Physics and Astronomy

(Year 11)

(4 hrs per week, 140 hrs in total, out of them 35 hrs for Astronomy)

Table of contents

1.	**Electrodynamics** Electromagnetic relations. Electric field. Substance in electric field. Conductors and dielectrics in the electric field. Work during the shift of charge in the uniform electric field. Electric field potential. Electric capacity. Electric capacity of a plate condenser. Connection of condensers. Electric field energy. Using condensers in machines. Direct electric current. Electromotive force. Full cycle Ohm's law. Electric current in metals. Dependence of specific resistance on temperature. Hyperconductivity. Electric conductivity of semiconductors. Own and extrinsic conductivity of semiconductors. Electron-hole transition: its features and use. Semiconductor element base of the modern microelectronic devices. Electric current in solutions and melts of electrolytes. Electrolysis and laws of electrolysis. Gas discharge and use thereof. Plasma. Electric current in vacuum. Thermal electron emission. Electric and magnetic relations. Relation of conductors with current. Current magnetic field. Magnetic field impact on an energized conductor. Ampere force. Action of magnetic law on moveable charged particles. Lorentz force. Electric engine work. Electromagnetic induction. Magnetic flow. Law of electromagnetic induction. Sel-induction. Induction capacity. Magnetic field energy. Use of electromagnetic induction in the modern machines and technologies.
2	**Oscillations and waves** Mechanic oscillations. Harmonic oscillations. Equations of harmonic oscillations. Mathematical and spring pendulums. Energy conversion during oscillations. Forced oscillations. Concept of self-oscillations. Resonance. Spread of mechanic oscillations in elastic medium. Huygens' principle. Free electromagnetic oscillations. Oscillating circuit. Forced electromagnetic oscillations. Alternative current and its features. Effective voltage and current. Transformer. Production, transfer and use of energy of electric current. Formation and spreading of electromagnetic waves. Features of electromagnetic waves. Physical bases of the modern telecommunications.
3.	**Quantum physics** Quantum atom features. Bohr's quantum postulates. Light emission and absorption by atoms. Atom and molecular spectra. Continuous light spectrum. Spectroscope. Spectral analysis and its use. Quantum light features. Planck postulate. Quantum of light. Photon energy and impulse. Photo-effect. Photo-effect equation. Use of photo-effect. Solar battery.

	Atom core. Nuclear forces and their features. Nuclear reactions. Radioactivity. Radioactive decay law. Relations between the mass and energy. Atom core connection energy. Nuclear power plants. Dosimetry. Radiation dose. Protection against ionizing emission. Elementary particles. General features of elementary particles. Quarks. Space radiation. Methods of registration of elementary particles.
4	**Bases of practical astronomy** Celestial bodies and celestial sphere. Constellations. Defining distance towards celestial bodies. Space coordinates. Visible movements of the Sun and planets. Kepler's laws and their relation to the Newton's laws. Astronomy and the definition of time. Calendar.
5	**Physics of solar system** Earth and Moon. Nature of the bodies in the solar system. Space studies of the bodies in the solar system. Movement of artificial satellites and automatic interplanetary stations. Space aeronautics development. Cosmogony of the solar system.
6	**Methods and means of physical and astronomic studies** The main photometric quantities and measuring them. Spectroscope. Spectral analysis and its use. Radiation of celestial bodies. Methods of astronomic observations. Work and structure of optical and radiotelescope, neutrino detectors, and gravitation waves. Radiation receivers. Using the developments of machines and technology in telescope production. Modern ground and space telescopes. Astronomy observatories.
7	**Stars and galaxies** Stars and their classification. The Sun, its physical features, structure and sources of energy. Solar activity and its impact on Earth. Types of stars. Planetary systems of other stars. Star evolution. Black holes. Milky Way. The structure of the Galaxy. The role of Sun in the Galaxy. Stellar clusters and associations. Nebulosity. Galaxy subsystem and its spiral structure. The world of galaxies. Quasars.
8	**Universe** Fundamental relations in nature. Role of physical and astronomic science in formation of the scientific worldview of a modern human. Single natural science picture of the world. History of beliefs on the Universe. Source and development of the Universe. The main provisions of the special relativity theory. Cosmology problems. Human in space. Anthropic principle. Possibility of life on other planets. Uniqueness of the Universe. The issue of existence of other universes.

Expected results

Pupil:

- *understands the key notions and terms;*
- *explains physical phenomena;*
- *solves tasks on the use of formulas and laws that are studied;*
- *explains the reasons of visible movement of stellar bodies in the celestial sphere; defines the duration of the day and calendar year according to astronomic observations;*

- *uses the planisphere to solve practical tasks; orients in space using the Sun and the Polar Star;*
- *presents the obtained results graphically and using formulas;*
- *experimentally checks the physical laws and phenomena;*
- *adheres to the rules of observation of celestial bodies using a school telescope;*
- *assesses the impact of astronomy observatories in Ukraine and the world in the development of theoretical and practical astronomy, the use of developments of machines and technology in telescope production.*