AL-FARABI KAZAKH NATIONAL UNIVERSITY

Physics and Technics Faculty

Approved by the University scientific-methodical Council meeting
Protocol № 6 from June 27, 2014

Dean of the Faculty _____ A. Davletov

SYLLABUS

PHYSICS

for Biology (5B060700) and Biotechnology (5B070100)
first year of Baccalaureate

Teacher: Anastassiya A. Migunova
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Goal: Knowledge of English physics terminology
Objectives: To master the classical concepts and fundamental physical laws and phenomena, together with the advanced trends in the study of Space, Materials, Electronics, Particle Physics and Nuclear Reactors and Accelerators, etc.

Prerequisites: school physics course

Postrequisites: The knowledge and skills of the discipline are the basis for working with the professional literature during the preparation of the bachelor's and master's theses.

Structure and content of the course

Weeks	Subjects	Hours	Grades
1	Lecture 1. Dynamics. Kinetic and potential energy. Deformation. Elastic properties of solids. Fluid mechanics. Bernullli equation. Torricelli's formula	1	0
	Practice 1. Determination of the liquid viscosity by Stokes method	1	10
	Self study 1. Viscosity. Laminar and turbulent flows	1	5
2	Lecture 2. Thermodynamics. The first and second laws. Isobaric, isochoric, isothermal and adiabatic processes. Carnot cycle	1	0
	Practice 2. Calculation of thermodynamic cycles	1	10
	Self study 2. Molecular-kinetic theory of gases. Ideal gas. Real gases.	1	5

	Van der Waals equation. Capillary phenomena.		
3	Lecture 3. Thermal properties of materials. Dulong-Petit, Joule-Kopp, Einstein, Debye heat capacity models. Phonons	1	0
	Practice 3. Calculation of the specific heat, thermal conductivity, thermal expansion, Debye temperature of given materials in the Mathcad program	1	10
	Self study 3. Thermal conductivity. Thermal expansion of solids	1	5
4	Lecture 4. Electricity. Conductors and insulators. Electric capacity. Ohm's law. Joule-Lenz law. Kirchhoff's rules for branched chains.	1	0
	Practice 4. Determination of resistance of a resistors with an ammeter and voltmeter	1	10
	Self study 4. Conductivity of electrolytes. Faraday's laws. Polarization of dielectrics. Ferroelectrics. Gas discharge. Plasma. Lightning	1	5
5	Lecture 5. Magnetism. Magnetic induction. Ampere force. Magnetic flux. Faraday's law. Lenz's law. Inductance. Self-induction	1	0
	Practice 5. Verification of Biot-Savart-Laplace law for solenoid	1	10
	Self study 5. Hall effect in crossed electric and magnetic fields. Ferromagnets. Magnetic hysteresis. Diamagnetics and paramagnetics	1	5
6	Lecture 6. Phenomenon of superconductivity. Barden-Cooper-Schrieffer theory. Meissner effect. The concept of phase transition. Superconductivity 1, 2 and 1.5 types. Abrikosov vortices	1	0
	Practice 6. Calculation of the current density in superconductors, specific heat jump at the critical point, levitation conditions, parameters of Josephson junctions in Mathcad software	1	10
	Self study 6. Josephson effects. HTSC ceramics. SC wires. SQUID	1	5
7	Lecture 7. Geometrical optics. Laws of imaging in thin lenses and mirrors. Wave optics. Interference. Fresnel and Fraunhofer diffraction. Diffraction grating. Newton's Rings	1	0
	Practice 7. Determination of the light wavelength with Newton's rings	1	10
	1st Interim Control (IC)		100
	MidlTermExam	2	100
8	Lecture 8. Optics. The polarization of light. Law of Malus. Brewster's law. Birefringence	1	0
	Practice 8. Laboratory work: Study of Malus law with photopolarimeter	1	10
	Self study 8. Kerr effect. Doppler effect. Prism as spectral instrument	1	5
9	Lecture 9. Thermal radiation. Kirchhoff's law. Rayleigh formula. Stefan-Boltzmann law. Wien's law. Black and gray bodies. Laws of the external photoelectric effect	1	0
	Practice 9. Study of the laws of the external photoelectric effect using vacuum photocells	1	10
	Self study 9. Radiation, color and brightness temperature. Pyrometers. Radiation pressure. Compton effect. Internal photoelectric effect	1	5
10	Lecture 10. Band theory of solids. Metal-semiconductor contact. *P-n* junction	1	0
	Practice 10. Determination of the contact potential difference, width of the depletion region. Construction of the energy band diagrams of diode structures	1	10
	Self study 10. Phenomena in strong electric fields: Gunn effect and Zener effect	1	5
11	Lecture 11. Interaction of radiation with matter. Spectra of reflection, transmission, absorption. Optical properties of materials: complex	1	0

	refractive index, absorption coefficient, complex dielectric constant, phase of the reflected wave and others. Photoluminescence and semiconductor LEDs. Lasers		
	Practice 11. Calculation of characteristics of solid-state lasers: peak power, energy, brightness, population inversion, number of modes, pulse duration	1	10
	Self study 11. The energy level scheme of ruby laser. Skin effect.	1	5
12	Lecture 12. Atomic physics. The line spectrum of the Bohr hydrogen atom. Lyman, Balmer series et al. De Broglie waves. Geyzenberg uncertainty. Quantum numbers: principal, azimuthal, magnetic, spin	1	0
	Practice 12. Determination of the Planck constant by retarding potential	1	10
	Self study 12. Frequencies of spectral lines. Zeeman effect. X-ray spectra	1	5
13	Lecture 13. Nuclear physics. Nuclear physical characteristics. Magic numbers. Binding energy. Isotopes. Island of stability. Radioactivity. Types of radiation. The law of radioactive decay. Nuclear chain reaction. Fission of uranium	1	0
	Practice 13. Determination of the nuclides activities, the binding energy of nucleons in nuclei, nuclear mass, mass defect	1	10
	Self study 13. Banana equivalent. Nuclear reactors. Nuclear explosion and its affecting factors. Thermonuclear reaction. Absorbed dose of radiation. Exposure dose of radiation	1	5
14	Lecture 14. Physics of elementary particles. Fundamental interactions and their carriers. Hadrons and leptons. Particles and antiparticles. Classification of elementary particles. Quarks. Gluons	1	0
	Practice 14. Determination of the quantum numbers of elementary particles: the baryon, parity and spin state, the radius of the weak interaction. Construction of Feynman diagrams to describe the interactions of elementary particles	1	5
	Self study 14. Gauge bosons. Casimir force. Cosmic microwave background radiation. Higgs boson. Tachyons. Tau leptons. Big Bang theory as the history of the Universe. Cosmic strings. Particle accelerators. Modern standards of the time. Modern methods of Universe age determination. "Time machine".	1	5
	2^{nd} Interim Control (IC)		100
Final Exam (FE): written, 2 theoretical questions, 1 problem		2	100

Total GPA: $\frac{1^{st} IC + 2^{nd} IC}{2} \times 0{,}6 + 0{,}1MT + 0{,}3FE$

Each student should have about 15 grades every week. To compensate the missing grades in next week will impossible

References

Basic

1 Halliday D., Resnick R., Walker J. Fundamentals of Physics. 5 Parts
2 Young H. D., Freedman R. A., Ford L. University Physics with Modern Physics with MasteringPhysics. – Addison-Wesley; 12 edition. – 2007. – 1632 p.
3 The Feynman Lectures on Physics
4 Fundamental of Physics. 8th Edition by J. R. Christman
5 Zitzewitz P. Physics: Principles and Problems. – 2004. – 943 p.

6 Irodov I. E. Fundamental laws of mechanics. – 1980. – 271 p.
7 Berkeley Physics Course. III volumes: V. 1 – Mechanics, V. 2 – Electricity and Magnetism, V. 3 – Waves

Aditional

8 Physics Today – magazine of the American Institute of Physics
9 Hubbard and Katz Physics Toolbox: A Survival Guide For Introductory Physics. – 2001. – 480 p.
10 Nelkon M. Principles of Physics. – 1981. – 624 p.
11 Giancoli D. C. Physics: Principles with Applications. – 2004. – 946 p.
12 Serway R. A. Physics for Scientists and Engineers with Modern Physics. – 2007. –1504 p.
13 Kuhn K. F. Basic Physics: a self-teaching guide. – 1996. – 320 p.
14 Beiser A. Concepts of Modern Physics. – 2002. – 560 p.
15 Basdevant J.-L., Rich J., Spiro M. Fundamentals of Nuclear Physics: From nuclear structure to Cosmology. – 2009. – 515 p.

Map of methodical support of the discipline

Grade	Equivalent (GPA)	%	Grade in traditional system
A	4	95-100	"Excellent"
A-	3,67	90-94	
B+	3,33	85-89	"Good"
B	3	80-84	
B-	2,67	75-79	
C+	2,33	70-74	" Satisfactory"
C	2	65-69	
C-	1,67	60-64	
D+	1,33	55-59	
D	1	50-54	
F	-	0-49	"Failing" (no-go mark)
I	-	-	"Incomplete"
W	-	-	"Withdrawal"
AW	-	-	"Administrative Withdrawal
AU	-	-	" Auditing – Discipline listened"
P/NP	-	65-100/0-64	"Pass / No Pass"

In grading the performance of the student during the semester is taken into account the following: attendance, active and productive participation in practical classes, study of basic and additional literature, fulfillment of the SSS, timely submission of all homeworks. For the late presentation of three SSS rating of AW.

The policy of academic behaviour and ethics

Be tolerant and respect other people's opinions. Objection was formulated in the correct form. Plagiarism and other forms of cheating are not allowed. Prompting and copy off from someone are not allowed during the delivery of the SSS, intermediate control and final exam, copying problems solved by others, passing the exam for another student. A student convicted of falsification of any information of the course will receive a final grade of «F».

Help: For advice on the implementation of independent work (SSS), their delivery and protection, as well as additional information on the studied material, and all other emerging questions for course please contact the instructor during his office hours.

Recommended at a meeting of the Department
Protocol # 36 from June 10, 2014

Head of Department
of Solid State Physics and Nonlinear Physics O. Yu. Prikhodko

Teacher A. A. Migunova