

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

APPROVED by
Dean of Faculty



Davletov A.E.

2018

EDUCATIONAL-METHODICAL COMPLEX OF DISCIPLINE

YaA5208 « Nuclear Astrophysics »

Specialty "6M060400 –Physics"

Educational program "Computer modeling of Multipartial Systems and Nuclear Astrophysics "

Course – 1

Semester – 2

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 "6M060400 – 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)

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

Syllabus
Spring semester, 2018-2019 academic year

Academic course information

Discipline's code	Discipline's title	Type	No. of hours per week			Number of credits	ECTS
			Lect.	Pract.	Lab.		
YaA5208	Nuclear Astrophysics	Elective	2	1	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	<p>Type of course "Nuclear Astrophysics" is elective component and its purpose: Theoretical Nuclear Physics.</p> <p>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. As a result of the discipline, the student will be able to:</p> <ul style="list-style-type: none"> – describe acquired knowledge (specifically) and it's understanding; – interpret an understanding of the overall structure of the study field and the relations between its elements (specifically); – generalize new knowledge in the context of basic knowledge, interpret its contents; – create educational and social interaction and cooperation in the group; – explain the solution of the problem, its importance; – classify criticism and to criticize; – decide to work in a team; – 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; – design active and interactive methods which are 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 their methods).
Prerequisites	Mathematical analysis, the theory of functions of complex variables, differentialequations, mathematical physics, statistical physics, physics of elementaryparticles.

Post requisites	The theory of gauge fields and electroweak interactions, chromodynamics, quantum gravity.												
Information resources	<p>Literature (with an indication of the authors and data output), the availability(number), software and consumables with information about where you can get them.</p> <p>Recommended:</p> <ol style="list-style-type: none"> 1. Richard N. Boyd. An Introduction to Nuclear Astrophysics. University of Chicago Press (April 15, 2008) 2. Norman K. Glendenning. Compact Stars: Nuclear Physics, Particle Physics, and General Relativity. Springer; 2nd edition (June 16, 2000) 3. D. Perlov, A.Vilenkin Cosmology for the Curious. Springer; 1st ed. 2017 edition. July 20, 2017 <p>Additional:</p> <ol style="list-style-type: none"> 4. Gershberg R.E. Active solar-type main sequence stars. Odessa: Astroprint 2002. 5. B.Greene.The Elegant Universe: Superstrings, Hidden Dimensions, and the Quest for the Ultimate Theory Hardcover – October 17, 2003 6. Cotnikova R. T Astrophysics. Irkutsk .: RIO 2005. 7. A.G.W. Cameron and David Miles Kahl.Stellar Evolution, Nuclear Astrophysics, and Nucleogenesis Dover Publications; 2 edition (March 21, 2013) Feb 21, 2013 												
Academic policy of the course in the context of university moral and ethical values	<p>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.</p> <p>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)</p>												
Evaluation and attestation policy	<p>Criteria-based evaluation: Assessment of learning outcomes in correlation with descriptors (verification of competence formation during midterm control and examinations).</p> <p>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.</p> $\text{Final grade for the discipline} = \frac{IC1 + IC2}{2} \cdot 0,6 + 0,1MT + 0,3FC$ <p>Below are the minimum estimates in percentage terms:</p> <table> <tr> <td>5% - 100%: A</td> <td>90% - 94%: A-</td> <td></td> </tr> <tr> <td>85% - 89%: B+</td> <td>80% - 84%: B</td> <td>75% - 79%: B-</td> </tr> <tr> <td>70% - 74%: C+</td> <td>65% - 69%: C</td> <td>60% - 64%: C-</td> </tr> <tr> <td>55% - 59%: D+</td> <td>50% - 54%: D-</td> <td>0% -49%: F</td> </tr> </table>	5% - 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
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Calendar (schedule) the implementation of the course content:

Wee ks	Topic title (lectures, practical classes, Independent work of master students)	Number of hours	Maximum score
Module 1			
1	Lecture-1 (L-1). Stars and interstellar medium.	2	-
	Seminar -1 (S-1).The birth of stars. Study interstellar medium.	1	5
2	L-2.Galaxies and quasars.	2	-
	S-2.Galaxies and quasars.	1	5
3	L-3. Basic physical laws.	2	-
	S-3.The use of physical laws to the study of space objects (stars, cosmic plasma) and the universe as a whole.	1	5
	MSWT 1.Prepare the report: The use of physical laws to the study of space objects (stars,cosmic plasma) and the universe as a whole.	1	20
4	L-4. Sources of stellar energy.	2	-
	S-4. Renewable energy sources.	1	5
Module 2			
5	L-5. Interaction of radiation with matter.	2	-
	S-5.Elementary bases of the interaction of matter and radiation.	1	5
	MSWT 2. Prepare the report: Elementary basis of the interaction of matter and radiation.	1	20
6	L.-6.Radiative transfer equation and it's simple solutions.	2	-
	S.-6. Consideration of problems using the transfer equation.	1	5
7	L.-7.Physical processes in celestial sources of radiation.	2	-
	S.-7. Nuclear reactions in stars and other astronomical objects.	1	5
	MSWT 3. Prepare the report: Nuclear reactions in stars and other astronomical objects.	1	25
	1st Intermediate Control (IC1)		100
8	Midterm (MT)		100
8	L-8.The theory of interactions.	2	-
	S-8.The interactions and reactions of two-particle and three-particle types	1	5
Module 3			
9	L-9. Energy and mechanisms of nuclear fission.	2	-
	S-9. Thermonuclear reactions, thermonuclear bomb.	1	5
	MSWT 4. Prepare the report: Thermonuclear reactions, thermonuclear bomb.	1	10
10	L-10. The luminosity of stars and their mass.	2	-
	S-10. The explosions of supernovae, quasars,pulsars, neutron stars.	1	5

11	L-11. Modern theoretical ideas about the nature of stars and their systems.	2	-
	S-11. Modern problems of astrophysics.	1	5
	MSWT 5. Prepare the report: Modern problems of astrophysics.	1	10
12	L-12. Physical methods of research of space objects.	2	-
	S-12. The use of the achievements of nuclear physics to the study of cosmic phenomena.	1	5
13	L-13. Current problems in astrophysics.	2	-
	S-13. The latest discoveries and developments in the study of the universe in recent years.	1	5
	MSWT 6. Prepare the report: The latest discoveries and developments in the study of the universe in recent years.	1	20
14	L-14. Nuclear reactions in astrophysical objects.	2	-
	S-14. Nuclear reactions in astrophysical objects.	1	5
15	L-15. Databases on nuclear reactions.	2	-
	S-15. Databases on nuclear reactions.	1	5
	MSWT 7. Prepare the report: Astrophysical observations.	1	25
	2nd Intermediate Control (IC2)		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.