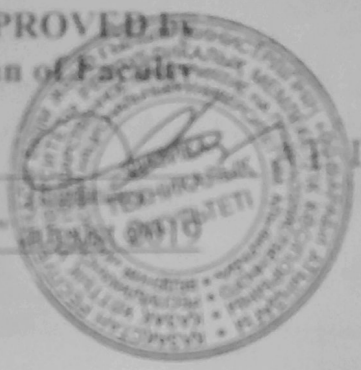
Al-Farabi Kazakh National University
Faculty of Physics and Technology
Department of Plasma physics, nanotechnology and computer physics

APPROVED BY
Dean of Faculty



_____ T.S. Davletov

"29" _____ 2019

EDUCATIONAL-METHODICAL COMPLEX OF DISCIPLINE

IVKFP7301 «Complex plasma physics with nano and micro particles»

Specialty "8D08112 - Nanomaterials and nanotechnology"
Educational program

Course – 1
Semester – 1
Number of credits – 3

Almaty 2019

Educational-methodical complex of the discipline is made by Prof. Dr. Tlekkabul Ramazanov.

Based on the working curriculum on the specialty "8D08112 - Nanomaterials and nanotechnology ".

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

on "27" august, 2019, protocol No.1

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

Recommended by the methodical bureau of the faculty

on "28" august, 2019, protocol No.1

Chairman of the methodical bureau of
the faculty of physics and technology _____ A.T. Gabdullina
(signature)

Syllabus for discipline IVKFP7301 « Complex plasma physics with nano and micro particles **»**
for the Specialty "8D07112 - Nanomaterials and nanotechnology "
Fall semester, 2019-2020 Academic year

Academic course information

Discipline's code	Discipline's title	Type	No. of hours per week			Number of credits	ECTS
			Lect.	Pract.	Lab.		
IVKFP7301	Selected problems of complex plasma physics		1	2		3	5
Lecturer	Prof. Dr. Tlekkabul Ramazanov		Office hours Saturday 14.00-14.50			Scheduled Tuesday 17.00-17.50	
e-mail	E-mail: ramazan@physics.kz						
Telephone number	Telephone: 377-31-89		Auditory			331	
Assistant	Prof. Dr. Tlekkabul Ramazanov		Office hours Saturday 14.00-14.50			Scheduled Tuesday 18.00-19.50	
e-mail	E-mail: ramazan@physics.kz						
Telephone number	Telephone: 377-31-89		Auditory			331	

Academic presentation of the course	The course " Selected problems of complex plasma physics " is an elective course in the educational program of the PhD doctorate in the specialty "8D07112 - Nanomaterials and nanotechnology". **Aim of course:** study of properties for nonideal plasmas on the basis of different modern theoretical methods. Student have to solve concrete tasks in plasmas physics and to assist in it discussions. **As a result of the course PhD students must be able to:** - to summarize the basis theoretical methods at investigation of ionization equilibrium and properties for complex plasmas; - to classify a fundamental problem in complex plasma physics and it applied; - to explain modern problems in physics of complex plasmas; - to describe plasma and corresponding apply necessary method of calculations; - to evaluate the model of interaction between particles, with take into account different effects (screening effects, quantum mechanical effects diffraction and symmetry, degeneration and etc.); - to explain derived knowledge for analyze of concrete physical phenomena; - to predict derived results in respect to real plasmas medium; - to calculate a properties of complex plasmas.
Prerequisites	General courses of physics "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	Literature: 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:** Obligatory attendance of classes, intolerance for being late, commitment to deadlines for completion and delivery of assignments (CDS, Practical classes, midterm exams, individual projects). **Academic values:** According to Article 5 of the Code of Honor of students of Al-Farabi Kazakh National University, a student must strictly fulfill his academic duties and prevent academic and legal violations (plagiarism, forgery, use of cribs, deceit of and disrespectful attitude to teaching stuff, absenteeism and coming late without respectful reasons). All students can receive counseling assistance in person, by phone at the numbers indicated or by e-mail provided.
Evaluation and attestation policy	**Criteria-based evaluation:** evaluation of achieving learning outcomes in accordance with the descriptors (checking competencies acquired at weeks of the intermediate control, midterm and final examinations) **Summative evaluation:** Final score of the discipline $=\frac{IC1+MT+IC2}{3} \cdot 0.6 + 0.4\,FE$ IC1, IC2, MT are intermediate controls, MT is Midterm, FE – final exam. Percent-rating letter system for assessing of achievements of leaning outcomes by students: 95% - 100%: A 90% - 94%: A- 85% - 89%: B+ 80% - 84%: B 75% - 79%: B- 70% - 74%: C+ 65% - 69%: C 60% - 64%: C- 55% - 59%: D+ 50% - 54%: D- 0% -49%: F

Calendar (schedule) the implementation of the course content:

Week / date	Topic title (lectures, practical classes, Independent work of students)	Number of hours	Maximum score
1	2	3	4
Module 1. The effective potentials of nonideal plasma.			
1	Lecture 1. Basic Concepts about Nonideal Plasma. Different Effects in a Plasma.	2	
	Practical class 1. To dimension the Relations between Plasma Parameters, such as Debye Radius, Average Distance between Particles and de Broglie Wave-Length.	1	10
2	Lecture 2. Basic Concepts about Nonideal Plasma. "Charge-Charge" Interactions in Nonideal Plasma.	2	
	Practical class 2. To dimension the effective potentials of "Charge-Charge" interactions.	1	10
	Independent work of student with teacher 1. To derive equation for effective charge-charge potential, which take into account the screening and quantum mechanical effects	1	20
3	Lecture 3. Basic Concepts about Nonideal Plasma. "Charge-Atom" Interactions in Nonideal Plasma.	2	
	Practical class 3. To dimension the effective potentials of "Charge-Atom" interactions.	1	10
Module 2. Experimental Generation Methods of Nonideal Plasma			
4	Lecture 4. Electrical Methods of Nonideal Plasma Generation	2	
	Practical class 4. Composition of ideal plasma on the basis of the Saha equation	1	10
	Independent work of student with teacher 2: Degeneration parameter for semiclassical plasma.	1	10
5	Lecture 5. Dynamic Methods of Nonideal Plasma Generation, Shock waves expieriments.	2	
	Practical class 5. The Lowering of Ionization Potential.	1	10
	Independent work of student with teacher 3: To derive equation for lowering of ionization potential of semiclassical nonideal hydrogen plasma.	1	20
	IC 1		100
6	Lecture 6. Ionization equilibrium and Composition of Nonideal Plasma.	2	
	Practical class 6. Composition of Classical Nonideal Plasma on the Basis of the Saha Equation with Taking into Account the Lowering of Ionization Potential.	1	10
Module 3. Structure, Thermodynamic and Transport Properties of a Nonideal Plasma			
7	Lecture 7. Thermodynamic Properties of a Nonideal Plasma.	2	
	Practical class 7. Composition of Semiclassical Nonideal Plasma on the Basis of the Saha Equation with Taking into Account the Lowering of Ionization Potential.	1	10

8	Lecture 8. Structural Properties of a Nonideal Plasma. Radial distribution function.	2	
	Practical class 8. To Calculate a Radial Distribution Function on the Basis of Expansion by small parameter.	1	30
9	Lecture 9. Ornstain-Zernike Equations for Nonideal Plasma.	2	
	Practical class 9. To Calculate a Radial Distribution Function on the Basis of Ornstain-Zernike Equations.	1	30
	Independent work of student with teacher 4: Ornstain-Zernike Equations for Nonideal Plasma.	1	10
10	Lecture 10. Transport Properties of a Nonideal Plasma by Molecular Dynamics Simulation.	2	
	Practical class 10 To analyze derived results.	1	20
	MIDTERM		100
Module 4. Physics of Strongly Nonideal Plasma (Dusty Plasma)			
11	Lecture 11. Basic Concepts about Dusty Plasma.	2	
	Practical class 11. A Determination of Parameters and Structure Characterizes of a Dusty Plasma.	1	10
	Independent Work Of Student With Teacher 5: A Determination of Parameters and Structure Characterizes of a Dusty Plasma.	1	10
12	Lecture 12. Processes and Mechanisms Charging of Dusty Particles.	2	
	Practical class 12. A Determination of Parameters and Structure Characterizes of a Dusty Plasma.	1	20
13	Lecture 13. Experimental methods Generated Dusty plasma.	2	
	Practical class 13. A Determination of Parameters and Structure Characterizes of a Dusty Plasma.	1	10
	Independent Work Of Student With Teacher 6: Degeneration parameter for semiclassical plasma.	1	10
14	Lecture 14. A Determination of Parameters and Structure Characterizes of a Dusty Plasma.	2	
	Practical class 14. A Determination of Parameters and Structure Characterizes of a Dusty Plasma.	1	20
	Independent work of student with teacher 7: Methods of Diagnostic for Dusty Plasma.	1	10
15	Lecture 15. Application of Dusty Plasmas.	2	
	Practical class 15. A Determination of Parameters and Structure Characterizes of a Dusty Plasma.	1	10
	IC 2		**100**
Final examinations			**100**

Lecturer T.S. Ramazanov

Head of the department of plasma physics, nanotechnology and computer physics S. K. Kodanova

Chairman of the Faculty Methodical Bureau A.T. Gabdullina