Al-Farabi Kazakh National University
Faculty of Theoretical and Nuclear Physics
Department of Theoretical and Nuclear Physics

APPROVED by
Dean of Faculty
_____ Davletov A.E.
___09___ 20 17y.

EDUCATIONAL-METHODICAL COMPLEX OF DISCIPLINE

VTS 5303 "Introduction to the theory of supersymmetry"

Specialty "6M060400 - Physics"
Educational program " 6M060401 – Theoretical Physics "

Course – 1
Semester – 1
Number of credits – 3

Almaty 2017

Educational-methodical complex of the discipline is made by __Takibayev Nurgali Zhabagaevich, d.s.p.-m., academic of NAS RK, professor___ (name, surname, scientific degree, academic rank)

Based on the working curriculum on the specialty
"6M060400 - Physics"

Considered and recommended at the meeting of the department ___of Theoretical and Nuclear Physics

from «_05_» _____09_____ 2017 year, protocol № 2

Head of department _____ Abishev M.Y.
(Signature)

Recommended by methodical bureau of the faculty
«__06__» _____09_____ 2017 year, protocol № 1

Chairman of the method bureau of the faculty _____Gabdullina A.T.
(Signature)

Al-Farabi Kazakh National University
Faculty of Physics and Technology
Chair of Theoretical and Nuclear Physics

Syllabus
Autumn semester, 2017-2018 academic year

Academic course information

Discipline's code	Discipline's title	Type	No. of hours per week			Number of credits	ECTS
			Lect.	Pract.	Lab.		
5303 VTS	Introduction to the theory of supersymmetry	Basic	2	1	0	3	5

Lecturer	TakibayevN.Zh., d.s.p.-m., academic of NAS RK, professor	Office hours	Scheduled
e-mail	E-mail: takibayev@gmail.com		
Telephone number	Telephone: *2925-133; 8-777-704-0396*	Auditory	319

Academic presentation of the course	**Type of course** (theoretical, practical; basic, elective) and its purpose (role and place of the course in the educational program): Theoretical Nuclear Physics. **The aim of the course:** to give the students the deep understanding of the modern physics of nucleus of atoms and quantum mechanics of many-particle systems and self study, to form a system of competences in the context of qualification requirements: * A) cognitive: be able to – demonstrate acquired knowledge (specifically) and it's understanding; - demonstrate an understanding of the overall structure of the study field and the relations between its elements (specifically); B) functional: be able to – include new knowledge in the context of basic knowledge, interpret its contents; - analyze educational situation and offer direction to solve it; - use methods (research, calculation, analysis, etc.) inherent to the field of study (specifically) individually or in a group teaching and research activities; ** C) systemic: be able to - synthesize, interpret and evaluate the learning outcomes of discipline, modules, midterm exam content (specifically); make an analysis of D) Social: be able to - constructiveeducationalandsocialinteractionandcooperationinthegroup; - propose to consider a problem, to reason its importance; - accept criticism and to criticize; - work in a team; E) metacompetences: be able to – recognize the role of taken course in the implementation of individual learning paths. *Thesystemofdescriptorverbsmustbeusedduringtheformationofcompetences (Look in Application 2) **Active and interactive methods is recommended to ensure deeper understanding and learning of educational material and to achieve learning out comes of the course (individual researches, group projects, case studies and other methods).
Prerequisites	Mathematical analysis, the theory of functions of complex variables, differential equations, mathematical physics, statistical physics, physics of elementary

	particles.
Post requisites	Actual problems of physics and ecology, trends in the development of technology and environmental problems, Problems of energy and nanotechnologies, Modern problems of space ecology and physics.
Information resources	**Literature:** 1. M. Kaku: Introduction to superstrings and M- Theory, Springer, 624 (1999). 2. *J. Wess, J. Bagger*:Supersymmetry and Supergravity, Princeton University Press (1992). 3. *E. Witten*, "Constraints on supersymmetry breaking", Nucl. Phys. **B202**, 253(1982). 4. *S.P. Martin*, "A supersymmetry primer",ArXiv:hep-ph/9709356. 5. *J.D. Lykken*, "Introduction to supersymmetry",ArXiv:hep-th/9612114. 6. *A. Bilal*, "Introduction to Supersymmetry",ArXiv:hep-th/0101055. 7. *D.I. Kazakov*, «Supersymmetric expansion of the Standard model of fundamental interactions», the works of the summer school of the «Dynasty» foundation «Physics of fundamental interactions», (2006). 8. *M. Shifman, A. Vainshtein*, "Instantons Versus Supersummetry: Fifteen years later,"ArXiv:hep-th/9902018. **Internet-resources:** 1. Krasnikov N V, Matveev V A hep-ph/9703204 2. *Y.A. Golfand, E.P. Likhtman*, JETP Lett. **13** 452 (1971) 3. Volkov D V, Akulov V P *Phys. Lett. B* **46** 109 (1973) 4. Wess J, Zumino B *Nucl. Phys. B* **70** 39(1974)
Academic policy of the course in the context of university moral and ethical values	**Academic Behavior Rules:** Compulsory attendance in the classroom, the impermissibility of late attendance. Without advance notice of absence and undue tardiness to the teacher is estimated at 0 points. **Academic values:** Inadmissibility of plagiarism, forgery, cheating at all stages of the knowledge control, and disrespectful attitude towards teachers. (The code of KazNU Student's honor)
Evaluation and attestation policy	**Criteria-based evaluation:** Assessment of learning outcomes in correlation withdescriptors (verification of competence formation during midterm control andexaminations). **Summative evaluation:** evaluation of the presence and activity of the work in the classroom; assessment of the assignment, independent work of students, (project / case study / program / ...)

Calendar (schedule) the implementation of the course content:

Weeks	Topic title (lectures, practical classes, Independent work of students)	Number of hours	Maximum score
	Module 1		
1	Lecture-1 (L-1). Continuous integrals and point particles.	2	-
	Seminar -1 (S-1).Relativistic point particles.	1	5
2	L-2.Secondary quantization.Harmonic oscillators.	2	-
	S-2.Currents and secondary quantization.	1	5

3	L-3. The strings of Nambu-Goto.	2	-
	S-3.Boson strings.	1	5
	MSWT-1. Prepare the report: Quantization in the calibration of a light cone.	1	20
4	L-4. Two-dimensional supersymmetry.	2	-
	S-4. Closed strings.	1	5
	Module 2		
5	L-5. Supersymmetry	2	-
	S-5. Supersymmetric point particles.	1	5
	MSWT-2. Prepare the report: Quantization.	1	20
6	L.-6.Two-dimensional supersymmetry.Trees.	2	-
	S.-6. Local two-dimensional supersymmetry.	1	5
7	L.-7.Conformal field theory and the Kac-Moody algebra.	2	-
	S.-7. Conformal field theory.	1	5
	MSWT-3. Prepare the report: Superconformal field theory.	1	25
	1stIntermediate Control (IC1)		**100**
8	**Midterm (MT)**		**100**
8	L-8.Fermion vertex operator. Spinors and trees.	2	-
	S-8.The Kac-Moody algebras.	1	5
	Module 3		
9	L-9. Multi-loop amplitudes and Teichmüller spaces.	2	-
	S-9. Unitarity. One-loop amplitudes.	1	5
	MSWT-4. Prepare the report: Harmonic oscillators.	1	10
10	L-10. Field theory in the calibration of the light cone.	2	-
	S-10. Derivation of the field theory of point particles.	1	5
11	L-11. Field theory of BRST.	2	-
	S-11.Covariant field string theory.	1	5
	MSWT-5. Prepare the report: Closed strings and superstrings.	1	10
12	L-12.Geometric field string theory.	2	-
	S-12String group.	1	5
13	L-13. Anomalies and the Atiyah-Singer theorem.	2	-
	S-13. Anomalies and Feynman diagrams.	1	5
	MSWT-6. Prepare the report: Reduction of anomalies in	1	20

	string theory.		
14	L-14.Heterotic strings and compactification.	2	-
	S-14.Spectrum of states. Covariant and fermion formulations.	1	5
15	L-15.On the theory of supersymmetry.	2	-
	S-15.Four-dimensional superstrings.	1	5
	MSWT-7. Prepare the report: Review of the theory of supersymmetry.	1	25
	2ndIntermediate Control (IC2)		**100**
	Exam		**100**
	Total		**100**
Note: Independent work of students with teacher is 7 hours for semester. 3, 5, 7, 9, 11, 13 and 15 weeksareincludedintosyllabus (assignmentsubmission)			

Lecturer_____TakibayevN.Zh.
Head of the Department_____Abishev M.E.
Chairman of the Faculty Methodical Bureau_____Gabdullina A.T.