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

APPROVED by
Dean of Faculty
_____ Davletov A.E.
"31" 08 2018

EDUCATIONAL-METHODICAL COMPLEX OF DISCIPLINE

ACST 7303 « Modern computational methods in nuclear physics contents »

Specialty "6D060500 – Nuclear Physics"
Educational program on specialty "6D060500 – Nuclear Physics"

Course – 1
Semester – 1
Number of credits – 3

Almaty 2018

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 "6D060500 – Nuclear Physics"

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

from «_28__ » ___08___ 2018 year, protocol № 1

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

Recommended by methodical bureau of the faculty

«__31__» __08__ 2018 year, protocol № 1

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

Syllabus

on discipline (SVMYaPh 7304) "Modern computational methods in nuclear physics contents"

"6D060500- Nuclear Physics"

Autumn semester, 2018-2019 academic year,

Course 1

Academic course information

Discipline's code	Discipline's title	Type	No. of hours per week			Number of credits	ECTS
			Lect.	Pract.	Lab.		
SVMYaPh 7304	Modern computational methods in nuclear physics contents	Elective	1	2	0	3	5

Lecturer	Takibayev N.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	The training course "Modern computational methods in nuclear physics contents" is **an elective** component in educational program of **doctoral student on specialty "6D060500 – Nuclear Physics"** **The aim of the course:** learning themodern physics ofatom nucleus and quantum mechanics of many-particlesystems. As a result of the discipline, the student will be able to: 1. describe acquired knowledge (specifically) and it's understanding; 2. interpret an understanding of the overall structure of the study field and the relations between its elements (specifically); 3. generalize new knowledge in the context of basic knowledge, interpret its contents; 4. create educational and social interaction and cooperation in the group; 5. explain the solution of the problem, its importance; 6. classify criticism and to criticize; 7. decide to work in a team; 8. combine 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; 9. design active and interactive methods which are recommended to ensure deeper understanding and learning of educational material; 10. achieve learning outcomes of the course (individual researches, group projects, case studies and their methods).
Prerequisites	Mathematical analysis, the theory of functions of complex variables, differentialequations, mathematical physics, statistical physics, physics of elementaryparticles.

Post requisites	Taken knowledge will be used in research work.
Information resources	Literatures (with an indication of the authors and data output), the availability(number), software and consumables with information about where you can getthem. 1. P.Bodenheimer, G.P.Laughlin, M.Rozyczka, T.Plewa, H.W Yorke. Numerical Methods in Astrophysics: An Introduction. 344 pages. CRC Press. December 13, 2006 2. M.Hjorth-Jensen, M.P.Lombardo, Ubirajara van Kolck. An Advanced Course in Computational Nuclear Physics: Bridging the Scales from Quarks to Neutron Stars. 644 pages. Springer; 1st ed. 2017 edition. June 7, 2017 3. C.H.Holbrow, J.N.Lloyd, J. C. Amato, E.Galvez, M.E.Parks. Modern Introductory Physics. 658 pages. Springer; 2nd ed. 2010 edition. September 23, 2010 4. Y.Azmy, E.Sartori. Nuclear Computational Science: A Century in Review. 470 pages. Springer; 2010 edition. May 14, 2010 5. J.H Hamilton, F.Yang. Modern Atomic and Nuclear Physics. 797 pages. World Scientific Pub Co Inc; Revised edition. March 30, 2010 6. Senior Fellow Continuous Electron Beam Accelerator Facility (Cebaf) Governor's Distinguished Cebaf Professor John Dirk Walecka. Theoretical Nuclear And Subnuclear Physics. 628 pages. Wspc/Icp; 2 edition. September 30, 2004 7. A.Das, T.Ferbel. Introduction to Nuclear and Particle Physics. 416 pages. World Scientific Pub Co Inc; 2 edition. December 29, 2003
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/casestudy/ 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 doctoral students)	Number of hours	Maximum score
	Module 1		
1	Lecture-1 (L-1). Introduction to the course "Programming and computer calculations in physics".	1	-
	Seminar -1 (S-1).Introduction to the system of Mathematica.	2	5
2	L-2.Model of calculating	1	-
	S-2. Numbers. Their representation and operations over them.	2	5
3	L-3. Arithmetic: the decomposition of integers into prime factors.	1	-
	S-3. Arithmetic: prime numbers.	2	5
	DSWT 1. Assignment submission № 1: Arithmetic: the greatest common divisor and least common multiple (prepare the report)	1	20
4	L-4. Модулярная арифметика: division with remainder, deductions, comparisons and the Chinese remainder theorem.	1	-
	S-4. Numerical functions.	2	5
	Module 2		
5	L-5. Multimedia: geometry, graphics, cinema, sound.	1	-
	S-5. Factorization Factor Integer ECM	2	5
	DSWT 2.Assignmentsubmission № 2: Factorization of very large numbers (prepare the presentation)	1	20
6	L.-6. Plotting	1	-
	S.-6. Linear programming	2	5
7	L.-7.NuclearForces	1	-
	S.-7. NuclearModels	2	5
	DSWT 3.Assignment submission№ 3: Nuclear Forces and Nuclear Models (in oral form)	1	25
	1st Intermediate Control (IC1)		**35+65=100**
	Midterm (MT)		**100**
8	L-8.Basic Concepts of Nuclear Physics	1	-
	S-8.Toward a Unified Model Description of Nuclei	2	5
	S-8.Toward a Unified Model Description of Nuclei	2	5
	Module 3		
9	L-9. Introduction to Nuclear Interactions and Reactions	1	-
	S-9. Coulomb Excitation, Compound Nucleus Reactions, and Other Reactions	2	5
	DSWT4. Assignment submission №4: Some Selected Applications of Nuclear Physics (prepare the presentation)	1	10
	L-10. Radioactive Decay Laws	1	-
10	S-10. Alpha, Proton, Heavy Cluster and Spontaneous Fission Decays	2	5
	L-11. Gamma Decay, Internal Conversion and Pair Production	1	-
11	S-11.Beta Decay	2	5

	DSWT5. Assignment submission № 5: Radioactive Decay (prepare the report)	1	10
	L-12.Introduction to Nuclear Interactions and Reactions	1	-
12	S-12. Reaction Kinematics	2	5
	L-13. Fission and Fusion: Atomic Energy Utilization	1	-
13	S-13. Some Selected Applications of Nuclear Physics	2	5
	DSWT 6. Assignment submission № 6:Nuclear Interactions and Reactions (prepare the presentation)	1	20
	L-14.Magnetic Dipole Hyperfine Interaction	1	-
14	S-14.Electric Quadrupole Hyperfine Interaction	2	5
	L-15.Particle Families and Interactions	1	-
15	S-15. Conservation Rules	2	5
	DSWT 7. Assignment submission№ 7:High-Energy Physics (in oral form)	1	25
	2nd Intermediate Control (IC2)		**35+65=100**
	Exam		**100**
	Total		**100**

Lecturer _____ Takibayev N.Zh.

Head of the Department _____ Abishev M.E.

Chairman of the Faculty Methodical Bureau _____ Gabdullina A.T.