Syllabus

On discipline (PVE5306) High Energy Physics

for specialty **"6M060400-Physics"**

Autumn semester, 2018-2019 academic year,

Course 2

Academic course information

Discipline's code	Discipline's title	Type	No. of hours per week			Number of credits	ECTS
			Lect.	Pract.	Lab.		
PVE 5306	Physics of high energy	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	**Type of course** "High Energy Physics" is elective component and its purpose: Theoretical Physics. **The aim of the course:** to learn to form a system of competences in the context ofqualification requirements.As a result of the discipline, the student will be able to: – 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 a0 group teaching and research activities; – synthesize, interpret and evaluate the learning outcomes of discipline, modules, midterm exam content (specifically); – constructive educational and social interaction and cooperation in the group; – propose to consider a problem, to reason its importance; – accept criticism and to criticize; – workin a team; – 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 – 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 there methods).
Prerequisites	Mathematical analysis, the theory of functions of complex variables, differential equations, mathematical physics, statistical physics, physics of elementary particles.
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. D.H. Perkins, Introduction to High Energy Physics, Cambridge University Press, 2000. 2. Hochenergiephysik, Addison-Wesley, 1990. (out of press) 3. B. Povhu.a., Teilchen und Kerne, Springer, 8. Auflage, 2009. (Paperback) 4. Encyclopedia of Applied High Energy and Particle Physics, Ed. R. Stock, Wiley 2009.

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. The formula for calculating the final grade. $\text{Final grade for the discipline} = \frac{\text{IC1} + \text{IC2}}{2} \cdot 0{,}6 + 0{,}1\text{MT} + 0{,}3\text{FC}$ 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, MSWT)	Number of hours	Maximum score
	Module 1		
1	Lecture-1 (L-1). Introduction: matter and forces. Matter content of the Universe. Forces, Grand unified theories	1	-
	Seminar -1 (S-1).The weak force. The strong force.Grand unified theories	1	*5*
2	L-2.Experimental possibilities. Neutrino experiments. High-energy colliding-beam experiments	1	-
	S-2.Bubble chambers. High-energy colliding-beam experiments	1	*5*
3	L-3. Heisenberg and interaction picture. Harmonic oscillator using Dirac operators	1	-
	S-3.Quick introduction: four-vectors, Lorentz transformation, light cone	1	5
	MSWT 1. Assignment submission № 1: Relativistic kinematics, centre-of-mass energy, Mandelstam variables	1	20
4	L-4.The Klein-Gordon equation.Feynman interpretation of negative energy solutions	1	-
	S-4.Definition of the cross section.Crosssectionevaluation.	1	*5*
	Module 2		
5	L-5. Relativistic spin-1/2 particles. Pauli matrices, commutation relations. The Diracequation, α, βand γmatrices.	1	-
	S-5.Solutions of the Dirac equation.	1	5
	MSWT 2 Assignment submission № 2: The adjoint Dirac equation and the conserved probability current	1	20

6	L.-6.$e^-\mu^-$ scattering. Electron in an EM field.	1	-
	S.-6. Spin, γ^5 and helicity.	1	5
7	L.-7.Trace theorems. $d\sigma/d\Omega$ for the process	1	-
	S.-7. Helicity conservation at high energies	1	5
	MSWT 3. Assignment submission № 3: Virtual photons and the photon propagator. Real and virtual photons.	1	25
	1st Intermediate Control (IC1)		100
8	**Midterm (MT)**		100
8	L-8. e^+e^- annihilation to $\mu^+\mu^-$	1	-
	S-8. Compton scattering.	1	5
	Module 3		
9	L-9. Massive spin-1 particles. Polarization vectors.	1	-
	S-9. Propagator for virtual vector bosons.	1	5
	MSWT 4. Assignment submission № 4: Propagator for unstable virtual vector bosons	1	10
10	L-10. Charge current weak interactions. π/K decay to e/μ.	1	-
	S-10. Relation between G_F and g_W. O(n), U(n) and SU(n).	1	5
11	L-11. Neutral current weak interactions. Weinberg-Salammodel.	1	-
	S-11.Neutral current processes.	1	5
	MSWT 5. Assignment submission № 5: An electron in an electromagnetic field	1	10
12	L-12.Charged Current interactions involving quarks	1	-
	S-12. νq scattering. Charged Pion and Kaon decay	1	5
13	L-13. The Strong Force.	1	-
	S-13. Local gauge invariance and QCD	1	5
	MSWT 6. Assignment submission № 6: Boson-Gluon fusion	1	20
14	L-14. Spontaneous symmetry breaking	1	-
	S-14.Scalar field.Complex field	1	5
15	L-15.The Higgs model	1	-
	S-15.Coupling of Higgs to the W and Z	1	5
	MSWT7. Assignment submission № 7: The Weinberg formulation of the Higgs Mechanism for $SU(2) \otimes U(1)$	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________________________Gabdullina A.T.