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

APPROVED by
Dean of Faculty
Davletov A.E.
30 06 2017

EDUCATIONAL-METHODICAL COMPLEX OF DISCIPLINE

VTYa 3301 « Introduction to the nucleus theory »

Specialty "5B060400 –Physics"
Educational program "Theoretical physics" IET I

Course – 4
Semester – 7
Number of credits – 3

Almaty 2017

Educational-methodical complex of the discipline is made by Takibayev N.Zh., d.s.p.-m., academic of NAS RK, professor lecturer (name, surname, scientific degree, academic rank)

Based on the working curriculum on the specialty "5B060400 – Physics"

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

from «_20_» ___06___ 2017 year, protocol № 42

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

Recommended by methodical bureau of the faculty

«__26__» __06__ 2017 year, protocol № 10

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.		
VTYa 3301	Introduction to the nucleus theory	Elective	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	**Typeofcourse** (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) 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) 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) be able to - synthesize, interpret and evaluate the learning outcomes of discipline, modules, midterm exam content (specifically); D) be able to – constructive educational and social interaction and cooperation in the group; - propose to consider a problem, to reason its importance; - accept criticism and to criticize; - work in a team; E) be able to – recognize the role of taken course in the implementation of individual learning paths. *The system of descriptor verbs must be used during the formation of competences (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 there methods).
Prerequisites	Mathematical analysis, the theory of functions of complex variables, differential equations, mathematical physics, statistical physics, physics of elementary

	particles.
Post requisites	Quantum scattering theory, quantum statistical physics.
Information resources	Literature (with an indication of the authors and data output), the availability (number), software and consumables with information about where you can get them. (8-9) Recommended: 1. Bethe H.A., Morrison P. Elementary Nuclear Theory, 1st ed. New York: Wiley, 1947. 147 p. 2. Heyde K. Basic Ideas and Concepts in Nuclear Physics: An Introductory Approach, 2nd Edition. Institute of Physics Publishing Bristol and Philadelphia, 1999. 547 p. 3. Kamal A. Nuclear Physics, Springer, 2014. — 612 p. — (Graduate Texts in Physics). 4. Iliadis Ch. Nuclear Physics of Stars, WILEY-VCH Verlag, Weinheim, 2007, 666 pages Martin B.R. Nuclear and Particle Physics: An Introduction, Wiley, 2006. — 415 p. 5. Takigawa N., Washiyama K., Fundamentals of Nuclear Physics, Springer, Japan, 2017. – 277 p. Additional: 1. Shultis J.K., Faw R.E. Fundamentals of Nuclear Science and Engineering, Kansas State University Manhattan, Marcel Dekker, New York, Basel, 2002, 506 pp. 2. Frobrich P., Lipperheide R., Theory of nuclear reactions, Clarendon Press, Oxford. 1996 - 476 p. 3. J.M.Blatt and V.F.Weisskopf, Theoretical Nuclear Physics, Springer, 1979, VII.5 4. Nuclear Physics by Irving Kaplan 2nd edition1962 Addison-Wesley
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 / ...) The formula for calculating the final grade. $\text{Final grade for the discipline} = \frac{IC1 + IC2}{2} \cdot 0{,}6 + 0{,}1MT + 0{,}3FC$ Below are the minimum estimates in percentage terms: 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:

Weeks	Topic title (lectures, practical classes, Independent work of students)	Number of hours	Maximum score
	Module 1		
1	Lecture-1 (L-1). Gravitational interaction.	2	-
	Seminar -1 (S-1). Characteristics of fundamental interactions.	1	5
2	L-2. Weak interaction.	2	-
	S-2. Decay of atomic nuclei.	1	5
3	L-3. Electromagnetic interaction.	2	-
	S-3. The theory of the Weinberg-Salam- Glashow.	1	5
	SSWT 1. Prepare the report: Electromagnetic interaction	1	20
4	L-4. Strong interaction.	2	-
	S-4. Potential of Yukavo.	1	5
	Module 2		
5	L-5. Some problems of physics of elementary particles.	2	-
	S-5. Quantum chromodynamics.	1	5
	SSWT 2. Prepare the report: Some problems of physics of elementary particles.	1	20
6	L.-6. The concept of mass in modern physics.	2	-
	S.-6. The concept of mass in modern physics.	1	5
7	L.-7. Physical experiment: the current state and prospects of development.	2	-
	S.-7. Some achievements of experimental physics.	1	5
	SSWT 3. Prepare the report: Physical experiment: current state and development prospects.	1	25
	1stIntermediate Control (IC1)		**100**
8	**Midterm (MT)**		**100**
8	L-8. Quarks and nuclei.	2	-
	S-8. The quark structure of the proton and neutron.	1	5
	Module 3		
9	L-9. Particle accelerators.	2	-
	S-9. Largest projects in the world.	1	5
	SSWT 4. Prepare the report: Particle accelerators.	1	10
10	L-10. Energetic properties of nuclei.	2	-
	S-10. The binding energy of nuclei.	1	5
11	L-11. Nuclei, which far from the stability region.	2	-
	S-11. Stability region.	1	5
	SSWT 5. Prepare the report: Nuclei, which far from the stability region.	1	10
12	L-12. Radioactivity.	2	-
	S-12 General characteristics of radioactive processes.	1	5
13	L-13. Spontaneous fission and spontaneously fissionable	2	-

	nuclear isomers.		
	S-13. Synthesis of transuranic elements.	**1**	5
	SSWT 6. Prepare the report: Spontaneous fission of nuclear isomers.	**1**	20
14	L-14. Radioactivity of proton and double-proton. Cluster radioactivity.	**2**	-
	S-14. Theory of alpha- decay.	**1**	5
15	L-15. Super dense nuclear matter. Transition radiation.	**2**	-
	S-15. Classification of radiations mechanisms of fast particles in the medium.	**1**	5
	SSWT 7. Prepare the report: Feynman diagrams.	**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 _____ A.T.Gabdullina A.T.