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

**APPROVED by**
**Dean of Faculty**
_____ Davletov A.E.
"__09__" ____09____ **2017**

# EDUCATIONAL-METHODICAL COMPLEX OF DISCIPLINE

## YaVPZM 7301 « Physical theory of nuclear reactor and installations »

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

Course – 1
Semester – 1
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 "6D060500 – Nuclear Physics"

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

from «_05__ » ___09___ 2017 year, protocol № 2

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

Recommended by methodical bureau of the faculty
«__06__» __09__ 2017 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, 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. | | |
| YaVPZM 7301 | Pysical theory of nuclear reactor and installations | Elective | 2 | 1 | 0 | 3 | 5 |

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|---|---|---|---|
| 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 |

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| 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): Pysical theory of nuclear reactor and installations.<br>**The aim of the course:** to familiarize the pre-laboratory with nuclear installations, the theory of nuclear reactors and the use of the acquired skills in experimental work.*<br>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);<br>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;<br>C) be able to - synthesize, interpret and evaluate the learning outcomes of discipline, modules, midterm exam content (specifically); make an analysis of<br>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;<br>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 | Organization and planning of research |
| Post requisites | It is necessary in a future professional practice |
| 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 |

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| | them. (8-9)<br>Recommended:<br>1. A. Lyubimov., D.Kish. Введение в экспериментальную физику частиц. 2nd edition. 2001.<br>2. "DOE Fundamentals Handbook: Nuclear Physics and Reactor Theory". 2008<br>3. Enrico, Fermi and Leo, Szilard U.S. "Neutronic Reactor" issued . 1955<br>4. Wilson, P.D., The Nuclear Fuel Cycle, OUP (1996)<br>5. Foster, Arthur R. and Wright, Robert L. Jr., Basic Nuclear Engineering, 3rd Edition, Allyn and Bacon, Inc., 1977.<br>6. Jacobs, A.M., Kline, D.E., and Remick, F.J., Basic Principles of Nuclear Science and Reactors, Van Nostrand Company, Inc., 1960.<br>Additional:<br>1. Technical and Economic Aspects of Load Following with Nuclear Power Plants, OECD Nuclear Energy Agency (June 2011)<br>2. Golubev, V. I.; Dolgov, V. V.; Dulin, V. A.; Zvonarev, A. V.; Smetanin, É. Y.; Kochetkov, L. A.; Korobeinikov, V. V.; Liforov, V. G.; Manturov, G. N.; Matveenko, I. P.; Tsibulya, A. M. (1993). "Fast-reactor actinoid transmutation"<br>3. Alex P. Meshik, The Workings of an Ancient Nuclear Reactor, Scientific American (26 January 2009; originally published in the October 2005 edition of Scientific American)<br>4. Knief, Ronald Allen, Nuclear Energy Technology: Theory and Practice of Commercial Nuclear Power, McGraw-Hill, 1981.<br>5. Lamarsh, John R., Introduction to Nuclear Engineering, Addison-Wesley Company, 1977 |
| Academic policy of the course in the context of university moral and ethical values | **Academic Behavior Rules:**<br>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.<br>**Academic values:**<br>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:**<br>Assessment of learning outcomes in correlation withdescriptors (verification of competence formation during midterm control andexaminations).<br>**Summative evaluation:**<br>evaluation of the presence and activity of the work in the classroom; assessment of the assignment, independent work of students, (project / case study / program / ...)<br>The formula for calculating the final grade.<br>$$\text{Final grade for the discipline} = \frac{IC1 + IC2}{2} \cdot 0,6 + 0,1MT + 0,3FC$$<br>Below are the minimum estimates in percentage terms:<br>5% - 100%: A 90% - 94%: A-<br>85% - 89%: B+ 80% - 84%: B 75% - 79%: B-<br>70% - 74%: C+ 65% - 69%: C 60% - 64%: C-<br>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). Physics of Elementary particles | **2** | - |
| | Seminar -1 (S-1). List of particles and characteristics | **1** | 5 |
| 2 | L-2. Discovering of Nucleon (proton and neuteron) | **2** | - |
| | S-2. Properties of Nucleon | **1** | 5 |
| 3 | L-3. Introduction to Nuclear Reactor. | **2** | - |
| | S-3. Classification of reactors | **1** | 5 |
| | DSWT 1. Prepare the report: Classification of reactors | **1** | 20 |
| 4 | L-4. Mechanism of nuclear power reactors | **2** | - |
| | S-4. Fission and heat generation | **1** | 5 |
| | **Module 2** | | |
| 5 | L-5. Mechanism of reactors: Cooling and reactivity control. | **2** | - |
| | S-5.Electrical power generation | **1** | 5 |
| | DSWT 2. Prepare the report: Mechanism of nuclear power reactors. | **1** | 20 |
| 6 | L.-6. Classification by type of nuclear reaction | **2** | - |
| | S.-6. Nuclear fission and fusion | **1** | 5 |
| 7 | L.-7. Current technologies | **2** | - |
| | S.-7. Future and developing technologies | **1** | 5 |
| | DSWT 3. Prepare the report: How to work with reactors: emergency, security. mechanism | **1** | 25 |
| | **1stIntermediate Control (IC1)** | | **100** |
| 8 | **Midterm (MT)** | | **100** |
| 8 | L-8. Nuclear fuel cycle | **2** | - |
| | S-8. Natural nuclear reactors | **1** | 5 |
| | **Module 3** | | |
| 9 | L-9. Energy and mechanisms of nuclear fission. | **2** | - |
| | S-9. Nuclear reactions, thermonuclear bomb. | **1** | 5 |
| | DSWT 4. Prepare the report: Nuclear reactions, Nuclear bomb. | **1** | 10 |
| 10 | L-10. The power rating of a nuclear power reactor | **2** | - |
| | S-10. Fuelling a nuclear power reactor | **1** | 5 |
| 11 | L-11. Physics of high energy matter | **2** | - |
| | S-11. Theoretical imagination of structure of nuclear interactions | **1** | 5 |
| | DSWT 5. Nuclear interaction: how is it going? | **1** | 10 |
| 12 | L-12. The main installations of material world: accelerator | **2** | - |
| | S-12 Mechanism of accelerator | **1** | 5 |
| 13 | L-13. Needed advances In Accelerators science. | **2** | - |
| | S-13. Technology and related apparatus | **1** | 5 |

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|---|---|---|---|
| | DSWT 6. Prepare the report: How to develop and future of nuclear installations. | **1** | 20 |
| **14** | L-14. Particle beams physics. | **2** | - |
| | S-14. Nuclear reactions in particles physics. | **1** | 5 |
| **15** | L-15. Databases on nuclear reactions. | **2** | - |
| | S-15. Databases on nuclear reactions. | **1** | 5 |
| | DSWT 7. Prepare the report: Other types of nuclear reactors and installations. | **1** | 25 |
| | **2nd Intermediate 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.