Fall semester 2020-2021 academic years
on the educational program «8D05306 – Physics»

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)		
IVFNP 7702	Selected problems of non-ideal plasma physics	98	15	30	0	5	7

Academic course information

Form of education	Type of course	Types of lectures	Types of practical training	Number of IWS	Form of final control
Offline	Theoretical	Problematic, analytical	Problem solving, situational tasks	7	Writing exam
Lecturer	Prof. Dr. Tlekkabul Ramazanov			Of./p.	By schedule
e-mail	ramazan@physics.kz				
Telephone number	377-31-89				

Academic presentation of the course

Aim of course	Expected Learning Outcomes (LO) As a result of studying the discipline the PhD student will be able to:	Indicators of LO achievement (ID) (for each LO at least 2 indicators)
Know and understand properties of complex plasma	**LO 1.** Explain the essence of the current state of development of the physics of dusty plasma	**ID 1.1.** Understand basic concepts about nonideal plasma
		ID 1.2. Classify different effects in plasma
	LO 2. Solve various problems with the properties of a complex plasma based on modern theories	**ID 2.1.** Apply dynamic methods of nonideal plasma
		ID 2.2. Calculate a radial distribution function on the basis of expansion by small parameter.
	LO 3. Calculate the properties of complex plasma	**ID 3.1.** Use ionization equilibrium and composition of nonideal plasma
		ID 3.2. Apply Ornstein-Zernike equationfor a radial distribution function
	LO 4. Evaluate the model of interaction between particles	**ID 4.1.** Derive equation for effective charge-charge potential, which takesinto account the screening and quantum mechanical effects
		ID 4.2. Find the degeneration parameter for semiclassical plasma
	LO 5. Describe the basic theoretical methods at investigation of ionization equilibrium	**ID 5.1.** Determine parameters and structures characterizes a dusty

		plazma **ID 5.2.** UseSaha equation for composition of semiclassical nonideal plasma
Prerequisites	"Probability theory", "Electricity and magnetism", "Thermodynamics and statistical physics", and "Introduction to plasma physics" and "Physics of nonideal plasma".	
Post requisites	Scientific-research work of doctorate	
Information resources	1. T.S. Ramazanov, K.N. Dzhumagulova, Phys. Plas. 9, 3758 (2002). 2. T.S. Ramazanov, K.N. Dzhumagulova, M.T. Gabdullin, Phys. Plasm. 17, 042703 (2010). 3. T.S.Ramazanov, K.N. Dzhumagulova, Yu.A. Omarbakiyeva, Phys. Plasm. 12, 092702 (2005). 4. Baimbetov F.B., Ramazanov T.S. Mathematical simulation in nonideal plasma physics. Almaty. Scinse. 1994.-212 P. (Monograph). 5. Hansen J.-P. Statistical mechanics of dense plasmas. (Review). Amsterdam. 1982. 6. Ichimaru S., Iyetomi H., Tanaka S. Statistical physics of dense plasmas. Physics Reports. 1987. V.149. No.2-3. W. Ebeling, W.-D. Kraeft, D. Kremp, Theory of bound states and ionization equilibrium in plasmas and solids (Akademie-Verlag, Berlin, 1976). 7. W. Ebeling, W.-D. Kraeft, D. Kremp, Theory of bound states and ionization equilibrium in plasmas and solids (Akademie-Verlag, Berlin, 1976).R. Redmer, Phys. Rep. 282, 35 (1997). 8. R. Redmer, G. Röpke, Contrib. Plasma Phys. 29, 343 (1989). 9. R.Redmer, Phys. Rev. E 59 1073-1081 (1999). 10. S. Kuhlbrodt, R. Redmer, Phys. Rev. E. 62, 7191 (2000). 11. B.M. Smirnov, Physics of atom and ion (Moscow, Nauka 1986). 12. G.I. Kerley, J. Chem. Phys. 85, № 9 5228-5231 (1986).	
Academic policy of the course in the context of university moral and ethical values	**Academic Behavior Rules:** 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. **Academic values:** - Practical trainings/laboratories, IWS should be independent, creative. - Plagiarism, forgery, cheating at all stages of control are unacceptable. - Students with disabilities can receive counseling at e-mail ramazan@physics.kz.	
Evaluation and attestation policy	**Criteria-basedevaluation:** assessment of learning outcomes in relation to descriptors (verification of the formation of competencies in midterm control and exams). **Summativeevaluation:** assessment of work activity in an audience (at a webinar); assessment of the completed task.	

CALENDAR (SCHEDULE) THE IMPLEMENTATION OF THE COURSE CONTENT:

weeks	Topic name	LO	ID	Amount of hours	Maximum score	Form of Knowledge Assessment	The Form of the lesson / platform
Module 1The effective potentials of nonideal plasma.							
1	**L.1** Basic Concepts about Nonideal Plasma. Different Effects in a Plasma.	LO 1	ID 1.1.	2			offline
1	**PT 1**To dimension the Relations between Plasma Parameters, such as Debye Radius, Average Distance between Particles and de Broglie Wave-Length.	LO 1	ID 1.2.	1	8	Analysis	offline
2	**L.2** Basic Concepts about Nonideal Plasma. "Charge-Charge" Interactions in Nonideal Plasma.	LO 1	ID 1.1-1.2.	2			offline
2	**PT 2** To dimension the effective potentials of "Charge-Charge" interactions	LO 1	ID 1.1.	1	8	Analysis	offline
3	**L.3** Basic Concepts about Nonideal Plasma. "Charge-Atom"Interactions in Nonideal Plasma.	LO 1	ID 1.2.				offline
3	**PT 3** To dimension the effective potentials of "Charge-Atom" interactions.	LO 1	ID1.1.		8		offline
3	**IWSP 1 Consultation on the implementation of IWS1**	LO 1	ID1.2.		5		offline
3	**IWS 1.** To derive equation for effective charge-charge potential, which take into account the screening and quantum mechanical effects	LO 2	ID 1.1-1.2.		20	Logictask	offline
Module II							
4	**L.4** Electrical Methods of Nonideal Plasma Generation	LO 3	ID 1.1-1.2.	1			offline
4	**PT 4** Composition of ideal plasma on the basis of the Saha equation	LO 1	ID 1.1-1.2.		8		offline
5	**L.5** Lecture 5. Dynamic Methods of Nonideal Plasma Generation, Shock waves expieriments.	LO 4	ID 1.1-1.2.				offline
5	**PT 5** The Lowering of Ionization Potential.	LO 1	ID2.1.		8		offline
5	**IWSP 2 Consultation on the implementation of IWS2**	LO 1	ID2.1.		5		offline
5	**IWS2** Degeneration parameter for semiclassical plasma.	LO 4	ID2.1.		20	Logictask	offline
5	**Make a structural and logical diagram of the readmaterial**	LO 1	ID2.2.		10		offline

5	**Intermediate Control 1**				100		
6	**L.6** Ionization equilibrium and Composition of Nonideal Plasma.	LO 1	ID2.2.	2			offline
6	**PT 6** Composition of Classical Nonideal Plasma on the Basis of the Saha Equation with Taking into Account the Lowering of Ionization Potential.	LO 1	ID2.1-2.2.	1	8	Analysis	offline
7	**L.7** Thermodynamic Properties of a Nonideal Plasma.	LO 1	ID3.2.				offline
7	**PT 7** Composition of Semiclassical Nonideal Plasma on the Basis of the Saha Equation with Taking into Account the Lowering of Ionization Potential.	LO 5	ID3.1-3.2.	1	8	Analysis	offline
8	**L.8** Structural Properties of a Nonideal Plasma. Radial distribution function.	LO 1	ID3.1-3.2.	2			offline
8	**PT 8** To Calculate a Radial Distribution Function on the Basis of Expansion by small parameter.	LO 1	ID3.1-3.2.		8	Analysis	offline
8	**IWSP 3 Consultation on the implementation of IWS3**	LO 1	ID3.1-3.2.		5		offline
8	**IWS 3** To derive equation for lowering of ionization potential of semiclassical nonideal hydrogen plasma.	LO 1	ID3.1-3.2.		25	Logictask	offline
9	**L.9** Ornstain-Zernike Equations for Nonideal Plasma.	LO 1	ID3.1-3.2.				offline
9	**PT 9** To Calculate a Radial Distribution Function on the Basis of Ornstain-Zernike Equations.	LO 1	ID4.1.	2	8	Analysis	offline
10	**L.10** Transport Properties of a Nonideal Plasma by Molecular Dynamics Simulation.	LO 1	ID4.1.	2			offline
10	**PT 10** To analyze derived results.	LO 1	ID4.1.		8	Analysis	offline
10	**IWSP 4 Consultation on the implementation of IWS4**	LO 1	ID4.1.		5		offline
10	**IWS 4** Ornstain-Zernike Equations for Nonideal Plasma.	LO 1	ID4.2.		15	Problem task	offline
10	**IWSP 5 Make a structural and logical diagram of the read material**	LO 1	ID4.1.		10		offline
10	**MT (MidtermExam)**				100		offline
11	**L.11** Basic Concepts about Dusty Plasma.	LO 1	ID4.2.				offline
11	**PT 11** A Determination of Parameters and Structure Characterizes of a Dusty Plasma.	LO 1	ID4.2.	1	8	Analysis	offline
12	**L.12**Processes and Mechanisms Charging of Dusty Particles.	LO 1	ID4.2.	1			offline
12	**PT 12** A Determination of Parameters	LO 1	ID4.2.	1	8	Analysis	offline

	and Structure Characterizes of a Dusty Plasma.						
12	**IWSP 6 Consultation on the implementation of IWS5**	LO 1	ID4.2.		5		offline
12	**IWS5** A Determination of Parameters and Structure Characterizes of a Dusty Plasma.	LO 1	ID4.2.		25	Problem task	offline
13	**L.13** Experimental methods Generated Dusty plasma.	LO 1	ID4.2.	1			offline
13	**PT 13** A Determination of Parameters and Structure Characterizes of a Dusty Plasma.	LO 1	ID5.1.	1	8	Analysis	offline
14	**L.14**A Determination of Parameters and Structure Characterizes of a Dusty Plasma.	LO 1	ID5.1.	1			offline
14	**PT 14**A Determination of Parameters and Structure Characterizes of a Dusty Plasma.	LO 1	ID5.1.	1	8	Analysis	offline
15	**L.15**Application of Dusty Plasmas.	LO 1	ID5.1.	1			offline
	PT 15A Determination of Parameters and Structure Characterizes of a Dusty Plasma.	LO 1	ID5.1.	1	8	Analysis	offline
	IWSP 7 Consultation on the implementation of IWS6	LO 5	ID 5.2.		5		offline
	IWS6 Degeneration parameter for semiclassical plasma.	LO 1	ID5.2.		15	Analysis	offline
	Тест	LO 1	ID5.2.		10		offline
	Intermediate Control 2				100		

[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.]

Considered and recommended at the meeting of the department of plasma physics, nanotechnology and computer physics

on "18" 08 2020, protocol No 1.

Head of department _____ S. K. Kodanova
(signature)

Recommended by methodical bureau of the faculty
on "20" 08 2020, protocol No 1.

Chairman of the method bureau of the faculty _____ Gabdullina A.T.
(signature)

Approved by the Academic Council of the faculty
Protocol no 1 of 21.08. 2020 .

Chairman of the Academic Council,
dean of faculty of physics and technology _____ Davletov A. E.

Lecturer _____ Ramazanov T.S.