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

FONT5301 «Fundamental Bases of Nanotechnology»

Specialty "6M074000 – Nanomaterials and Nanotechnologies"
Educational program "6M074000 – Nanomaterials and Nanotechnologies"

Course – 1
Semester – 2
Number of credits – 2

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 "6M074000 – Nanomaterials and Nanotechnologies "

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	Fundamental Bases of Nanotechnology	Elective	1	1	0	2	4

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	**Type of course "Fundamental Bases of Nanotechnology" is elective component** and its purpose: 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. As a result of the discipline, the student will be able to: – 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	Organization and planning of research, physical fundamentals of microelectronics, nanotechnology in electronics, nanotechnology in metallurgy.

Post requisites	Nanomedicine based on plasma technology, synthesis of carbon composite materials in the plasma medium, nanostructered materials in construction, thermal plasma in nanotechnology.
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. Recommended: 1. J. W. Steed, J. L. Atwood (eds.), *Encyclopedia of Supramolecular Chemistry*, Marcel Dekker, New York, NY, USA, 2004. 2. P. J. Cragg, *Practical Supramolecular Chemistry*, John Wiley & Sons, Ltd, Chichester, UK, 2006. 3. K. Ariga, T. Kunitake, *Supramolecular Chemistry – Fundamentals and Applications*, Springer- Verlag, Heidelberg, 2006 4. J. W. Steed, D. R. Turner, K. J. Wallace, *Core Concepts in Supramolecular Chemistry and Nanochemistry*, John Wiley & Sons, Ltd, 2007. Additional: 1. Introduction to Nano. Basics to Nanoscience and Nanotechnology. Editors: Sengupta, Amretashis, Sarkar, Chandan Kumar, 2015. 2. Nanotechnology: Principles and Practices. Authors: Kulkarni, Sulabha K.. 2015. 3. Functional Nanostructures. Processing, Characterization, and Applications, Editors: Seal, Sudipta, 2008.
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 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. $$\text{Final grade for the discipline} = \frac{IC1 + IC2}{2} \cdot 0{,}6 + 0{,}1MT + 0{,}3FC$$ Below are the minimum estimates in percentage terms: 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

Calendar (schedule) the implementation of the course content:

Weeks	Topic title (lectures, practical classes, Independent work of master students)	Number of hours	Maximum score
	Module 1		
1	Lecture-1 (L-1). The history of the emergence and basic principles of nanotechnology.	1	-
	Seminar -1 (S-1). Carbon nanomaterials. Quantum dots.	1	5
2	L-2. Features of physical interactions on nanoscale. Quantum mechanics of nanoobjects.	1	-
	S-2. X-ray scattering and crystal temperature.	1	5
3	L-3. Nanosystems Research Methods.	1	-
	S-3. X-ray diffraction. Optical spectroscopy methods.	1	5
	MSWT 1. Prepare the report: Electron microscopy (TEM, SEM). Probe microscopy (STM, AFM, etc.).	1	20
4	L-4. Physics of nanodevices. Devices for optoelectronics and nanoelectronics.	1	-
	S-4. Tunnel diode. Single electronics. LEDs and lasers on double heterostructures. Photodetectors on quantum wells.	1	5
	Module 2		
5	L-5. Optical switches and filters.	1	-
	S-5. Magnetic nanodevices for recording and storing information.	1	5
	MSWT 2. Prepare the report: Nanosensors.	1	20
6	L.-6. Supramolecular approaches to the synthesis of nanoobjects.	1	-
	S.-6. Discrete supramolecular nano-objects.	1	5
7	L.-7. Determination of supramolecular (SM) chemistry.	1	-
	S.-7. Supermolecules and SM ensembles. Classification of intermolecular interactions.	1	5
	MSWT 3. Prepare the report: The concept of their energy and orientation.	1	25
	1st Intermediate Control (IC1)		**100**
8	**Midterm (MT)**		**100**
8	L-8. Hydrogen bond (VS). Components VS. Multiple sun. Sun in Nature. Examples of synthetic use of the sun.	1	-
	S-8. Endo-receptors. Coordination liaison (CS). Examples of discrete complexes. Exo receptors. Examples of use for constructing discrete (0D) CM polygons and polyhedra.	1	5
	Module 3		
9	L-9. Supramolecular approaches to the synthesis of nanoobjects.	1	-
	S-9. Supramolecular polymers.	1	5

	MSWT 4. Prepare the report: Coordination polymers (KP) as a subclass of CM polymers.1D, 2D and 3D KP - chains, grids and frames - geometric requirements for tectons.	1	10
10	L-10. Functional inorganic nanomaterials.	1	-
	S-10. Lithium batteries are the most efficient energy storage devices.	1	5
11	L-11. Nanomaterials for fuel cells - the most efficient sources of electrical energy.	1	-
	S-11. High-temperature superconductors - 21st century materials for efficient use of energy.	1	5
	MSWT 5. Prepare the report: Functional inorganic nanomaterials.	1	10
12	L-12. Perovskite structure - an inexhaustible source of new materials.	1	-
	S-12. Nanomaterials for fuel cells - the most efficient sources of electrical energy.	1	5
13	L-13. Nucleic acid nanotechnology.	1	-
	S-13. DNA in nanotechnology.	1	5
	MSWT 6. Prepare the report: DNA based materials.	1	20
14	L-14. Nanotechnology in drug delivery.	1	-
	S-14. Behavior patterns of nanoparticles in the body.	1	5
15	L-15. Nanobioanalytical systems: from molecular recognition to biodetection.	1	-
	S-15. Development of bioanalytical methods.	1	5
	MSWT 7. Prepare the report: Theoretical foundations of molecular recognition processes.	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.