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

Syllabus
4st semester
_____academic year

Academic course information

Discipline's code	Discipline's title	Type	No. of hours per week			Number of credits	ECTS
			Lect.	Pract.	Lab.		
	Introduction to the nucleus theory		2	1	0	3	4.5

Lecturer	Takibayev Nurgali Zhabagaevich, Doctor of Science in Physics and Mathematics, Professor	Office hours	Scheduled
e-mail	E-mail: takibayev@gmail.com		
Telephones	Telephone: 87777040396	Auditory	319
Assistant	Full name, academic degree, academic rank.	Office hours	Scheduled
e-mail	E-mail:		
Telephones	Telephone:	Auditory	

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); - analyze dynamics of scientific problems decision of the course (scientific reviews of specific issues researches); - make an analysis of learning outcomes of the course, generalize them through scientific essays, presentations, reviews, scientific review, etc.);

	D) Social: 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) metacompetences: 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 outcomes 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.
References and 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 Behaviour 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. Submission of assignments (Independent work of students, midterm control, laboratory tasks, projects and etc.) prior to the deadlines. The violation of submission deadlines leads to the deduction of penalty points. **Academic values:** Academic honesty and integrity: independent performance of assignments;

	inadmissibility of plagiarism, forgery, cheating at all stages of the knowledge control, and disrespectful attitude towards teachers. (The code of KazNU Student's honor) Students with disabilities may receive advice via ... E- address, phone ...
Evaluation and attestation policy	**Criteria-based evaluation:** assessment of learning outcomes in correlation with descriptors (verification of competence formation during midterm control and examinations). **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.
Calendar (schedule) the implementation of the course content (Appendix 1)	Weekly description of lecture topics, practical / seminar / laboratory / project work , assignments for independent work of students; an indication of the topic scope and grading scheme, including an assessment of the control task. Summary and analysis of the curriculum content after the first half of the semester (midterm control 1) in the form of a scientific essay / system-oriented analysis of scientific issues of studied topics / presentation of individual case studies / evaluation of personal contribution to the development of a group project assignment, and others.

Lecturer_____ N.Zh.Takibayev
Head of the Chair_____ M.E.Abishev
Chairman of the Faculty Methodical Bureau_____A.T.Gabdullina

APPENDIX 1

Calendar (schedule) the implementation of the course content

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	8
1	Lecture 1. Gravitational interaction. Seminar 1. Characteristics of fundamental interactions.	3	8
2	Lecture 2. Weak interaction. Seminar 2. Decay of atomic nuclei.	3	8
3	Lecture 3. Electromagnetic interaction Seminar 3. The theory of the Weinberg-Salam-Glashow. SSW 1. Prepare the report	3	8
4	Lecture 4. Strong interaction. Seminar 4. Potential of Yukavo.	3	8
5	Lecture 5. Some problems of physics of elementary particles. Seminar 5. Quantum chromodynamics. SSW 2. Reports.	3	8
6	Lecture 6. The concept of mass in modern physics.	3	8

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7	Lecture 7. Physical experiment: the current state and prospects of development. Seminar 7. Some achievements of experimental physics. SSW 3. Prepare the report	3	8
8	Lecture 8. Quarks and nuclei. Seminar 8. The quark structure of the proton and neutron.	3	8
9	Lecture 9. Particle accelerators. Seminar 9. Largest projects in the world. SSW 4. Particle accelerators.	3	8
10	Lecture 10. Energetic properties of nuclei. Seminar 10. The binding energy of nuclei.	3	8
11	Lecture 11. Nuclei, which far from the stability region. Seminar 11. Stability region SSW 5. Nuclei, which far from the stability region.	3	8
12	Lecture 12. Radioactivity Seminar 12. General characteristics of radioactive processes.	3	8
13	Lecture 13. Spontaneous fission and spontaneously fissionable nuclear isomers. Seminar 13. Synthesis of transuranic elements. SSW 6. Spontaneous fission of nuclear isomers	3	8
14	Lecture 14. Radioactivity of proton and double-proton. Cluster radioactivity. Seminar 14. Theory of alpha- decay.	3	8
15	Lecture 15. Super dense nuclear matter. Transition radiation. Seminar 15. Classification of radiations mechanisms of fast particles in the medium. SSW 7. Feynman diagrams.	3	8
Independent work of students with teacher is 7 hours for semester. 3, 5, 7, 9, 11, 13 and 15 weeks are included into syllabus (assignment submission)			