

**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 equation for a radial distribution function					
LO 4. Evaluate the model of interaction between particles		ID 4.1. Derive equation for effective charge-charge potential, which takes into 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	<ol style="list-style-type: none"> 1. T.S. Ramazanov, K.N. Dzhumagulova, <i>Phys. Plas.</i> 9, 3758 (2002). 2. T.S. Ramazanov, K.N. Dzhumagulova, M.T. Gabdullin, <i>Phys. Plasm.</i> 17, 042703 (2010). 3. T.S. Ramazanov, K.N. Dzhumagulova, Yu.A. Omarbakiyeva, <i>Phys. Plasm.</i> 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, <i>Phys. Rep.</i> 282, 35 (1997). 8. R. Redmer, G. Röpke, <i>Contrib. Plasma Phys.</i> 29, 343 (1989). 9. R. Redmer, <i>Phys. Rev. E</i> 59 1073-1081 (1999). 10. S. Kuhlbrodt, R. Redmer, <i>Phys. Rev. E.</i> 62, 7191 (2000). 11. B.M. Smirnov, Physics of atom and ion (Moscow, Nauka 1986). 12. G.I. Kerley, <i>J. Chem. Phys.</i> 85, № 9 5228-5231 (1986).
Academic policy of the course in the context of university moral and ethical values	<p>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.</p> <p>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.</p>
Evaluation and attestation policy	<p>Criteria-based evaluation: assessment of learning outcomes in relation to descriptors (verification of the formation of competencies in midterm control and exams). Summative evaluation: assessment of work activity in an audience (at a webinar); assessment of the completed task.</p>

CALENDAR (SCHEDULE) THE IMPLEMENTATION OF THE COURSE CONTENT:

wee ks	Topic name	LO	ID	Am oun tof hou rs	Max imu m scor e	Form of Knowled ge Assessm ent	The Form of the lesson / platform
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Module I The 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	ID 1.1.		8		offline
3	IWSP 1 Consultation on the implementation of IWS1	LO 1	ID 1.2.		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 experiments.	LO 4	ID 1.1-1.2.				offline
5	PT 5 The Lowering of Ionization Potential.	LO 1	ID 2.1.		8		offline
5	IWSP 2 Consultation on the implementation of IWS2	LO 1	ID 2.1.		5		offline
5	IWS2 Degeneration parameter for semiclassical plasma.	LO 4	ID 2.1.		20	Logictask	offline
5	Make a structural and logical diagram of the readmaterial	LO 1	ID 2.2.		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 Ornstein-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 Ornstein-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 Ornstein-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.14A Determination of Parameters and Structure Characterizes of a Dusty Plasma.	LO 1	ID5.1.	1			offline
14	PT 14A 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
	Tecr	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.

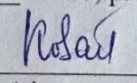
Comments:

- 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

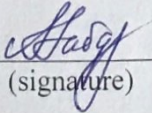
on "18" 08 2020, protocol No 1.

Head of department

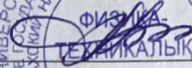

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S. K. Kodanova

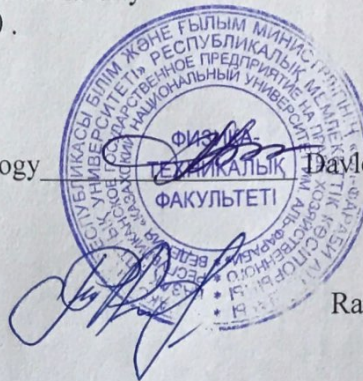
Recommended by methodical bureau of the faculty
on " 20 " 08 . 2020, protocol No 1 .

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  Dayletov A. E.

Lecturer



Ramazanov T.S.