Time of assessment | Weeks 32-33 | 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 1 theoretical question and 3 practical tasks based on the topics covered

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|---|---|
| | 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.<br>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 1 theoretical question and 3 practical tasks. |
| **Teaching materials and media** | |
| | Projector; white/black board; hand-outs; flipchart; visualization aids for presentation; demonstration materials. |

# DTPB3041 Differential topology 2

| Study semester: | 6 (full time) | ECTS: | 2 |
|---|---|---|---|

## Workload

| Contact Time | | Self-study | |
|---|---|---|---|
| Lectures | 14 h | Preparation for Contact Time | 20 h |
| Exercises | 16 h | Literature review | 10 h |
| Sum | 30 h | Sum | 30 h |
| **Total workload** | **60 h** | | |

## Lecturers

R.B.Beshimov – Professor at the Department of "Geometry and topology",
S.S.Saitova – Associate Professor at the Department of "Geometry and topology".

## Teaching contents

Tangent space of a differentiable manifold, tangent bundle. Differentiable maps between smooth manifolds, differential of differentiable maps. Compact-open topology on the space of maps. Countable basis of the compact-open topology on the space of maps. Partition of unity on a manifold. Openness of the set of submersions in the space of differentiable maps. Openness of the set of immersions in the space of differentiable maps. Approximation of continuous functions by differentiable functions. Embedding of manifolds into Euclidean space (Embedding Theorems).

## Learning outcomes

To successfully complete this discipline, students:

- have an understanding of analytic geometry, higher and linear algebra, differential geometry, and topology[1];
- possess skills in solving algebraic equations and systems of equations both analytically and numerically[2];
- be able to mathematically model processes using mathematical symbols and simple systems, construct models for specific economic processes, perform calculations within the framework of the constructed model, and apply this knowledge by utilizing the main methods and guidelines for processing experimental data[3].

[1]Knowledge; [2]Skill; [3]Competence.

## 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: 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 1, Mathematical analysis 2, Analytical geometry 1, Analytical geometry 2, Differential geometry, Differential topology 1.

## Reading list


1. Садовничий Ю.В., Бешимов Р.Б., Жураев Т.Ф., Топология. Учебное пособие. -Т.: "Университет", 2021. -200 стр.
2. J.M.Lee Introduction to Riemannian Manifolds, Department of Math, University of Washington, seattle, WA. USA, 2018.
3. Сборник задач по дифференциальной геометрии и топологии, Мищенко А.С., Соловьев Ю.П., Фоменко А.Т., 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.

| 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.<br>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 tasks. |
| **Teaching materials and media** | |
| | Projector; white/black board; hand-outs; flipchart; visualization aids for presentation; demonstration materials. |

# PRGB3041 Projective geometry 2

| Study semester: | 6 (full time) | ECTS: | 2 |
|---|---|---|---|

## Workload

| Contact Time | | Self-study | |
|---|---|---|---|
| Lectures | 14 h | Preparation for Contact Time | 20 h |
| Exercises | 16 h | Literature review | 10 h |
| Sum | 30 h | Sum | 30 h |
| **Total workload** | **60 h** | | |

## Lecturers

A.S.Sharipov – Professor at the Department of "Geometry and topology",
A.M.Bayturaev – Associate Professor at the Department of "Geometry and topology".

## Teaching contents

Subject of projective geometry. Harmonic quadruple of points. Harmonic properties of a perfect quadruple. Second-order straight lines in the projective plane. Pole and polar. Classification of second-order straight lines in the projective plane. Theorems of Steiner, Pascal, and Brianchon.

## Learning outcomes

To successfully complete this discipline, students:

- within the framework of the tasks implemented in the process of mastering the subject "Projective Geometry", the bachelor must know analytical geometry, higher and linear algebra[1];
- possess skills in solving algebraic equations and systems of equations[2];
- must have the skills to apply analytical and numerical solutions of algebraic equations, analytical and numerical solutions of systems of equations[3].

[1]Knowledge; [2]Skill; [3]Competence.

## 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: Ability to perform arithmetic operations with numbers. Ability to perform operations with algebraic fractions. Ability to follow discipline, order and to use necessary literature and internet resources by knowing Russian and English languages, Mathematical analysis 1, Mathematical analysis 2, Analytical geometry 1, Analytical geometry 2, Differential geometry, Projective geometry 1.

## Reading list


1. A.Y. Narmanov. Differentsial geometriya. Toshkent. “Universitet”. 2016 y.
2. J. Israilov, Z.Pashayev. Geometriya, 1 gism T. 2004 y.


## 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 |
|---|---|---|
| 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 subjects and independent learning materials. Each version of the final assessment consists of 2 theoretical questions and 3 practical tasks.

## Teaching materials and media

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

# YFGB3041 Age physiology and hygiene

| 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 hygiene, know the age-related structural features of organs during the periods of growth and development, know the age-related physiology and hygiene of excitable tissues and the musculoskeletal system, have knowledge about the age-related physiology and hygiene of the nervous system, know the physiology and hygiene of sensory systems and higher nervous activity and describe the age-related physiology and hygiene of the endocrine and visceral systems, and to be able to apply this knowledge[1].
- should be able to select mental and physical loads appropriate to the age of children and choose individual loads based on the characteristics of the higher nervous system and determine anthropometric indicators[2];
- should give a hygienic assessment of the environment under various conditions and take age-related characteristics into account in the educational process[3].

[1]Knowledge; [2]Skill; [3]Competence.

## 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. 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.
5. 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.

| 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.

# HFXB304 Life safety

| 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. Firefighting 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 and 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 and recommended methods of providing first aid (self-help and first aid to the victim)[1];
- 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) and create and maintain safe living conditions[2];
- 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 and ensuring the development and implementation of regulatory acts in the field of labor protection[3].

[1]Knowledge; [2]Skill; [3]Competence.

## 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.

| 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.

# UNB3041 Measure theory

| | | | |
|---|---|---|---|
| **Study semester** | **6** (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

R.N. Ganikhodzhaev – Professor at the Department of "Algebra and Functional Analysis",
A.N. Azizov – Senior Lecturer at the Department of "Algebra and Functional Analysis".

## Teaching contents

Maps. The cardinality of sets. Operations on measurable sets. The Lebesgue measure and its properties. Measurable sets and measurable functions, their properties. Types of convergence for sequences of measurable functions. Lebesgue integral and its properties. The relationship between Lebesgue and Riemann integrals. The direct product of measurable spaces and Fubini's theorem.

## Learning outcomes

To successfully complete this discipline, students:

- should have knowledge and understanding of measurable spaces, be familiar with measurable sets and functions and their key properties and understand the concept of Lebesgue measures and integrals[1];
- should be able to perform operations under measurable sets and functions, identify the types of convergence of the sequence of measurable functions and verify whether a given function is integrable in the meaning of Lebesgue or not[2];
- should be capable of interpreting and analyzing the structure of advanced measurable spaces, identify and evaluate properties of measurable sets and functions and apply measure theory tools to solve real-world problems in mathematics, physics, biology or chemistry involving abstract space structures and transformations[3].

[1]Knowledge; [2]Skill; [3]Competence.

## 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. 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. Funksional analiz va integral tenglamalar, Toshkent: Turon-Iqbol, 2022.
2. Yu.X. Eshqobilov va boshq. Funksional analiz (misol va masalalar yechish), I-qism, Toshkent: Turon-Iqbol, 2022.


## 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 |
|---|---|---|
| Time of assessment | Weeks 32-33 | 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 1 theoretical question and 3 practical tasks 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 1 theoretical question and 3 practical tasks. |
| **Teaching materials and media** | |
| | Projector; white/black board; hand-outs; flipchart; visualization aids for presentation; demonstration materials. |

# SNB3041 Number theory

| Study semester: | **6** (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

E.P. Normatov – Senior Lecturer at the Department of "Algebra and Functional Analysis",
F.N. Ibragimov – Associate Professor at the Department of "Algebra and Functional Analysis".

## Teaching contents

Division. Elementary Properties of Division. Division with remainder. GCD and LCM. Euclidean algorithm. Lame's Theorem. Basic Theorem of Arithmetic. Fractions with an infinite chain. Euler-Lagrange theorem. Floor and fractional functions, Multiplicative functions. The Möbius function. The Euler function. Congruences and their properties. Fermat and Euler theorems First-degree one-variable congruences. Systems of congruences with one unknown of the first degree. Higher-order congruences by prime modulus. Higher-order congruences for an arbitrary modulus. Quadratic congruences. Legendre symbol. Proof of the law of quadratic reciprocity. Jacobi symbol. Initial roots and indices. Initial roots by modules.

## Learning outcomes

To successfully complete this discipline, students:

- should have knowledge and understanding of the basic properties of integers, including divisibility, division with remainder, and the concepts of GCD and LCM, be familiar with the Euclidean algorithm and its theoretical foundation in Lamé’s Theorem and understand congruences, modular arithmetic, and key theorems such as Fermat’s Little Theorem and Euler’s Theorem[1];
- should be able to perform calculations with GCD and LCM using the Euclidean algorithm, solve linear and nonlinear congruences, including systems with one variable and use indices and primitive roots to solve higher-order congruences[2];
- should be apply number-theoretic methods to solve problems involving congruences and arithmetic functions, analyze and interpret congruence relations in theoretical and applied contexts and construct rigorous proofs in elementary number theory, including those involving quadratic residues and reciprocity laws[3].

[1]Knowledge; [2]Skill; [3]Competence.

## Teaching and learning methods

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

## Entrance requirements

Mandatory: None
Recommended: Familiarity with calculus (limits, continuity, differentiation, integration). Algebra 1, Algebra 2, Algebra 3. Basic skills in a programming language such as MAPLE, MathCad.

## Reading list

1. Ayupov A.SH., Omirov B.A., Xudoyberdiyev A.X., Haydarov F.H. Algebra va sonlar nazariyasi, Toshkent, “Tafakkur bo‘stoni”, 296 bet, 2019 y.

## 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 |
|---|---|---|
| Time of assessment | Weeks 32-33 | 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 1 theoretical question and 3 practical tasks 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.<br>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 1 theoretical question and 3 practical tasks. |
| **Teaching materials and media** | |
| | Projector; white/black board; hand-outs; flipchart; visualization aids for presentation; demonstration materials. |

# FANB310 Functional analysis 2

| Study semester: | 7 (full time) | ECTS: | 6 |
|---|---|---|---|

## Workload

| Contact Time | | Self-study | |
|---|---|---|---|
| Lectures | 30 h | Preparation for Contact Time | 80 h |
| Exercises | 30 h | Literature review | 40 h |
| Sum | 60 h | Sum | 120 h |
| **Total workload** | **180 h** | | |

## Lecturers

R.N. Ganikhodzhaev – Professor at the Department of "Algebra and Functional Analysis",
A.A. Rakhimov – Professor at the Department of "Algebra and Functional Analysis".

## Teaching contents

Bounded linear operators. Uniform, strong, and weak convergence of operators. Principle of Uniform Boundedness. Operator space. Joint operator. Self-adjoint operator. Operator spectrum and resolvent. Compact operators. Hilbert-Schmidt theorem. Fredholm integral equation.

## Learning outcomes

To successfully complete this discipline, students:

- should understand the definitions and properties of bounded linear operators on normed and Hilbert spaces, describe the types of convergence for sequences of operators: uniform, strong, and weak convergence, explain the Principle of Uniform Boundedness and its consequences, know the definitions and properties of self-adjoint operators, understand the Hilbert–Schmidt theorem and the structure of compact self-adjoint operators and recall the formulation and importance of the Fredholm integral equation[1];
- should be able verify boundedness and linearity of a given operator on a normed space, distinguish between uniform, strong, and weak operator convergence in concrete examples, apply the Uniform Boundedness Principle to families of operators, determine whether an operator is self-adjoint, compact, or bounded in specific cases, compute or characterize the spectrum and resolvent set of a linear operator, apply the Hilbert–Schmidt theorem to analyze compact operators on Hilbert spaces and should be able to formulate and solve simple Fredholm integral equations of the second type[2];
- should be analyze operator behavior in various topologies and convergence modes, use operator-theoretic tools to study the structure of linear transformations in functional spaces and formulate rigorous arguments using abstract operator theory in proofs and problem solving[3].

[1]Knowledge; [2]Skill; [3]Competence.

## 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 1, Mathematical analysis 2, Mathematical analysis 3, Mathematical analysis 4, Algebra 1, Algebra 2, Algebra 3. Functional analysis 1.

## Reading list


1. J.Muscat, Functional analysis, Springer, 2024.
2. Abdullayev J.I., G‘anixo‘jayev R.N., Shermatov M.H., Egamberdiyev O.I., Funksional analiz va integral tenglamalar, Toshkent, Turon-Iqbol-2022.
3. Abdullayev J.I., Eshqobilov Y.X., G‘anixo‘jayev R.N. Funksional analiz ( misol va masalalar yechish) I, II qismlar, Toshkent, Turon-Iqbol-2022.


## 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 |
|---|---|---|
| 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 1 theoretical question and 3 practical tasks 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.<br>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 1 theoretical question and 3 practical tasks. |
| **Teaching materials and media** | |
| | Projector; white/black board; hand-outs; flipchart; visualization aids for presentation; demonstration materials. |

# MUMB404 Methods of teaching mathematics

| 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

A.Y. Narmanov – Professor at the Department of "Geometry and topology",
A.M. Bayturaev – Associate Professor at the Department of "Geometry and topology".

## Teaching contents

The main periods in the history of the development of mathematics and their brief characteristics. Laws governing the development of mathematics. The emergence of elementary mathematical and geometric concepts. About numbers and their notations. The origin of concepts of geometric figures. Main directions of modern mathematics. Characteristics of mathematics as an academic subject and reasons for changes in its content. Goals of teaching mathematics in secondary school. The connection of mathematics with other subjects. The subject of the methodology of teaching mathematics and its features. History of its development and current state. Nature of changes in mathematics teaching methodology. The international system of traditional mathematics education in secondary school. Relationship of mathematics teaching methodology with other subjects, reasons for changing and reforming the content of mathematics education. Two main directions in the movement for reform. Reform of mathematics education in the former Soviet school. The newly introduced education system in Uzbekistan and some problems of its implementation. General characteristics of scientific research methods. Scientific methods of teaching mathematics: observation and experiment, comparison, analysis and synthesis, generalization and specialization, abstraction and concretization, classification. Forms of thinking in the process of teaching mathematics: mathematical concept, mathematical judgment, and mathematical inference. Main forms of mathematical reasoning: induction, deduction, and analogy in teaching mathematics. Main didactic principles in mathematics education. Use of induction, deduction, and analogy in teaching mathematics. The concept of teaching methods. Typology of teaching methods and forms of mathematics education. Traditional and non-traditional methods: lecture, discussion, independent work, heuristics, programmed learning and active learning, problem-based learning, methods of individualization. New pedagogical technologies. The math lesson and its structure. Types of lessons. Preparation for math lessons. Lesson analysis. Requirements for a math lesson. Organization of independent work with students, assessment and evaluation of students' knowledge and skills. Methods of control, forms and tools. Evaluation criteria. Distance learning and electronic textbooks. Dnevnik.com as an educational resource and digital platform designed to strengthen collaboration between parents and schools, enabling teachers to plan lessons online, create lesson plans, and keep records of attendance and student achievements electronically. Methodology of organizing extracurricular and elective mathematics classes. Main goals, content, and forms of extracurricular work. Mathematics clubs. Olympiads. Working with additional literature in math education. Methods of organizing extracurricular work with underperforming students. Elective math classes and their methodology. General views on the approach to studying the school mathematics course from the set theory perspective. Content of set theory in the school math curriculum. Methodology of forming fundamental theoretical concepts. Concepts of relations in the school math curriculum. Methodology for introducing concepts of numbers, natural numbers, decimal fractions, rational numbers, positive and negative numbers in the school math course. Some problems in introducing real numbers. Types of calculations and real substitutions. Their role, place, and teaching methodology. Exact substitutions in algebraic, irrational, trigonometric, modular, logarithmic, and other expressions. Approximate calculations and their essence. Methods of teaching algebraic, trigonometric, and transcendental functions. Different methods of graphing functions. Representing function properties on graphs and vice versa. About the interpretation of equations and inequalities with variables. Equivalence of equations and inequalities. Types of equations and inequalities studied in the math course and their methodological features. Methods of solving equations and inequalities. Methodology of solving systems of equations and inequalities. Word problems and their solving methodology. Teaching elements of mathematical analysis in the school math course. Methodology of introducing and teaching the concepts of numerical sequences and their limits, numerical progressions, function limits and continuity, derivatives and their applications, elementary functions and integrals. Simple differential equations in the school math course. Logical foundations of the geometry course. Various methodological approaches to constructing the school geometry course. General characteristics of the school geometry course. Methodological features of studying geometric concepts, axioms, and theorems. Methodology for studying theorems. Methodology for studying vectors in the math course. Methodology for studying geometric constructions. Methodology for studying elements of trigonometry. Methodology of teaching certain geometry topics for grades V-VI, VII-IX, and X-XI. The axiomatic method and its essence in mathematics and the school math course. Axiomatization in textbooks.

## Learning outcomes

To successfully complete this discipline, students:

- know the advantages of mathematical methods, the universality of mathematical concepts, and mathematical modeling, use models for functional and computational problems, develop knowledge using mathematical symbols to describe quantitative and qualitative relationships between objects, design key methods, and interpret experimental results; perform qualitative analysis of constant and variable quantities[1];
- be able to demonstrate strong knowledge of both theoretical and practical aspects of the subject, and apply fundamental theoretical and applied knowledge to solve various real-world problems and able to study scientific sections and topics using textbooks and educational resources[2];
- be able to analyze parts of reports based on distributed materials, be knowledgeable about methods for presenting and studying new processes and technologies and generalize learning sessions using active and problem-based learning methods[3].

[1]Knowledge; [2]Skill; [3]Competence.

## 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: 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 1, Mathematical analysis 2, Mathematical analysis 3, Mathematical analysis 4.

## Reading list

1. A.Abduraxmanov A., A.Y.Narmanov, N.Narmuratov. Matematika tarixi. ”Fan va texnologiya” nashriyoti. Тошкент - 2016.
2. S. Alixonov. Matematika o`qitish metodikasi. Cho`lpon nomidagi nashriyot-matbaa ijodiy uyi. Toshkent-2011.

## 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 |
|---|---|---|
| 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 subjects and independent learning materials. Each version of the final assessment consists of 2 theoretical questions and 3 practical tasks.

## Teaching materials and media

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

## VHOB404 Variational calculus and optimization methods

| 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

N.Mamadaliev – Professor at the Department of "Differential equations and mathematical physics",
Sh.Kasimov – Professor at the Department of "Differential equations and mathematical physics",
Z.Madraximova – Associate Professor at the Department of "Differential equations and mathematical physics",
X.Mustapokulov – Associate Professor at the Department of "Differential equations and mathematical physics".

### Teaching contents

Basic elements of the theory of extremal problems. Irrelevant functions. Reflections. Irrelevant functions defined from a single equation and a system of equations. Multivariable functions. Taylor's formula for multivariable functions. Unconditional and conditional extrema of multivariable functions. Calculus of variations, problems leading to variational problems. Geodesic line and geodesic distance. Basic lemmas of the calculus of variations, Statement of the main problems of the calculus of variations. Variations of a functional. Lagrange's lemma. Euler-Lagrange equation. Necessary conditions of the second order. Hilbert's theorem. Minimum conditions for piecewise smooth functions. Necessary conditions for the minimum of a problem with fixed ends in the case of n unknown functions. Euler-Poisson equation. Generalization of the Euler-Lagrange equation. Conditional extremum problems of the calculus of variations. Transversality condition. Lagrange's problem. Problems of the calculus of variations for multiple integrals, extrema of double and triple integrals. Variational principles of mechanics. Maupertuis-Euler and Lagrange's principles. D'Alembert and Relais' principles. Variational problems with moving boundaries. Problems of the calculus of variations with discontinuities. Elements of the general theory of fields. Sufficient conditions for extremum. The subject of linear programming, problems solved by linear programming methods and their mathematical models. Geometric interpretation of the linear programming problem. Graphical method. Controlled objects, permissible controls and trajectories. Multivalued mapping and its Lebesgue integral. Dynamic programming method. Pontryagin's maximum principle.
Dynamic programming. Bellman's equation. The problem of optimal control synthesis. Construction and study of the Bellman function for the control problem of speed. Linear optimal control problems and their formulation. Simplified maximum principles. Conditions in general provisions as sufficient conditions for the maximum principle. Theorems on determining the permutation number. Feldbaum's theorem. Pontryagin's first and second methods. Optimality principle. Concept of differential games.

### Learning outcomes

To successfully complete this discipline, students:

- know mathematical analysis, analytical geometry, higher algebra and differential equations, theory and methods of finding extrema of linear and nonlinear functions of one or more variables, theory and methods of finding extrema (strong and weak maxima and minima) given in the form of single and multiple integrals and theoretical basis of the maximum principle and dynamic programming, and also have the skills of theoretical knowledge in practice[1];
- understand the skills of finding suitable methods for solving certain problems, the skills of applying the acquired theoretical knowledge to solve examples and problems and the theoretical basis of optimization problems in a finite-dimensional space[2];
- apply various methods for solving an optimization problem, various methods for studying the properties of optimization problems and be able to distinguish between types of optimizations and formulate possible problems for them[3].

[1]Knowledge; [2]Skill; [3]Competence.

### 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: 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 1, Mathematical analysis 2, Mathematical analysis 3, Mathematical analysis 4, Analytical geometry 1, Analytical geometry 2, Differential equations 1, Differential equations 2.

## Reading list

1. Mamadaliyev N. Variatsion hisob va optimallashtirish usullari. I qism. Darslik. –T.: “Ma’rifat”, 2024. 794 bet.
2. To’xtasinov M. Jarayonlar tadqiqoti: darslik. O‘zR Oliy va o‘rta-maxsus ta’lim vazirligi. –T. “Barkamol Fayz media” nashriyoti, 2017. -572 b.
3. Mamadaliev N., To’xtasinov M. Variatsion hisob va optimal boshqaruvning asosiy masalalari. O’quv qo’llanma. Toshkent, “Universitet”. 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.

| 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 subjects and independent learning materials. Each version of the final assessment consists of 2 theoretical questions and 3 practical tasks.

## Teaching materials and media

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

# HUSB404 Computational methods

| 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.O‘. Khudoyberganov – Head of the Department of "Computational Mathematics and Information Systems", Associate Professor, Doctor of Physical and Mathematical Sciences,
A.J. Seytov – Associate Professor at the Department of "Computational Mathematics and Information Systems", Doctor 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, 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 and have a knowledge of function approximation methods and the derivation of numerical integration formulas[1];
- should be able to estimate the errors of approximate calculation methods, capable of selecting appropriate numerical solution methods, evaluate the difference between exact and approximate solutions of a problem and use a programming language to approximately solve a problem[2];
- should be competent in applying numerical methods to solve mathematical problems, analyze model and solve real-world problems using numerical approaches, critically assess the reliability and accuracy of numerical results and demonstrate the ability to integrate theoretical knowledge with computational tools in practical situations[3].

[1]Knowledge; [2]Skill; [3]Competence.

## 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 1, Mathematical analysis 2, Mathematical analysis 3, Mathematical analysis 4, Algebra 1, Algebra 2, Algebra 3, Differential equations 1, Differential equations 2, Fundamentals of programming 1, Fundamentals of programming 2, Mathematical physics equations.

## Reading list


1. Isroilov M.I. Hisoblash metodlari. Toshkent, O‘qituvchi, 1-qism, 2003, 2-qism, 2008. (Isroilov M.I. Computational methods. Tashkent, O‘qituvchi, Part 1, 2003, Part 2, 2008.).
2. Aloyev R.D., Xudoyberganov M.O‘. Hisoblash usullari kursidan laboratoriya mashg‘ulotlari to‘plami. O‘zMU. O‘quv qo‘llanma. 2008 y.110b. (Aloyev R.D., Khudoyberganov M.O. Collection of laboratory exercises from the course of computational methods. National University of Uzbekistan. Textbook. 2008 y.110p.).
3. 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)
4. Richard L.Burden,J.Doudlas Faires. Numerisal Analesus, Youngstown State University, Boston, USA, Brooks/Cole, 2011.

| | |
|---|---|
| | 5. Scolt I.R. Numerisal Analesus. Princeton University Press, 2011.-342 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 |
|---|---|---|
| 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

# AQBB4041 Advanced topics in analysis

| Study semester | 7 (full time) | ECTS: | 6 |
|---|---|---|---|

## Workload

| Contact Time | | Self-study | |
|---|---|---|---|
| Lectures | 46 h | Preparation for Contact Time | 60 h |
| Exercises | 44 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",
T.T. Tuychiyev – Associate Professor at the Department of "Mathematical Analysis".

## Teaching contents

Functions of bounded variation: definition, class of functions of bounded variation. Properties of functions of bounded variation. Representation of functions of bounded variation as the difference of two monotone functions. Expression of the full variation of a function as a limit. Jordan's theorem. Stieltjes integral and its properties. Class of functions integrable in the sense of Stieltjes. Integration by parts. Reduction of the Stieltjes integral to the Riemann integral. Geometric meaning of the Stieltjes integral. Mean value theorem for the Stieltjes integral. Proof of the second mean value theorem for the Riemann integral. Limit transition under the Stieltjes integral sign. Continuity of the Stieltjes integral. Scalar field and its geometric representation. Directional derivative. Examples. Gradient of a scalar field. Tangent plane and normal to the surface. Vector field. Problem of fluid flow. Divergence of a vector field. Gauss-Ostrogradsky formula. Curl, circulation and Stokes formula. Potential fields, Hamiltonian operator. The space of functions defined by scalar multiplication. Orthogonality of trigonometric systems. The process of orthogonalization in functional space. Generalized Fourier series. Fourier transform. Convergence of Dirichlet series and definition of the convergence region.

## Learning outcomes

To successfully complete this discipline, students:

- should have knowledge and understanding of functions of bounded variation, be familiar with functions of bounded variation and their key properties, understand the concept of Stieltjes integrals and gain a complete understanding of fields[1];
- should be able to calculate the full variation of a function, verify whether a given function is integrable in the meaning of Stieltjes or not, identify the types of convergence of the sequence of measurable functions and use Fourier transforms[2];
- should be able to visualize the full range of a function given its graph, apply the Stieltjes integral as a generalization of the Riemann integral and the tools of field theory to solve real-world problems involving abstract spatial structures and transformations in mathematics, physics, biology, or chemistry[3].

[1]Knowledge; [2]Skill; [3]Competence.

## 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: Basic knowledge of set theory. Familiarity with calculus (limits, continuity, differentiation, integration). Introductory exposure to real analysis. Basic skills in a programming language such as MATLAB, Python.

## Reading list


1. Tuychiyev T.T., Bedaryov A.S. Analizning tanlangan boblari. T. “Universitet”. 2010.
2. Туйчиев Т.Т., Тишабаев Ж.К. Дополнительные главы анализа. Т. “Университет” 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.

| Type of assessment | Midterm | Final |
|---|---|---|

| | | | |
|---|---|---|---|
| | Time of assessment | Weeks 9, 15 | Weeks 19-20 |
| | Form of assessment | Written and oral examination | 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 question and 3 practical tasks 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.<br>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 question and 3 practical tasks. | | |
| **Teaching materials and media** | | | |
| | Projector; white/black board; hand-outs; flipchart; visualization aids for presentation; demonstration materials. | | |

# KAQB4041 Advanced topics in complex analysis

| Study semester: | 7 (full time) | ECTS: | 6 |
|---|---|---|---|

## Workload

| Contact Time | | Self-study | |
|---|---|---|---|
| Lectures | 46 h | Preparation for Contact Time | 60 h |
| Exercises | 44 h | Literature review | 30 h |
| Sum | 90 h | Sum | 90 h |
| **Total workload** | **180 h** | | |

## Lecturers

J.K.Tishabaev – Professor at the Department of "Mathematical Analysis",
S.I. Kurbonboev – Associate Professor at the Department of "Mathematical Analysis".

## Teaching contents

The concept of analytic continuation. Canonical elements. Continuation along a path.
Properties of continuation along a path. The concept of an analytic function. Elementary functions. Roots, logarithm, inverse trigonometric functions, functions of arbitrary degree, functions with arbitrary exponents. The concept of a Riemann surface. Riemann surfaces of root and logarithmic functions. Geometric principles. Argument principle. Rouche's theorem. Principle of domain preservation. Maximum modulus principle. Schwarz's lemma. Concept of the Riemann mapping theorem.
Principle of symmetry. Harmonic functions. Connection between harmonic and holomorphic functions. Infinite differentiability of harmonic functions. Mean value theorem. Uniqueness theorem. Maximum principle. Harnack's theorem. Dirichlet problem. Poisson's formula. Subharmonic functions and their properties.

## Learning outcomes

To successfully complete this discipline, students:

- should have a solid understanding of basic complex analysis, including the definition and properties of holomorphic functions, know fundamental calculus concepts such as limits, derivatives, and integrals for real and complex functions and understand sequences and series of functions, and the concept of uniform convergence[1];
- should have basic experience with constructing and analyzing mathematical examples and counterexamples, be familiar with elementary functions (exponential, logarithmic, trigonometric, and their inverses) in both real and complex contexts and be able to work with mathematical notation and symbolic manipulation fluently[2];
- should demonstrate independent analytical thinking in solving advanced problems in complex analysis and be able to apply complex function theory in interdisciplinary contexts (physics, engineering, etc.)[3].

[1]Knowledge; [2]Skill; [3]Competence.

## 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: Good understanding of Calculus (limits, continuity, differentiation, integration) for real and complex functions. Basic knowledge of topology in the complex plane (open and closed sets, connectedness, compactness). 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. Худойберганов Г., Ворисов А., Мансуров Х. Комплекс анализ (магистрантлар учун). Т. 2003
2. Саъдуллаев А., Худойберганов Г., Мансуров Х., Ворисов А., Туйчиев Т. Математик анализ курсидан мисол ва масалалар тўплами. 3-қ (комплекс анализ). Т. "Ўзбекистон". 2000.
3. Саъдуллаев А. Теория плюрипотенциала. Применения. Palmarium akademik publishing. Saarbrüchen, Deutschland. 2012.
4. Лян Г.М. Дополнительные главы теории функций комплексного переменного. Т. НУУз. 2009.


## 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 |
|---|---|---|
| Time of assessment | Weeks 9, 15 | Weeks 19-20 |
| Form of assessment | Written and oral examination | Written and oral examination |

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 question and 3 practical tasks 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 question and 3 practical tasks.

## Teaching materials and media

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

# MGQB4041 Additional chapters of mathematical physics

| | | | |
|---|---|---|---|
| **Study semester:** | **7** (full time) | **ECTS:** | **6** |

## Workload

| Contact Time | | Self-study | |
|---|---|---|---|
| Lectures | 30 h | Preparation for Contact Time | 80 h |
| Exercises | 30 h | Literature review | 40 h |
| Sum | 60 h | Sum | 120 h |

**Total workload** **180 h**

## Lecturers

A. Khalmukhamedov – Professor at the Department of "Differential equations and mathematical physics",

E.Kuchkorov – Associate Professor at the Department of "Differential equations and mathematical physics".

## Teaching contents

Space of basic functions, decomposition of unity. Space of generalized functions. Completeness of the space of generalized functions. Support of generalized functions. Regular and singular generalized functions. Sokhotskii formula. Linear change of variables of generalized functions. Multiplication of generalized functions. Differentiation of generalized functions. Properties of the generalized derivative. Antiderivative of a generalized function. The concept of a direct product. Properties of a direct product. Convolution of generalized functions. Properties of a convolution. Existence of a convolution. Convolution of generalized functions. Regularization of generalized functions. Space *J* of rapidly decreasing basic functions. Space *J'* of generalized functions of slow growth. Examples of generalized functions of slow growth. Structure of generalized functions with point support. Direct product of generalized functions of slow growth. Convolution of generalized functions of slow growth. Fourier transform of generalized functions of slow growth. Properties of the Fourier transform. Fourier transform of a convolution. Laplace transform of locally integrable functions. Laplace transform of generalized functions. The concept of a fundamental solution of a linear differential operator. Fundamental solutions. Inhomogeneous equations. The descent method. Fundamental solution of ordinary linear differential equations. Eigenvalue problem. Green's formulas. Properties of the operator *L*. Properties of the eigenvalues and eigenfunctions of the operator *L*. The Sturm-Liouville problem. Reduction of the Sturm-Liouville problem to an integral equation. Properties of the eigenvalues and eigenfunctions. Boundary value problems for elliptic equations. Basic boundary value problems. Uniqueness of a solution. Reduction of boundary value problems to an integral equation. Study of integral equations. Solution of the Dirichlet and Neumann problems for a sphere. Green's function for elliptic equations. Green's function in the Dirichlet problem for elliptic equations. Poisson's formula. Reduction of boundary value problems to integral equations. Basic properties of eigenfunctions and eigenvalues. Mixed problems of mathematical physics. Fourier method. Fourier method for an eigenvalue. General scheme of the Fourier method. Examples. Mixed problems for hyperbolic equations. Homogeneous hyperbolic equations. Inhomogeneous hyperbolic equations. Classical solution. Energy integral. Uniqueness of the solution and continuous dependence of the solution on the given ones. Generalized solution. Uniqueness of the generalized solution and continuous dependence on the given ones. Existence of generalized and classical solutions. Mixed problems for parabolic problems. Classical solution. Maximum principle. Existence of a solution and continuous dependence of the classical solution. Generalized solution. Existence of a generalized and classical solution.

## Learning outcomes

To successfully complete this discipline, students:

- be able to apply Fouret series and Fouret substitutions to solve problems in mathematical physics, know the basics of generalized functions (distribution theory) and methods for finding solutions to elliptic differential equations in functional spaces[1];
- should have an idea of the basic concepts of the relevant theories and the skills of logical thinking and draw correct conclusions[2];
- should an idea of a correctly posed problem and abilities to prove that solutions to boundary value problems, mixed and other problems exist and are unique, and apply the acquired theoretical knowledge in practice[3].

[1]Knowledge; [2]Skill; [3]Competence.

## 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: 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 1, Mathematical analysis 2, Mathematical analysis 3, Mathematical analysis 4, Differential equations 1, Differential equations 2, Equations of mathematical physics 1, Equations of mathematical physics 2.

## Reading list


1. Qosimov Sh.G‘., Aliqulov T.N., va boshqalar. Matematik fizikaning zamonaviy usullari. Toshkent. Universitet 2016. 1- 2 T.
2. Владимиров В.С., Жаринов В.В. Уравнения математической физики. Учебник для ВУЗов. М.: ФИЗМАТЛИТ. 2021.
3. Тихонов А.Н., Самарский А.А. Уравнения математической физики. М. Изд-во МГУ. 2022.


## 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 |
|---|---|---|
| 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 subjects and independent learning materials. Each version of the final assessment consists of 2 theoretical questions and 2 practical tasks.

## Teaching materials and media

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

# INTB4041 Integral equations

| Study semester | 7 (full time) | ECTS: | 6 |
|---|---|---|---|

## Workload

| Contact Time | | Self-study | |
|---|---|---|---|
| Lectures | 30 h | Preparation for Contact Time | 80 h |
| Exercises | 30 h | Literature review | 40 h |
| Sum | 60 h | Sum | 120 h |
| **Total workload** | **180 h** | | |

## Lecturers

B.Islomov – Professor at the Department of "Differential equations and mathematical physics",
Sh.Kasimov – Professor at the Department of "Differential equations and mathematical physics".

## Teaching contents

The concept of an integral equation. Converting a differential equation to an integral equation. Method of successive approximation. Integral equations with a continuous kernel. Duplicate core. Resolventa. Voltaire's integral equation. The principle of reduced reflection and its applications. The resolvent of Voltaire's integral equation. Integral equations with a polar core. Integral equations with discrete kernels. Fredholm theorems. Fredholm theorems for integral equations with discrete kernels. Fredholm theorems for integral equations with polar kernels. Results from Fredholm theorems for integral equations with continuous kernels. Fredholm theorems for integral equations with polar kernels. Hammerstein equation. Duplicate cores. Characteristic numbers and characteristic functions of the integral equation. Integral operators with Hermitian kernels. Artsela-Ascoli lemma. Hermitian continuous kernel integral equations. Application of Hilbert–Schmidt theory to Hermitian polar kernel integral equations. Hilbert–Schmidt theorem and its results. Monolinear extension of repeated kernels. Monolinear extension of Hermitian continuous kernel. Positive definite kernels. Application of Hilbert–Schmidt theory to Hermitian polar kernel integral equations. Singular integral equations. Singular integral equations with Cauchy kernels. Riemann problem. Composition of singular operators. Characteristic equation and its adjoint equation. Composition of singular operators. Complete singular integral equations. Noether theorems. Fourier transform. Regularization of complete singular integral equations. Noether theorems. Carleman-Vequa regularization method. Fourier transform. Fourier transform of a function integrating by its square.

## Learning outcomes

To successfully complete this discipline, students:

- have to knowledge of integral equations and Fredholm, Voltaire and singular integral equations[1];
- have to solving skills of the Fredholm and Voltaire integral equations of the first and second kind, integral equations with symmetric kernels, integral equations with weak singularity, singular integral equations and Fourier transforms of a function integrating by a square[2];
- able to know and use the Hammerstein equation, repeated kernels, linear extension of repeated kernels and application of Hilbert–Schmidt theory to Hermitian polar kernel integral equations, singular integral equations with Cauchy kernels, characteristic equation and its adjoint equation, composition of singular operators, regularization of complete singular integral equations, proving theorems on the Fourier transform of a function that is integrated by its square[3].

[1]Knowledge; [2]Skill; [3]Competence.

## 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: 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, Recommended: Mathematical analysis 1, Mathematical analysis 2, Mathematical analysis 3, Mathematical analysis 4, Analytic geometry 1, Analytic geometry 2, Differential equations 1, Differential equations 2.

## Reading list

1. Владимиров В.С., Жаринов В.В. Уравнения математической физики. Учебник для ВУЗов.

М.: ФИЗМАТЛИТ. 2021.
2. Владимиров В.С., Михайлов В.П., Михайлова Т.В., Шабунин М.И. Сборник задач по уравнениям математической физики. М.: ФИЗМАТЛИТ. 2016. – 520 с.
3. Qosimov Sh.G‘., Aliqulov T.N. Integral tenglamalarga doir masala va mashqlar. Toshkent “Universitet” 2014. O‘quv qo‘llanma. O‘zMU 2-nashri.

## 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 |
|---|---|---|
| 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 2 practical tasks 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.

# YDAB415 Final State Attestation (Including bachelor thesis)

| Study semester | 8 | | ECTS: | 15 |
|---|---|---|---|---|

## Workload

| Contact Time | | Self-study | |
|---|---|---|---|
| | | Preparation and defense of the Bachelor thesis | 450 h |
| | | Sum | 450 h |

**Total workload** **450 h**

## Lecturers

Associate Prof., Dr. Bayturaev Ashur; Prof., Dr. Omirov Bakhrom; Prof., Dr. Tishabaev Djurabay; Prof., Dr. Khalmukhamedov Alimdjan; Prof., Dr. Sharipov Olimjon; Prof., Dr. Akhmedov Akrom.

## Course content

**Geometry and topology:** Planes, Spaces, Vectors, Coordinate systems, Equations of the functions, Distance, Canonical equations, Curves, Directions, Surfaces, Fields.
**Algebra and functional analysis:** Linear Algebraic Equations, Matrix algebra, Equation solving methods, Spaces, Dimension and basis, Roots and their properties, Polynomials, Main algebraic theorems, Main rules and formulas, Relations, Groups, Mappings, Rings, Fields, Sets.
**Mathematical analysis:** Sets, Operations, Mappings, Numbers, Limits, Functions, Main theorems, formulas and rules, Derivatives, Differential of functions, Fundamental theorems of calculus, Extrema of a function, Asymptotes, Integral and its applications, Spaces, Continuity.
**Differential equations and mathematical physics:** Differential equations, Integral curves, Field, Derivatives, The theorem of existence and uniqueness, Intermediate integrals, Systems of differential equations. Integral formulas, Autonomous systems, Properties of solutions, first integrals of system of differential equations, Existence of system of first integrals, Stability theory, Boundary value problems for differential equations, Concept of eigenvalues and eigenfunctions, Integration of differential equations, Partial differential equations, System of simultaneous equations, Methods for finding a complete integral, Characteristic and integral surfaces.
**Mechanics and mathematical modeling:** Kinematics, Motions, Dynamics, Mechanics, Basic dynamic quantities, Analytical statics, Canonical equations, Variational principles of mechanics, Tensors, Kinematics of a Deformable Medium, Theory of Deformations, Mechanics of continuous media-mass and density. Dynamic equations of continuum mechanics. Continuous medium.
**Probability theory and mathematical statistics:** Spaces, Basic concepts of probability theory, Discrete, classical and geometric probability models, Algebra of Events, Axioms and properties of Probability, Conditional Probability, Independence of events, Main probability theorems and their applications, Distributions, Composition formulas, Expectations, Characteristic functions, Limit theorems and their applications, Sets, Empirical distribution functions and their properties, Statistical estimation and their properties, Exponential family, Confidence interval method, Statistical hypotheses and their types, Principles for selecting criteria to test statistical hypotheses, Parametric criteria, Goodness-of-fit criteria, Nonparametric criteria for testing the homogeneity of samples, Two-dimensional sampling, Least squares method, Linear regression equation.

## Learning outcomes

- Understand the fundamental mathematical rules and processes related to the chosen topic of the bachelor's thesis; demonstrate knowledge of the key theoretical concepts and literature relevant to the selected research area; be familiar with the methods of the relevant topics; understand the structures, methodology and ethical principles of scientific research and reporting[1];
- Apply theoretical knowledge to analyze and interpret mathematical phenomena and processes related to the thesis topic; use computational formulas and properties correctly in problem-solving and data processing; work independently on the bachelor's thesis, preparing a coherent and scientifically grounded written report; use modern information technologies for data processing, visualization, and documentation[2];
- Independently plan, conduct, and complete a small-scale scientific or applied research project in mathematics; critically evaluate results and propose improvements or refinements; present and justify research findings both in written and oral forms using the scientific facts and argumentations; integrate theoretical knowledge for solving specific problems; demonstrate responsibility, initiative, and professional ethics during the research and reporting process[3].

[1] Knowledge; [2] Skills; [3]Competence.

## Teaching and learning methods

Self-study; problem-solving sessions; group discussions; group work; giving presentations.

## Admission requirements

Mandatory: All courses of Linear algebra and functional analysis, Analytical geometry, Mathematical analysis, Differential geometry and topology, Probability theory and mathematical statistics, Differential equations and mathematical physics and Mechanics and mathematical modeling;
Recommended: All other subjects in Mathematics.

## Bibliography


1. Narmanov A.Y. Analitik geometriya. Toshkent, “Innovatsiya-Ziyo”, 154 bet, 2021-yil. Darslik.
2. Fayziyev Y.E., Buvayev Q.T., Qo‘chqorov E.I., Analitik geometriya va chiziqli algebra, “Turon-iqbol”, 112 bet, 2022. Uslubiy qo‘llanma.
3. Sharipov A.S. Analitik geometriya. Toshkent, “Tilsim” nashriyoti, 304 bet, 2023 y. Darslik.
4. Ayupov A.Sh., Omirov B.A., Xudoyberdiyev A.X. Chiziqli algebra, Toshkent, “Muxr-Press”, 392 bet, 2023-yil. Darslik.
5. Ayupov A .SH., Omirov B.A., Xudoyberdiyev A.X. Abstrakt algebra, Toshkent, “Fan”,296 bet, 2022.
6. 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,
7. Abdullayev J.I., G‘anixo‘jayev R.N., Shermatov M.H., Egamberdiyev O.I. Funksional analiz va integral tenglamalar, Toshkent, Turon-Iqbol-2022.
8. Abdullayev J.I., Eshqobilov Y.X., G‘anixo‘jayev R.N. Funksional analiz (misol va masalalar yechish) I, II qismlar, Toshkent, Turon-Iqbol-2022.
9. Tao T. Analysis 1, 2. Hindustan Book Agency, India, 2014. Darslik.
10. Alimov SH, O., Ashurov R.R. Matematik analiz 1,2,3 q. T. “Mumtoz so`z”, 2018. Darslik,
11. Туйчиев Т.Т., Тишабаев Ж.К. Дополнительные главы анализа. Т. “Университет” 2015.
12. Арнольд В.И. Обыкновенные дифференциальные уравнения. -2-е изд. М. МЦНМО, 2018. -344 с.
13. Филиппов А.Ф. Сборник задач по дифференциальным уравнениям. Учебное пособие. Изд. М.: ЛЕНАНД. 2024. 240 с.
14. Понтрягин Л.С. Обыкновенные дифференциальные уравнения. М., “Наука”, 2023. 336 с.
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16. Боровков А.А. Математическая статистика, Москва, “Лань”, 2010. -704 с.
17. Sh.Q. Formanov, Ehtimolliklar nazariyasi, Toshkent, “Universitet”, 2014 y.
18. Бухгольц Н.Н. Основной курс теоретической механики. Ч.1,2. Спб: Лань, 2021, 2023. -448 с. -336 с.
19. Rashidov T.R. va bosh. Nazariy mexanika. T.: VNESHINVESTPROM, 2020.
20. Мещерский И. В. Задачи по теоретической механике: учебное пособие для вузов. Санкт-Петербург: Лань, 2023. -448 с. -ISBN 978-5-507-46953-6.
21. Механика сплошных сред в задачах: классический учебник МГУ / под ред. М.Э. Эглит. - М.: Московский лицей, 2017. -640 с.


## 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 | Final assessment |
|---|---|
| Time of assessment | Weeks 36-38 |
| Form of assessment | Written report and oral exam |

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:

**Grade “5”** –

- the student is able to draw independent conclusions and make decisions;
- demonstrates creative thinking;
- shows independent judgment;

| | |
|---|---|
| | • can apply the acquired knowledge in practice;<br>• understands the essence of the discipline (topic);<br>• possesses solid knowledge of the subject;<br>• can clearly express and explain the content;<br>• demonstrates a comprehensive understanding of the discipline (topic).<br>• **Grade “4”** –<br>• the student shows independent judgment;<br>• can apply the acquired knowledge in practice;<br>• understands the essence of the discipline (topic);<br>• possesses sufficient knowledge of the subject;<br>• can express and explain the content;<br>• demonstrates understanding of the discipline (topic).<br>• **Grade “3”** –<br>• the student can apply the acquired knowledge in practice;<br>• understands the main idea of the discipline (topic);<br>• possesses basic knowledge of the subject;<br>• can express and explain the content;<br>• demonstrates partial understanding of the discipline (topic).<br>• **Grade “2”** –<br>• the student has not mastered the course program;<br>• does not understand the essence of the discipline (topic) and demonstrates no understanding of the subject matter. |
| **Educational materials and media** | |
| | Projector; white/black board; printed handouts; flipchart; visualization aids for presentation; demonstration equipment and materials. |