

**SYLLABUS**  
**Fall semester 2021-2022 academic years**  
**on the educational program “8D06104 - Mathematical and Computer Modeling”**

Discipline's code	Discipline's title	Independent work of students (IWS)	No. of hours per week			Number of credits	Independent work of student with teacher (IWST)
			Lectures (L)	Practical training (PT)	Laboratory (Lab)		
MMNFP 7201	Mathematical modeling of nonstationary physical processes	98	15	15	15	5	5
<b>Academic course information</b>							
Form of education	Type of course	Types of lectures	Types of practical training	Number of IWS	Form of final control		
online	theoretical	analytical	Task solution	6	writing		
Lecturer	Abdibekov Ulalikhhan Seidildaevich						
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<b>Academic presentation of the course</b>							
Aim of course	Expected Learning Outcomes (LO)			Indicators of LO achievement (ID)			
	As a result of studying the discipline the undergraduate will be able to:						
	LO 1. Description of turbulent processes by mathematical equations			ID.1 numerical method construction			
	LO 2. Construction of a mathematical model of the process			ID.2 constructing an algorithm			
	LO 3. Selection of closure methods			ID.3 constructing an algorithm			

	LO 4. Construction of a mathematical model of turbulent flow for large Reynolds numbers	ID. 4comprling program code
	As a result of studying the discipline, the doctoral candidate will be able to independently understand scientific articles and independently build models for turbulent flow	
<b>Prerequisites</b>	Mathematical and computer modeling of physical processes, continuum mechanics, mechanic of fluid, computational fluid dynamic	
<b>Post requisites</b>		
<b>Information resources</b>	<p><b>Literature:</b></p> <ol style="list-style-type: none"> <li>1. Монин А.С., Яглом А.М. Статистическая гидромеханика. - М.:Наука, 1965. - Ч. 1, - 676 с.</li> <li>2. Монин А.С., Яглом А.М. Статистическая гидромеханика. - М.:Наука, 1965. - Ч. 2 - 686 с.</li> <li>3. Хинше И.О. Турбулентность. М.:Физматгиз, 1963. - 680 с.</li> <li>4. Турбулентность. Принципы и применения. - М.: Мир, 1980. - 535 с.</li> <li>5. Методы расчета турбулентных течений. - М.: Мир, 1984. -464 с.</li> <li>6. Davidson P.A. Turbulence. An Introduction for Scientists and Engineers, OXFORD University Press 2004. – 678 p.</li> <li>7. P.Sagaut,S.Deck,M.Terasol_Multiscale_and_Multiresolution_Approaches_in_Turbulence_Impertial College Press 2006. – 356 p.</li> <li>8. Жуматулов Б.Т., Абдибеков У.С., Исахов А.А. Основы математического и компьютерного моделирования естественно-физических процессов. Алматы, Казак университеті, 2014, -206 стр.</li> </ol> <p><b>Internet-resources:</b> Additional educational material, lecture and practical classes, CDS assignments are uploaded to the teaching materials section of the univver.kaznu.kz website.</p>	
<b>Academic policy of the course in the context of university</b>	<p><b>Academic Behavior Rules:</b>  All students have to register at the MOOC. The deadlines for completing the modules of the online course must be strictly observed in accordance with the discipline study schedule.  ATTENTION! Non-compliance with deadlines leads to loss of points! The deadline of each task is indicated in the calendar (schedule) of implementation of the content of the curriculum, as well as in the MOOC.  <b>Academic values:</b>  - Practical trainings/laboratories, IWS should be independent, creative.</p>	

<b>moral and ethical values</b>	- Plagiarism, forgery, cheating at all stages of control are unacceptable. - Students with disabilities can receive counseling at e-mail uali@kaznu.kz
<b>Evaluation and attestation policy</b>	<b>Criteria-based evaluation:</b> assessment of learning outcomes in relation to descriptors (verification of the formation of competencies in midterm control and exams). <b>Summative evaluation:</b> assessment of work activity in an audience (at a webinar); assessment of the completed task.

**Calendar (schedule) the implementation of the course content:**

Week / date	Topic title (lectures, practical classes, Independent work of students, IWS)	LO	ID	Number of hours	Maximum score	Form of Knowledge Assessment	The Form of the lesson / platform
<b>Module 1. Modeling the problems of the atmosphere and ocean.</b>							
1	Lecture 1. The mathematical modeling physical processes. Introduction.	LO.1-LO.4	ID.1-ID.4	1			Video lecture in MS Teams
	Practical class 1. Related exercises	LO.1-LO.4	ID.1-ID.4	2	6		
2	Lecture 2. Mathematical modeling of atmospheric processes	LO.1-LO.4	ID.1-ID.4	1			Video lecture in MS Teams
	Practical class 2. Related exercises	LO.1-LO.4	ID.1-ID.4	2	6		Webinar in MS Teams
3	Lecture 3. Mathematical modeling of pollution of oceans and seas.	LO.1-	ID.1-ID.4	1			Video lecture

	Practical class 3. Related exercises	LO.1- LO.4	ID.1-ID.4	2	6		in MS Teams Webinar in MS Teams
	Independent work of student with teacher: IWST.				20 20		
4	Lecture 4. Mathematical modeling of short-term weather forecast.	LO.1- LO.4	ID.1-ID.4	1			Video lecture in MS Teams
	Practical class 4. Related exercises	LO.1- LO.4	ID.1-ID.4	2	6		Webinar in MS Teams
5	Lecture 5. Mathematical modeling of tropical cyclones (tornadoes).	LO.1- LO.4	ID.1-ID.4	1			Video lecture in MS Teams
	Practical class 5. Related exercises	LO.1- LO.4	ID.1-ID.4	2	6		Webinar in MS Teams
	Independent work of student with teacher: IWST.				30		
	<b>MTT 1</b>				<b>100</b>		

### Module 2. Modeling complex physical processes

6	Lecture 6. Mathematical modeling of near space.	LO.1- LO.4	ID.1-ID.4	1			Video lecture in MS Teams
	Practical class 6. Related exercises	LO.1- LO.4	ID.1-ID.4	2	6		Webinar in MS Teams
7	Lecture 7. Mathematical modeling of the hydrodynamics of aluminum electrolyzers	LO.1- LO.4	ID.1-ID.4	1			Video lecture

	Practical class 7. Related exercises	LO.1- LO.4	ID.1-ID.4	2	6		in MS Teams Webinar in MS Teams
8	Lecture 8. Modeling the dynamics of ionospheric plasma	LO.1- LO.4	ID.1-ID.4	1			Video lecture in MS Teams
	Practical class 8. Related exercises.	LO.1- LO.4	ID.1-ID.4	2	6		Webinar in MS Teams
	Independent work of student with teacher: IWST.				20 20		
9	Lecture 9. Mathematical modeling of internal flows.	LO.1- LO.4	ID.1-ID.4	1			Video lecture in MS Teams
	Practical class 9. Related exercises	LO.1- LO.4	ID.1-ID.4	2	6		Webinar in MS Teams
10	Lecture 10. Mathematical modeling of chemical processes in a confined space	LO.1- LO.4	ID.1-ID.4	1			Video lecture in MS Teams
	Practical class 10. Related exercises	LO.1- LO.4	ID.1-ID.4	2	6		Webinar in MS Teams
	Independent work of student with teacher: IWST.				30		
	<b>MT (Midterm Exam)</b>				<b>100</b>		

### Module 3. CFD nonstationare processes

11	Lecture 11. Fractional-Step Methods for three-dimensional parabolic equation.	LO.1- LO.4	ID.1-ID.4	1			Video lecture
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	Practical class 11. Related exercises	LO.1- LO.4	ID.1-ID.4	2	6		in MS Teams Webinar in MS Teams
12	Lecture 12. Fourier method for the three-dimensional pressure equation.	LO.1- LO.4	ID.1-ID.4	1			Video lecture in MS Teams
	Practical class 12. Related exercises	LO.1- LO.4	ID.1-ID.4	2	6		Webinar in MS Teams
	Independent work of student with teacher: IWST.				20		
13	Lecture 13. RANS for nonstationare physical processes	LO.1- LO.4	ID.1-ID.4	1			Video lecture in MS Teams
	Practical class 13. Related exercises	LO.1- LO.4	ID.1-ID.4	2	6		Webinar in MS Teams
14	Lecture 14. A Reynolds stress model for velocity and scalar fields.	LO.1- LO.4	ID.1-ID.4	1			Video lecture in MS Teams
	Practical class 14. Related exercises	LO.1- LO.4	ID.1-ID.4	2	6		Webinar in MS Teams
	Independent work of student with teacher: IWST.	LO.1- LO.4	ID.1-ID.4		25		
15	Lecture 15. LES for physical processes.	LO.1- LO.4	ID.1-ID.4	1			Video lecture in MS Teams
	Practical class 15. Related exercises	LO.1- LO.4	ID.1-ID.4	2	6		Webinar in MS Teams

	Independent work of student with teacher: IWST.									Teams
										Webinar in MS Teams
	<b>MT 2</b>								<b>100</b>	
	<b>Exam</b>								<b>100</b>	

[Abbreviations: QS - questions for self-examination; TK - typical tasks; IT - individual tasks; CW - control work; MT - midterm.

Comments:

- Form of L and PT: webinar in MS Teams / Zoom (presentation of video materials for 10-15 minutes, then its discussion / consolidation in the form of a discussion / problem solving / ...)
- Form of carrying out the CW: webinar (at the end of the course, the students pass screenshots of the work to the monitor, he/she sends them to the teacher) / test in the Moodle DLS.
- All course materials (L, QS, TK, IT, etc.) see here (see Literature and Resources, p. 6).
- Tasks for the next week open after each deadline.
- CW assignments are given by the teacher at the beginning of the webinar.]

**Dean**

**Chairman of the Faculty Methodical Bureau**

**Head of the Department**

**Lecturer**