Federal State Autonomous Educational Institution of Higher Education
PEOPLES' FRIENDSHIP UNIVERSITY OF RUSSIA
RUDN University
Academy of Engineering

educational division -faculty/institute/academy

COURSE DESCRIPTION
27.03.04 Control in Technical Science

DATA ENGINEERING AND SPACE SYSTEMS CONTROL
field of studies / speciality code and title

Course Title	Algebra and Geometry
Course Workload	8 / 288
Course contents	
Course Module Title	**Brief Description of the Module Content**
Principles of linear algebra and analytic geometry	Linear and affine spaces
	Linear dependence of vectors
	Rank of matrix and system of vectors
	Matrices and operations on them
	Action of a matrix on a vector
	Dot product and its matrix notation
	Degeneracy and non-degeneracy
	Permutations and their signs
	Multiplication (composition) of permutations
	Determinant, its geometric meaning
	Matrix trace
	Coordinate systems, vector and mixed product of vectors
	Equations of lines and planes
	Distance from a point to a straight line (plane)
	Angles between straight lines
	Orientation of a straight line (plane, space)
Systems of linear equations	Matrix notation of a system of linear equations
	Gauss method for solving systems of linear equations
	Kronecker-Capelli theorem
	Non-degenerate systems
	Calculating the inverse matrix
	Cramer's formulas
	Homogeneous systems of linear equations
	Space of solutions of a system of linear equations
	Geometric meaning of systems of linear equations
	Sum and intersection of linear subspaces
	Mutual arrangement of affine subspaces
Linear mappings and linear operators	Linear mappings and operations on them
	Linear transformation matrix
	Dependence of the transformation matrix on the choice of basis
	Canonical form of linear mapping
	Eigenvalues and eigenvectors of a linear operator
	Characteristic polynomial of the operator
	Diagonalizable Operators
	Linear operators in Euclidean space
	Orthogonal operator and its diagonalizability
	Symmetric operator and its diagonalizability

	Movements on a plane and in space
	Representation of movement as a composition of rotation and parallel translation
	Affine transformations of plane and space
	Representation of an affine transformation as a composition of homothety and motion
Lines and surfaces of the second order	General second order equation and its reduction to canonical form
	Intersection of a second-order line and a straight line
	Tangent to a line of second order
	Classification of second order lines
	Second order surfaces
Polynomials and algebraic numbers	Division with remainder in the ring of polynomials with one unknown and the ring of integers
	Greatest common divisor of two polynomials (integers)
	Euclid's algorithm
	Least common multiple
	Irreducible polynomial (prime number)
	Fundamental Theorem of Arithmetic
	Roots of a polynomial
	Multiple roots
	Derivative of a polynomial
	Taylor polynomial
	Algebraic and transcendental numbers
	Minimal polynomial of an algebraic number
	Algebraic integers
	Polynomials in several unknowns
	Lexicographic ordering of monomials
	Symmetric polynomials
	The main theorem of the theory of symmetric polynomials
	Vieta formulas

Course Title	Mathematical Analysis
Course Workload	15/540
Course contents	
Course Module Title	**Brief Description of the Module Content**
Elementary functions and their graphs	Introduction to the course
	Elements of logic
	Statements and predicates, operations on them
	Constructing the negation of a complex statement
	Theorem as implication
	Necessity and sufficiency
	Direct, inverse and opposite theorems, connection between them
	Proof by contradiction
	Method of mathematical induction
	Bernoulli's inequality
	Binomial theorem
	Sets, operations on them, their properties
	The set R of real numbers and its axiomatics
	Completeness of the set R
	Gaps
	Neighborhoods of endpoint and infinity
	Nested segment principle (Cauchy-Cantor)
	Bounded and Unbounded Sets in R
	Exact upper and lower bounds of a set

	Archimedes' principle and consequences from it
	Display and function
	Graph of a function
	Types of mappings: surjective, injective, bijective
	Reverse mapping
	The concept of power of a set
	Countable sets
	Uncountability of the set R
	Composition of functions
Number sequence limit	Numerical sequence, its limitations and monotony
	Sequence limit
	Infinitesimal and infinitely large sequences
	Properties of convergent sequences
	Weierstrass's theorem
	Theorem on arithmetic operations under the limit sign
	The number e as the limit of a number sequence
	Hyperbolic functions
	Set limit points
	Bolzano-Weierstrass principle
	Sequence limit points
	Fundamental number sequence
	Cauchy criterion for the convergence of a number sequence
Function limit	Determination of the limit of a function according to Cauchy
	Theorem on the connection between the two-sided limit and the one-sided limit
	Determination of the limit of a function according to Heine
	Equivalence of the definitions of the limit according to Heine and Cauchy
	Theorem on the uniqueness of the limit of a function
	Theorem on the local boundedness of a function having a finite limit
	Infinitesimal functions
	Theorem on the connection between a function, its limit and an infinitesimal
	Properties of infinitesimal functions
	Theorem on arithmetic operations on functions having a limit
	Theorem on the limit of a complex function (change of variable in the limit)
	Theorem on the constancy of sign of a function having a nonzero limit
	Limit passage in inequality
	Theorem on the limit of an intermediate function
	Infinitely large functions
	Theorem on the connection between infinitely large and infinitesimal functions
	The first and second remarkable limits and consequences from them
	Weierstrass's theorem on the limit of a monotone and bounded function
	Comparison of infinitesimals
	Order of smallness, equivalent infinitesimals, incomparable infinitesimals
	Table of equivalent infinitesimals
	Properties of equivalent infinitesimals
	Rules for working with "small things"
	Comparison of infinitely large
	Theorems on equivalent infinitesimals

Course Title	History and Methodology of Science
Course Workload	Credits and academic hours
Course contents	
Course Module Title	**Brief Description of the Module Content**
Continuity of function	Continuity of a function at a point
	Various definitions of continuity and their equivalence
	Continuity of a function over an interval
	One-sided continuity at a point
	Continuity of a function on a segment
	Properties of functions continuous at a point (relationship of continuity with one-sided continuity, local boundedness, constancy of sign, arithmetic operations with continuous functions, passage to the limit, continuity of a complex function)
	Breakpoints and their classification
	Properties of functions continuous on an interval (theorems on zeros, on intermediate values, on boundedness, on reaching the exact edges of a function continuous on an interval)
	Continuity on a segment of a monotonic function, connection between continuity, injectivity and strict monotonicity
	Theorem on the existence of an inverse function
	Breakpoints of a monotonic function
	Continuity criterion for a monotonic function
	Continuity theorem for the inverse function
	Continuity of basic elementary functions
	Uniform continuity of functions
	The connection between uniform continuity on a set and continuity at a point on this set
	Cantor's theorem on the uniform continuity of a function on an interval
Differential calculus of a function of one variable	Function differential
	Theorem on the connection between derivative and differential
	Geometric meaning of differential
	Rules for working with differentials (differential of sum, difference, product, quotient)
	Invariance of the form of writing the first differential
	Approximate calculations using differentials
	Higher order differentials, lack of invariance
	Basic theorems of differential calculus (Fermat, Rolle, Cauchy, Lagrange) and their geometric meaning
	The Bernoulli-L'Hopital theorem and the disclosure of uncertainty of type $[0/0]$
	The Bernoulli-L'Hopital theorem and the disclosure of uncertainty of the type [infinite. / infinite] (no proof)
	Comparison of the orders of growth of logarithmic, power and exponential functions at infinity
	Disclosure of uncertainties like [0, infinite], [infinite, -infinite], [0 to degree. 0], [1 to degree infinite], [infinite in the steppe 0]
	Taylor's formula for polynomials
	Taylor polynomial for arbitrary functions
	Taylor formula with remainder term in Peano form

		Theorem on the uniqueness of the expansion of a function according to the Taylor formula with a remainder term in Peano form
		Taylor's formula with a remainder term in general form
		Corollaries: remainder term in Cauchy form and in Lagrange form
		Maclaurin formula
		Expansion of basic elementary functions using the Maclaurin formula
		Using Decompositions to Unravel Uncertainties
		Approximate calculations using Taylor's formula
		Application of differential calculus to study functions and construct their graphs
		Relationship between derivative and monotonicity
		Necessary and sufficient conditions for monotonicity. Local extremum of a function
		A necessary condition for the existence of a local extremum of a differentiable function
		Sufficient conditions for the existence of an extremum in the first derivative, in the second derivative, in the nth derivative
		Concept of upward (downward) convexity of a function
		The geometric meaning of determining the convexity of a function is the relative position of the graph of the function and the chord
		Lemma on the convexity of a function and its geometric meaning
		Necessary and sufficient condition for convexity with respect to the first derivative
		Corollaries: necessary and sufficient condition for the convexity of a twice differentiable function, sufficient condition for the strict convexity of a twice differentiable function
		Relationship between the direction of convexity of the graph of a function and the position of the tangent
		Inflection points of a function graph
		Necessary and sufficient conditions for the existence of an inflection point of a twice differentiable function
		Asymptotes of the graph of a function: vertical, horizontal, oblique
		Oblique asymptote theorem
		General scheme for studying functions and constructing their graphs
Indefinite integral		The concept of an antiderivative
		Antiderivative theorem
		Indefinite integral and its properties
		Table of basic indefinite integrals
		General methods of integration: substitution under the differential sign (replacement of a variable), substitution, integration by parts
		Integration of rational functions by decomposition into simple fractions
		Integrating expressions containing trigonometric functions and irrational functions
		Examples of integrals that cannot be expressed through elementary functions
Definite integral		Examples of problems leading to a definite integral
		Definite integral as a limit of integral sums
		Darboux sums and integrals
		Criterion for the existence of a definite integral
		Basic properties of the definite integral

	Theorems on the evaluation of the definite integral and on the mean value of the integrand
	Derivative of the integral with respect to the upper limit
	Newton-Leibniz formula
	Calculation of a definite integral by integration by parts and by replacing a variable (substitution)
	Integration of even and odd functions on a segment symmetrical about the origin
	Improper integrals of continuous functions over an infinite interval
	Improper integrals of unbounded functions on an interval
	Signs of convergence and divergence of an improper integral
	Absolute and conditional convergence of improper integrals
	Area of a flat figure
	Calculating the area of a flat figure in rectangular and polar coordinates

Course Title	Physics
Course Workload	6/216

Course contents	
Course Module Title	**Brief Description of the Module Content**
Mechanics	Kinematics of a material point. Mechanical movement. Material point. Reference system. Rectilinear and curvilinear, uniform and variable movement. Speed, displacement, path, trajectory, acceleration. Normal and tangential acceleration.
	Dynamics of a material point and a system of material points. Newton's first law. Inertial reference systems. Mass and momentum. Newton's second law in differential form. Force as a derivative of impulse. Newton's third law. System of material points; center of mass and momentum of the system. Theorem on the motion of the center of mass. Law of conservation of momentum of a system of material points. Meshchersky equation. Tsiolkovsky formula
	Work and energy. Work of constant and variable force. Power. Potential and non-potential forces. Potential and kinetic energy. Law of conservation of mechanical energy. Sliding friction. Dissipation of mechanical energy. Central absolutely elastic and inelastic impacts.
	Rotational movement of the body. Translational and rotational movement of the body. Angular displacement, angular velocity, angular acceleration. Rotational moment. Moment of inertia of the body. Huygens-Steiner theorem. Momentum of a rotating body. The second law of dynamics for the rotational motion of a body. Work and power during rotational motion. Law of conservation of angular momentum. Gyroscopes and their applications.
	Gravitational forces. Inertia forces. The law of universal gravitation. Gravitational field. Gravity and body weight. Weightlessness. The work of gravity when moving a body in the Earth's gravitational field. Kepler's laws. First and second escape velocities. Non-inertial reference systems. Centrifugal and Coriolis inertial forces in a rotating system. Movement of bodies near the Earth's surface.

	Fundamentals of the special theory of relativity. Postulates of the special theory of relativity. Lorentz transformations. Relativity of lengths and time intervals.
	Elastic properties of continuous media. Particle vibrations. Types of elastic deformations: tension, shear, torsion, volumetric expansion and compression. Hooke's law for elastic deformations. Young's modulus. Shear modulus. Poisson's ratio. Simple harmonic oscillation. Energy of an oscillating particle. Pendulums. Free damped oscillations. Forced vibrations. Resonance.
	Mechanical waves. Acoustics elements. Running wave. Transverse and longitudinal waves. One-dimensional wave equation. Longitudinal waves in a solid. Waves in gases and liquids. Flow of traveling wave energy. Wave interference. Standing waves. Shock waves. Sound. Sound speed. Dependence of the speed of sound on the elastic properties of the medium. Pitch, timbre, intensity and volume of sound. Ultrasound and its application.
Molecular physics	Kinetic theory of gases. Ideal gas. Equation of state of an ideal gas. Basic equation of the kinetic theory of gases. Root mean square, average and most probable velocities of molecules. Maxwellian velocity distribution of gas molecules. Barometric formula. Boltzmann distribution.
	Laws of thermodynamics. Thermodynamic systems. Work when gas volume changes. The first law of thermodynamics. Internal energy of an ideal gas. Heat capacity at constant volume and constant pressure. Equilibrium and nonequilibrium processes. Second law of thermodynamics.
	Methods of thermodynamics. The concept of entropy of an ideal gas. Relationship between entropy and the thermodynamic probability of the state of the system. An increase in entropy in an isolated system. Third law of thermodynamics. Adiabatic process. Poisson's equation. Work, heat and change in internal energy during isoprocesses in an ideal gas. The number of degrees of freedom of a molecule. Carnot cycle. Efficiency of the Carnot cycle.
	Transference phenomena. Thermal conductivity, Fourier's law, thermal conductivity coefficient. Diffusion, Fick's law, diffusion coefficient. Relationship between thermal conductivity and diffusion of an ideal gas.
	Real gases. Lenard-Jones pairwise intermolecular interaction potential. Van der Waals equation. Critical point. Reduced form of the van der Waals equation. Law of corresponding states. Joule-Thomson effect. Inversion point. Liquefaction of gases.
	Solids. Crystalline and amorphous bodies. Types of crystal structures: ionic, atomic, metallic and molecular. Types of bonds in a crystal. Heat capacity of solids. Dulong and Petit's law. Point defects in crystals: vacancies, interstitial impurities, substitutional impurities. Edge and screw dislocations.
	Liquids. Characteristics of the liquid state. Surface layer of liquid. Surface tension. Pressure of a curved liquid surface. Laplace's formula. Capillary phenomena. Wetting hard surfaces. Surfactants, their properties and applications.

	Phase transitions. Thermodynamic phases. Phase equilibrium condition. Phase transitions of the first order. Phase equilibrium line (binodal). State diagram of a one-component substance. Triple point. Critical point. Clapeyron-Clausius equation. Dependence of saturated vapor pressure on temperature. Thermodynamic stability of the phase. Spinodal. Metastable phases. Liquid-vapor transition according to the van der Waals equation. Van der Waals isotherms. Explosive boiling.
Electricity and magnetism	Electrostatic field. Electric, magnetic and electromagnetic field. Charges. Elementary charge. Law of conservation of charge. Coulomb's law. Electrostatic field. Tension and field lines. Potential nature of the electrostatic field. Potential. The relationship between tension and potential. Conductors in an electric field. Electric field induction. Induction vector flux. Ostrogradsky-Gauss theorem. Relationship between surface charge density and field strength near the surface of a charged conductor.
	Field of charged conductors and capacitors. Electrical capacity of conductors and capacitors. Field of a charged plate. Field of a parallel-plate capacitor. Electric field energy. Energy density. Field of a spherical capacitor. Field of the solitary sphere. The relationship between the surface charge density and the curvature of the surface of a charged conductor. Field of a cylindrical capacitor.
	Dielectrics. Dielectric constant of dielectrics. Electric dipole moment. Polarization of dielectrics. Polarization vector. Electric field strength in a dielectric. Polar and non-polar dielectrics. Dependence of the dielectric constant of a dielectric on temperature. Ferroelectrics and their properties. Direct and reverse piezoelectric effect. Application of piezoelectrics.
	Laws of direct current. Current strength and density. Ohm's and Joule-Lenz's laws; differential form of these laws. Electromotive force of the source. Ohm's law for a circuit containing an emf. Kirchhoff's rules for branched electrical circuits.
	Electronic properties of metals. Metals, dielectrics, semiconductors. Degenerate electron gas in a metal. Fermi energy. Electrical conductivity of metals. Dependence of the electrical resistance of metals on temperature, impurities and defects in the crystal structure. Superconductivity of metals. High temperature superconductivity.
	Contact phenomena in metals. The work function of an electron leaving a metal. Contact potential difference. Thermocouple. Thermoelectromotive force. Temperature measurement with a thermocouple. Peltier effect and its application.
	Electric current in a vacuum. Thermionic emission. Vacuum diode. Volt-ampere characteristics of the diode. The role of space charge. Richardson's formula. Vacuum triode. Characteristics and parameters of the triode.
	Semiconductors. Semiconductor materials. The band gap of a semiconductor. Intrinsic electrical conductivity of a semiconductor. Conductivity due to impurities. Donor and acceptor semiconductors, eg the transition of two semiconductors. Semiconductor diodes.

	Electric current in gas. Gas ionization. Non-self-sustaining gas discharge. Electrical conductivity of gas. Types of independent discharges: glow, spark, corona, arc. Plasma and its main parameters.
	A magnetic field. A magnetic field. Lorentz force. Induction and magnetic field strength. Biot-Savart-Laplace law. Field of circular and linear currents. Magnetic field of a toroid and solenoid. Vortex nature of the magnetic field. Ampere's law. The force of interaction between long parallel conductors and current. Magnetic moment of a current-carrying circuit. The effect of a magnetic field on a current-carrying circuit. Magnetic flux. Circulation of the magnetic field induction vector.
	Electromagnetic induction. Causes of e.m.f. induction and induced current. Faraday's law and Lenz's rule. Induction emf when a conductor moves and a circuit rotates in a uniform magnetic field. Loop inductance. E.m.f. self-induction. Self-induction when closing and opening DC circuits. Magnetic field energy, energy density. Mutual induction of two circuits. Eddy currents. Skin effect.
	Magnetic properties of matter. Magnetization of matter. Magnetization vector. Elementary currents of Ampere. Diamagnets and paramagnets. Dependence of magnetization of magnets on magnetic field strength and temperature. Properties of ferromagnets. Curie point. Magnetic hysteresis.
	Charged particles and plasma in magnetic and electric fields. Lorentz force. Movement of a charged particle in a magnetic field. Charged particle accelerators. Mass spectroscopy. Cathode-ray tube. Plasma in a magnetic field. Current in plasma. Pinch effect.
	Electromagnetic vibrations. Oscillatory circuit. Free oscillations in the circuit. Forced vibrations. Contour quality factor. Active resistance, capacitance and inductance in an alternating current circuit. Alternating electric current. Resonance of currents. Voltage resonance. Impedance. Power at alternating current.
	Electromagnetic waves. Electromagnetic waves. Equation of the simplest electromagnetic wave in ordinary and differential forms. The speed of propagation of electromagnetic waves. Electromagnetic wave energy. Umov-Poynting vector.
	Maxwell's equations. Bias current. Maxwell's first equation. Vortex electric field. Maxwell's second equation. Maxwell's system of equations in integral and differential form.
Optics, atomic physics, elements of nuclear physics	Laws of geometric optics: Snell, reflection of light, rectilinear propagation of light, independence of light rays.
	Characteristics of thin lenses: focal length, optical power. Thin lens formula. Rules for constructing images in a lens.
	Photometric quantities and their units: luminous flux, luminous intensity, illumination, brightness, luminosity. Lambert's relation. Spectral sensitivity of the human eye. Magnification of optical instruments: magnifying glass, lens, microscope, telescope.
	The concept of an electromagnetic wave. Plane and spherical waves. Monochromatic. Electromagnetic wave scale. Electromagnetic wave equation for

	spherical and plane waves. The speed of propagation of electromagnetic waves in a medium. The concept of phase and group velocity. Umov-Poynting vector. Volumetric energy density of electromagnetic waves.
	Interference. Conditions for observing interference. The concept of coherence. Optical path difference. Conditions for maximum and minimum intensity. Methods for observing interference: Young's method, Fresnel mirror, Fresnel biprism. Interference on plane-parallel plates and plates of variable thickness. Newton's rings. Michelson interferometer. Fabry-Perot standard.
	Diffraction of light. Fresnel diffraction. Fraunhofer diffraction. Huygens' principle. Huygens-Fresnel principle. Fresnel zone method. Method of graphical addition of amplitudes. Fresnel diffraction on the simplest obstacles: on a round hole, on a round disk, on the straight edge of a half-plane. Cornu spiral. Fraunhofer diffraction by a slit. Diffraction grating. Rayleigh solvability criterion. X-ray diffraction.
	Holography. Method for obtaining and restoring an image.
	Dispersion. Bouguer's law. Absorption of waves in liquids and gases. Scattering of light. Rayleigh's law.
	Polarization. Types of polarization.
	Absolutely black body. Gray body. Wien's law of displacement.
	Photo effect. Einstein's equation for the photoelectric effect.
	Compton effect. Wave-particle duality. De Broglie waves.
	Heisenberg uncertainty principle.
	Bohr's postulates. Quantum transitions. Series by Lyman, Balmer, Paschen, Brackett, Pfund.
	Spin concept.
	Pauli's principle. Fermions and bosons.
	Fermi-Dirac and Bose-Einstein statistics.
	The structure of the atomic nucleus. Mass and binding energy of the atomic nucleus. Mass defect of the atomic nucleus.
	Radioactivity. Radioactive decay. Nuclear forces. The mechanism of action of nuclear forces. Nuclear reactions.
	The principle of laser operation.

Course Title	Theory of Probability and Mathematical Statistics
Course Workload	7/252
Course contents	
Course Module Title	**Brief Description of the Module Content**
Probability space	Space of elementary outcomes.
	Events, actions on them.
	Axiomatic definition of probability.
	Probability space
Classical and geometric probabilities	Classic definition of probability
	Elements of combinatorics
	Hypergeometric distribution
	Geometric definition of probability. Meeting problem. Buffon's problem (throwing a needle).
	Conditional probability. Probability multiplication formula.
	Independence of events in pairs and in aggregate. Bernstein's example of events that are independent in pairs, but dependent in aggregate

Conditional probability. Independence of events. Total Probability and Bayes Formula	Total probability formula. Bayes' formula.
Bernoulli scheme	Bernoulli scheme, Bernoulli formula.
	Poisson's theorem.
	Local theorem of Moivre-Laplace. Integral theorem of Moivre-Laplace.
	Bernoulli's theorem (law of large numbers in Bernoulli form). Polynomial circuit.
Random variables and their distributions	Random value. Distribution function and its properties.
	Discrete random variable. Distribution series. Binomial, Poisson, geometric distributions.
	Continuous random variable. Distribution density and its properties. Uniform, exponential, normal, gamma distributions.
	Function of a random variable (calculation of distributions of a function of a random variable for various cases).
Multidimensional random variables and their properties	Multidimensional random variable (using the example of a 2-dimensional one). Joint distribution function and its properties.
	Discrete two-dimensional random variable.
	Continuous two-dimensional random variable. Joint distribution density and its properties.
	Multidimensional normal law.
	Conditional distributions of random variables. Independent random variables.
	Functions of a two-dimensional random variable (calculation of distributions). Convolution formula.
Numerical characteristics of random variables	Mathematical expectation of a random variable, its properties.
	Dispersion of a random variable, its properties.
	Covariance and correlation coefficient of random variables, their properties. Covariance matrix.
	Moments of the highest order. Median, quantile, mode, entropy.
Convergence of random variables	Convergence of random variables. Types of convergence. Chebyshev's inequality. (Weak) law of large numbers for independent identically distributed random variables, its generalizations.
Central limit theorem	Central limit theorem for independent identically distributed random variables.
Introduction to mathematical statistics and parameter estimation theory	Basic concepts of mathematical statistics
	Estimates of unknown parameters, properties of estimates. Basic Point Estimation Methods
	Interval estimation.
Testing statistical hypotheses	The concept of a statistical hypothesis. Errors of the first and second kind. Statistical test. Power of criterion.
	Algorithm for testing a statistical hypothesis. Neyman-Pearson Lemma. Criteria for testing parametric hypotheses. Chi-square goodness-of-fit test for testing the hypothesis about the type of distribution of a random variable.
	Student's test, Fisher's test, Kolmogorov-Smirnov test. Test based on sample correlation coefficient.
	Rank criteria. Wilcoxon test. Spearman's rank correlation coefficient. Criteria for checking the independence of two random variables.
Applications of mathematical statistics	Regression analysis. Regression models. Least square method. Gauss-Markov scheme.
	Simple linear regression. Method of statistical tests. The concept of planning an experiment.
Random processes	The concept of a random process. Classification and main characteristics of random processes
	Stationary random processes. Linear and nonlinear transformations, differentiation and integration of random processes.

	Stationary white noise. The concept of a Markov random process. Discrete and continuous Markov processes. Markov chain.

Course Title	Differential Equations
Course Workload	7/252
Course contents	
Course Module Title	**Brief Description of the Module Content**
First order differential equations	Integration of differential equations with separable variables and differential equations. Integration of homogeneous differential equations.
	Linear differential equations of the 1st order. Integration of linear remote controls.
	Equations not resolved with respect to the derivative. General method for entering a parameter. Lagrange and Clairaut equations.
Higher order equations and systems of equations	Integrable cases of high-order equations (equations that can be reduced in order).
	Solving systems of differential equations by reducing them to higher order equations
Existence and uniqueness theorems	Lipschitz condition. Theorem for the existence and uniqueness of a solution to the Cauchy problem in a bounded domain and in a strip
Approximate analytical and numerical methods for solving the Cauchy problem	Method of successive approximations. Power series method. Small parameter method. Numerical methods
Boundary value problems.	Green's function method. Approximate analytical methods for integrating boundary value problems.
Elements of qualitative theory of differential equations.	Singular points of linear autonomous dynamic systems of the 2nd order. Phase plane method.
Stability of solutions of linear equations and systems.	The concept of stability of solutions. Theorem of Lyapunov and Chetaev.
First order partial differential equations	Nonlinear systems. First order partial differential equations.

Course Title	History of Russia
Course Workload	4/144
Course contents	
Course Module Title	**Brief Description of the Module Content**
The science of history	The subject and objectives of the course. The science of history. Social, political and socio-natural history. Periodization of the world-historical process. Civilizational, culturological and formational approaches to the history of humanity.
Ancient Russia	Chronological and geographical framework of the history of Russia. The history of Russia as part of world history. The origin of man. Ethnogenesis of the Eastern Slavs as a people of the Indo-European family.
	The main stages of the formation of the state of Rus in early Medieval Europe. Adoption of Christianity. The influence of the heritage of ancient civilizations on Russia.
Russia in the late X – first half of the XIII centuries.	Features of the social system of the countries of Europe and Asia during the Middle Ages. The evolution of the East Slavic statehood from the beginning of the XII century; features of the development of the largest centers of Russia of this period: Vladimir-Suzdal and Galician-Volyn principalities, the Novgorod Republic.
	Mongol conquests in Asia and Europe. Russia in the system of the Horde state. Consequences and significance of the establishment of Mongol domination.

	Russia's struggle for independence in the XIII century. Western expansion.
Russian lands in the second half of the XIII – early XVI centuries and the European Middle Ages	The process of formation of an unified state in early Modern Times in Russia and in Western Europe (England, France, Spain, Portugal): general and special. The influence of natural and climatic conditions.
	The main events of the final stage of the formation of a unified Russian state. The reign of Ivan III. Economy, society, system of government, culture.
	The Grand Duchy of Lithuania. The influence of East and West on the development of Russia at the turn of the XV – XVI centuries.
Russia and the countries of Western Europe in the XVI - XVII centuries.	The origin of the concept of "New Age", chronological framework and periodization.
	Russia and Western Europe countries in the XVI century. The reign of Ivan IV. Serfdom and capitalist vectors of development in the East and West of Europe. The concept of "Moscow – the Third Rome". The culture of the medieval era.
	The systemic crisis of the beginning of the XVII century. The Time of Troubles in Russia. The fight against foreign intervention and its consequences.
	Modernization processes in the West and in Russia. The reign of Alexey Mikhailovich. The reform of the church. Old Believers as a Russian form of Protestantism. Accession of Ukraine.
	The Thirty Years' War and the Westphalian system of international relations.
Russia, West and East in XVIII century	Reforms of Peter I. Modernization and its features in Russia. Russian foreign Policy in the 1st quarter of the XVIII century. The formation of the Russian Empire and its features
	The era of palace coups. The reign of Elizabeth Petrovna. The Seven Years' War.
	The Age of Enlightenment. The reign of Catherine II. Peasant uprisings. Russia's relations with the countries of the West and East (wars and alliances). The Revolution of 1789 in France and its impact on Russia's domestic and foreign policy. The era of wars and "revolutionary storms" of the late XVIII - early XIX centuries. in Europe. The reign of Paul I.
	Gallomania of the Russian elite. Culture of Russia XVIII. Social thought (NI Novikov, MM Shcherbatov, AN Radishchev). Freemasonry. Cultural influences.
Russia and the world in the first half of the XIX century.	Reforms of Alexander I.
	The Patriotic War of 1812: the impact on the development of the country and international relations. Foreign campaign.
	The rise of nationalism in Europe. Features of socio-economic, political and cultural development of Russia and Western countries.

	Decembrism
	The reign of Nicholas I.
	The "Golden Age" of Russian literature. Westerners and Slavophiles.
	Russia's foreign policy and the surge of Russophobia. Russia and Poland.
Russia and the world in the second half of the XIX century.	The Eastern question in the system of international relations.
	The Crimean War and its consequences.
	The abolition of serfdom in Russia and the Civil War in the United States.
	Features of the Russian social structure in the era of modernization. The national question. Peculiarities of relations between the Russian Empire and its national suburbs.
	Social movement in post-reform Russia: liberals, conservatives, populists, Marxists. Disputes about the ways of Russia's development and its attitude to the West.
	The results of the reign of Alexander II.
	International relations in the 1870s-1890s. The accession of Central Asia to Russia. The beginning of the formation of military blocs. The folding of the colonial system. The "Big Game" is the confrontation between Russia and Britain in the East. Russia's policy in the East.
	The policy of Alexander III.
	Culture and science of Russia of the 2nd half of the XIX century.
Russia and the world at the beginning of the XX century.	Features of the imperial policy of Russia, Great Britain, France and Germany. The rapprochement of Russia with France. Formation of the Entente.
	The growth of the global socio-economic crisis. Russian reforms in the context of world development at the beginning of the XX century.
	The first Russian Revolution.

	Socio-economic and political development of Russia in 1907-1917. III and IV State Duma. Political parties.
	The theory of imperialism. The end of the division of the world and the aggravation of imperialist contradictions. Blocs formation.
	The beginning of the First World War. Plans of the parties. The impact of the war on the economy and society of the Russian Empire. Consequences of the war. The Versailles system of international relations.
	Approaching national crisis
	Development of culture and science in the early twentieth century. The Silver Age of Russian Literature.
Russia and the World in 1917 – 1939	The Great Russian Revolution of 1917-1922: causes, essence, chronological framework in historical literature, results. The revolutionary crisis in Europe in 1918-1919: the idea of a world revolution and attempts to implement it. The Civil War. War communism.
	The folding of the Soviet socio-political model. Formation of a one-party political system.
	The national outskirts of Russia during this period. Formation of the USSR. Features of the Soviet national policy and national-state structure.
	New economic policy. Internal party struggle in the CPSU(b).
	Strengthening the power of Joseph Stalin. The course of building socialism in one country. Modernization in the USSR of the 1930s. The implementation of socialist industrialization in the USSR. The first five-year plans and their results. Mass collectivization of agriculture and its consequences. The successes of the Soviet government in the cultural sphere and in the field of education. Evolution of the political regime.
	The foreign policy of the USSR in the 1930s. The world economic crisis of 1929 and the "Great Depression", their impact on the development of Western countries. The emergence of fascism and National Socialism. "The New Deal" by F. Roosevelt. "Popular fronts" in Europe. The Spanish Civil War. Japanese aggression on Lake Hassan and on the Khalkhin-Gol River. The Molotov-Ribbentrop Pact. The Soviet-Finnish War. Modern disputes in the historical literature about international relations in 1939-1941 of the political system.
	Repressions. Discussions about the events of the 1930s. The theory of totalitarianism.
The Second World War.	Background and the beginning of the Second World War. Main stages of the Great Patriotic War. The restructuring of the economy in a military way. Changes in the structure of power. Creation of the anti-Hitler coalition. The main battles of the Great Patriotic War. Partisan warfare. The Soviet rear during the war. Liberation of the occupied territories of the USSR and Eastern European states from fascist invaders. Heroism of the Soviet people. Generals. The Allies' development of global strategic solutions for the post-war reconstruction of the world (Tehran, Yalta, Potsdam Conferences). The Nuremberg Trials: The conviction and punishment of leading Nazi criminals.

	The world of concentration camps. Collaborationism and the policy of the USSR in relation to the national fascists in the Western territories. The decisive contribution of the Soviet Union to the defeat of fascism and Japanese militarism.
	Modern falsifications of the history of the Second World War. Discussions about the culprit of the war, the price of victory and the role of the USSR in the defeat of Nazi Germany.
The USSR and the world in 1945 -1991.	Power and society in the USSR in the first post-war years. Reformatory searches in the Soviet leadership. The content and significance of the reforms of GM Malenkov and NS Khrushchev in the development of the USSR economy in 1954 – 1964. XX Congress of the CPSU and its impact on the development of the country and international relations. The "thaw" in the spiritual sphere. Changes in the theory and practice of Soviet foreign policy. Unconstitutional transfer of the RSFSR Crimea and Sevastopol to Ukraine.
	The formation of a bipolar world. The loss of the US nuclear monopoly. New international organizations. The beginning of the Cold War. The creation of NATO. The Marshall Plan and the final division of Europe. Formation of the socialist camp. Creation of the Council of Mutual Economic Assistance (COMECON). The scientific and technological revolution and its impact on the course of world development. The collapse of the colonial system. Aggravation of the international situation. Creation of the Warsaw Pact Organization. The victory of the revolution in China and the creation of the PRC. The Korean War of 1950-1953. Japan after World War II. The creation of the State of Israel and the problem of conflict resolution in the Middle East. Hungarian events of 1956. Formation of the Non-Aligned Movement. Arab revolutions, "free Africa". Revolution in Cuba. Strengthening the confrontation between the superpowers and the two world systems. The Berlin Crisis of 1961. The Caribbean crisis (1962).
	The development of the world economy in 1964-1991. Creation and development of international financial structures (World Bank, IMF, IBRD). Transformation of neocolonialism and economic globalization. Integration processes in post-war Europe. Creation of the European Economic Union.
	The USSR in the mid–1960s - 1980s: stabilization and the growing crisis. The era of "stagnation". Power and society in the first half of the 80s. The formation of the dissident movement in the USSR.
	The Vietnam War. The Arab-Israeli conflict. The Socialist movement in the countries of the West and the East. The political crisis of 1968 in socialist countries and the consequences of its forceful solution. Creation of the USSR nuclear missile shield. Achieving strategic parity with NATO. Helsinki Conference on Security in Europe (August 1975). Formation of the CSCE (since 1994 – OSCE). The Nuclear club. IAEA. The formation of control systems for the non-proliferation of nuclear weapons. Participation of the armed forces of the Soviet Union in the internal political events in Afghanistan.
	The reasons and the first attempts at comprehensive reform of the Soviet system in 1985. Policy of "acceleration". Gorbachev's "perestroika". Strengthening of centrifugal tendencies in a multinational state (1990-1991). "Parade of sovereignties". "New political thinking" and the changing geopolitical position of the USSR.
	Foreign Policy of the USSR in 1985-1991 Discussion about the time of the end of the Cold War. Withdrawal of Soviet troops from Afghanistan. The collapse of the CMEA and the crisis of the world socialist system.
	The State Emergency Committee and its consequences: the collapse of the USSR, the termination of the activities of the CPSU. Formation of the Commonwealth of Independent States (CIS). Culture and science of the USSR in 1945-1991.

	Russia in the 1990s. Search for the ways of development. The liberal concept of Russian reforms: the transition to the market, the first steps towards the formation of civil society and the rule of law. "Shock therapy" - economic reforms of the early 1990s. The decline of industrial and agricultural production, scientific and technical potential. Formation of private property rights. Polarization of society.
	The political crisis of 1993 and the forceful dismantling of the Soviet power system. The Constitution of the Russian Federation 1993 Aggravation of interethnic relations. The military-political crisis in Chechnya, its causes and consequences. The formation of new power structures in Russia. Formation of a multi-party system. Education, science and culture in a market economy. The collapse of liberal reforms.
	Foreign policy in 1991 – 1999 Concessions to the West. Difficulties in establishing political, military and economic ties with the CIS countries. The Collective Security Treaty of the CIS countries. Measures to protect Russian compatriots living in the post-Soviet space. Formation of the Union of Russia and Belarus. Contractual beginnings of the Russian Federation with NATO and the Council of Europe. Globalization of the world economic, political and cultural space. Russia's place in a multipolar world. The expansion of NATO and the EU to the east. Russia's regional and global interests.
Russia and the world in the late XX – early XXI centuries.	The Russian Federation at the beginning of the XXI century. Changes in the political system of Russian society. Russia's change of priorities in foreign policy at the turn of the XX-XXI centuries. VV Putin's presidency, his domestic and foreign policy, national idea. Socio-economic situation of the Russian Federation in the period 2000-2017. Culture and religion in modern Russia.
	Modern problems of mankind and the role of Russia in their solution. Models of modernization of society and ways of intensification of the Russian economy. Strategy of the State national policy of the Russian Federation. Global financial and economic crises and their impact on the Russian economy. Establishing international economic and military ties. EurAsEC (since 2015 EAEU), CSTO, SCO, BRICS. Russia's access to the WTO. The Joint Declaration of Russia and China on a multipolar world.
	The modern concept of Russian foreign policy in a multipolar world. The Russian Federation's opposition to US attempts to invade the sphere of geopolitical interests in the Caucasus, Central Asia and the Baltic States. The use of US armed force against Yugoslavia and Iraq. The elimination of statehood in Libya. The creation of extremist movements supported by the United States as the main factor of population migration from the Middle East and North Africa. International terrorism, refugees. Georgian-Russian military conflict in August 2008. Coup d'etat in Ukraine (February 2014).
	Russia in the context of modern geopolitical challenges. The essence of the global processes of modernity. Refusal to fight neo-Nazism in the countries that were members of the anti-Hitler coalition (Great Britain, USA, etc.) in violation of the Resolution of the 69th UN session (December 2014). The return of Crimea and Sevastopol to the Russian Federation. US and EU sanctions against Russia and their consequences. The rise of international tension. 2022. The beginning of a special military operation. The policy of aggressive Russophobia on the part of the United States and NATO countries. Information wars against the Russian Federation. "The abolition of culture."
The role of RUDN as a "soft power" in the international relations	Peace initiatives of the USSR in the postwar period, especially the opening of the Peoples Friendship University in 1960, the mission of the University, especially the first rector – S. Rumyantsev, the second rector – V. Stanis, the third rector – V. Filippov. RUDN Rector named after P. Lumumba since 2020 O. Yastrebov.

Name of the discipline	Fundamentals of military training. Life safety
Scope of discipline, ЗЕ/ак.ч.	4/144
CONTENT OF DISCIPLINE	
Sections	**Themes**
Section 1 Life safety.	Topic 1.1 Fundamentals of human life safety: essence and content
	Topic 1.2 Fire safety
	Topic 1.3 Anti-terrorism security
	Topic 1.4. Anti-corruption and prevention of corruption risks
	Topic 1.5. Healthy lifestyle
	Topic 1.6. Personal information security
	Topic 1.7. Human life safety in emergency situations
	Topic 1.8. Civil defense as a system of nationwide measures to protect the population from dangers
	Topic 1.9. Basics of labor protection
Section 2 Basic Military Training. Life Safety	Topic 2.1. Radiation, chemical and biological protection
	Topic 2.2. Fundamentals of tactics of combined arms units
	Topic 2.3. Fire training
	Topic 2.4. Fundamentals of engineering support and communication organization
	Topic 2.5. Drill
	Topic 2.6. General military regulations of the RF Armed Forces
	Topic 2.7. Legal basis for state defense
	Topic 2.8. Military-political training
	Topic 2.9. First aid with elements of tactical medicine
	Topic 2.10. Military topography. Unmanned aerial vehicles

Course Title	Complex Analysis
Course Workload	5/180
Course contents	
Course Module Title	**Brief Description of the Module Content**
Introduction	Definition of a complex number. Algebraic form of a complex number. Operations on complex numbers. Properties of operations.
	Geometric interpretation of a complex number. Trigonometric and exponential forms of complex numbers. Extracting the root of a complex number.
Functions of a complex variable	Sequences and series of complex numbers. Extended complex plane. Stereographic projection. Riemann sphere. Curves and regions on the complex plane.
	Continuous complex-valued functions of a real variable. Continuous functions of a complex variable. Exponential, trigonometric and hyperbolic functions.
Differentiation and integration	Integration of functions of a complex variable. Definition of integral. Properties of integrals. Integral estimates.
	Differentiation of functions of a complex variable. Definition of derivative. Rules of differentiation.
	Cauchy-Riemann conditions. Differentiable functions at a point and in a region. Necessary and sufficient conditions for differentiability of a function at a point.
	Geometric meaning of derivative. The concept of mapping conformality. Inverse function theorem. Multivalued functions "root" and logarithm. Cauchy's integral theorem. Composite contour theorem.
	Antiderivative. Newton–Leibniz formula.
Regular features	Regular features. Power series. Absolute and uniform convergence of power series. Abel's theorem. Integration and differentiation of power series.
	Integral Cauchy formula. Properties of domain-regular functions. Harmonic functions.

	Theorems about mean values. Sufficient conditions for the regularity of a function in a domain. Maurer's theorem. Weierstrass's first and second theorems. Uniqueness theorem.
	Analytical continuation of regular functions. Isolated singular points of unambiguous nature.
Laurent series	Expansion of a regular function into a Laurent series. Uniqueness of decomposition. Study of singular points using Laurent series. Criteria for the existence of a removable singular point, pole, or essentially singular point. The behavior of a function in a neighborhood of an essentially singular point. Theorems of Sokhotsky and Picard.
	Whole functions. Liouville's theorem. Fundamental theorem of algebra.
Residue theory and its application	Residue theory and its application. The main theorem of residue theory. Calculation of integrals using residues.
	Integrals over a closed loop. Calculation of improper integrals of a real variable. Jordan's Lemma

Course Title	Jurisprudence
Course Workload	3/108
Course contents	
Course Module Title	**Brief Description of the Module Content**
Introduction to the theory of law.	Concept and signs of law. Law in the system of social norms.
	Sources and principles of law. The rule of law and its structure.
	Legal relations: concept and signs. Legal facts. Offense and legal liability.
	Lawmaking: concept and types. Systematization of law.
	System of law. National and international law.
	Human rights and freedoms. Classification of human rights. Mechanisms for the protection of human rights.
Introduction to the theory of state.	Origin of the state. The concept and characteristics of the state.
	Functions and mechanism of the state.
	Form of state: form of government, form of government, political regime.
Fundamentals of constitutional law.	The concept of constitutional law as a branch of law. Subject and method of constitutional law.
	Sources of constitutional law.
	Basic institutions of constitutional law.
Fundamentals of administrative law.	The concept of administrative law as a branch of law. Subject and method of administrative law.
	Sources of administrative law.
	Basic institutions of administrative law.
	The concept of administrative offense and administrative responsibility.
Fundamentals of civil law.	The concept of civil law as a branch of law. Subject and method of civil law.
	Sources of civil law. Principles of civil law.
	Civil legal relations. Individuals and legal entities as subjects of civil law. Objects of civil rights.
	The concept and content of property rights.
	The concept of a civil transaction. The concept and content of a civil contract.
	Deadlines in civil law. Limitation of actions.
	Concept and types of obligations. Civil liability.
	Basics of inheritance law.
Fundamentals of criminal law.	The concept of criminal law as a branch of law. Subject and method of criminal law.
	Sources of criminal law. The action of criminal law in space, time and circle of persons.
	Concept, signs and corpus delicti.
	The concept and signs of criminal liability. Circumstances excluding the criminality of the act. Grounds for exemption from criminal liability.
	Punishment and types of criminal penalties.
Fundamentals of labor law.	The concept of labor law as a branch of law. Subject and method of labor law.
	Sources of labor law.
	Employment contract: concept, content and types.

	Working time and rest time. The concept of remuneration.
	Labor discipline and work routine.
	Labor disputes: concept and types.
Fundamentals of family law.	The concept of family law as a branch of law. Subject and method of family law.
	Sources of family law. Basic institutions of family law.
	Concept, signs, conditions and procedure for marriage. Recognition of marriage as invalid. Divorce.
	Rights and obligations of spouses. Rights of minor children.
	Alimony obligations.

Course Title	Philosophy
Course Workload	2/72

Course contents	
Course Module Title	**Brief Description of the Module Content**
The nature of philosophical knowledge	Philosophy in the world of spiritual culture: the main subject of philosophy
	Philosophy and pictures of the world
	Philosophy and science
Historical types of philosophy	Ancient philosophy and the formation of rational knowledge
	Medieval philosophy, Renaissance and Modern philosophy
	Modern philosophy: directions, issues and trends
Problems of philosophy of science: man and society in the modern world	Philosophy and social and humanitarian knowledge: models of reality
	Modern problems of natural science and mathematics: philosophical foundations of science
	Modern problems of philosophy and global scientific challenges

Course Title	Equations of Mathematical Physics
Course Workload	8/288

Course contents	
Course Module Title	**Brief Description of the Module Content**
Equations of mathematical physics	Basic equations of mathematical physics
	Cauchy problem for the equation of string vibrations
	d'Alembert's formula
	Vibrations of a semi-bounded string
	Fourier series
	Solution of the Cauchy problem for the vibration equation of a string with fixed ends
	Forced string vibrations
	Equation of heat propagation in a rod
	Thermal conductivity in the final rod
	Laplace's equation
	Recording in polar coordinates
	Fourier method for Laplace's equation
Methods for solving equations of mathematical physics	Potential theory methods
	Numerical methods
	Variational methods
	Projection methods
	Asymptotic methods

Course Title	Physical Culture
Course Workload	Credits and academic hours

Course contents	
Course Module Title	**Brief Description of the Module Content**
Module 1 Practical	1.1. Physical culture in general cultural and professional training of students
	1.2. Social and biological foundations for Physical Culture
	1.3. Track and Field athletics
	1.4. Essentials for healthy lifestyle
	1.5. Self control in in physical exerciseing and sports

	1.6. Skiing
	1.7.Physical culture in production activities of bechelor and specialist
Module 2 Control	Control tests and normatives acceptation

Course Title	Foreign Language
Course Workload	10/360
Course contents	
Course Module Title	**Brief Description of the Module Content**
Household communication	I and my family. Family traditions. The concept of the article.
	Leisure. Groups of pronouns. Order of words in a sentence.
Educational and cognitive sphere of communication	Me and my education. Higher education in Russia. My university. Cases.
	The oldest universities in foreign countries. Numerals. Scientific life of students.
Social and cultural sphere of communication	Me and the world. Foreign language in the modern world and its role. Modal verbs.
	Country of the language being studied. Traditions and customs. Adverb. Complex sentence.
Professional sphere of communication	Job vacancy announcements. Responsibilities of specialists. Future tense. Participle.
	Outstanding scientists. Discoveries. Passive voice. Past tense.

Course Title	Russian as a Foreign Language
Course Workload	10/360
Course contents	
Course Module Title	**Brief Description of the Module Content**
Ordinals. Time constructions what number? and what date?	Pronunciation and spelling
	Genitive case to indicate direction (with the question from where?). Adverbs of place answering the question from where? (from here, etc.) Conjugations of the verbs sleep and buy. Peculiarities of translation into Russian of English expressions Itdepends, Shall (should) I +infinitive.
	Repetition of the rules for using the verbs go, go, walk, ride. Verbs of motion go, go, go, go, come, arrive, walk, ride. Time constructions that answer the question how long? Peculiarities of translation into Russian of the preposition forin temporary constructions. An impersonal construction, it seems to me (to you). Genitive case with preposition without.
	Features of conjugating verbs with the particle –sya. Verb to return. Construction What is the name...?
	Telephone etiquette. Formation and use of imperative forms with the word let. Formation and use of imperative forms with the word let (let him call me back). Using the words so and so with adverbs and adjectives. Verb to gather (+infinitive).
	Genitive case with prepositions from and y (from whom? from whom?). Dative case with the preposition to (to whom?) Comparison of constructions answering the questions where? Where? where? to whom? who? from whom?
	Theme: "Health". Names of body parts and some diseases. Reflexive pronoun self.
	Impersonal constructions with the words possible, necessary and impossible. Impersonal and personal constructions with the word need. Constructions, how old are you and me... years old. Speech etiquette: offering help (help you?).

Course Title	Second Foreign Language (practical course)
Course Workload	8/288
Course contents	
Course Module Title	**Brief Description of the Module Content**
Acquaintance	Introductory phrases. Personal information about yourself. Location. Days of the week. Numerals. Order of words in a sentence.

	Family, relatives and friends. Description of the house/apartment. Family traditions. Pronouns and their types.
Everyday life	My everyday life. Free time. Hobbies and interests. Singular and plural nouns.
	Weather forecast. Climate. Calendar. Time. Regular and irregular verbs.
In the city	Transport. Rest. Trips. Verb tenses.
	Food. National cuisine. Order in a cafe. Purchases. Prepositions of place, time and movement.
Future profession	My university. Disciplines studied. Profession engineer. Types of adverbs.
	Dream job. Description of the workflow. Career. Modal verbs. Future and past tense.

Course Title	Computer Science and Programming
Course Workload	21/756
Course contents	
Course Module Title	**Brief Description of the Module Content**
Information and computer science	Basic concepts. Subject and tasks of computer science
	Information and its properties
	Arithmetic and logical foundations of computer operation
	Encoding information
	Prospects for the development of computer science
	Modern aspects of programming. Classification and areas of application of modern programming languages
Computer technology	History of development and classification of computers
	Computer architecture. Composition of the computing system
	Principles of functioning of elements of a computer system
	Computer networks. Client-server architecture
Software	System software
	Application software
Basic concepts of modeling and algorithmization	Stages of solving a problem using a computer
	Models and their classification
	Concept and properties of the algorithm. Ways to describe the algorithm
Python programming language	Interpreter. Basic syntax. Memory model. Data types
	Logical constructions. Loops and branches
	Functions. Passing arguments. Area of visibility. Call stack
	Working with files. Properties and types of files. Data Serialization
	Block organization of the program. Modules and packages. pip package manager
Python libraries for solving scientific and applied problems	Data visualization using Matplotlib library
	Solving statistics and linear algebra problems using NumPy and Pandas libraries
Programming Paradigms	Basic paradigms and their features: procedural programming, object-oriented programming, functional programming
	Object-oriented programming in Python. Encapsulation, polymorphism, inheritance. Classes and objects. Class inheritance
	Functional programming in Python. Anonymous functions: syntax and context of use. Function decorators
	Visual block programming as a tool for creating and managing VR worlds
Data structures	Basic data structures and their properties
	Standard Python data structures and features of working with them
	Graph data structure. Python libraries implementing the graph data structure and features of working with them
Algorithms	The concept of calculation and computability. Classification of algorithms. Turing machines.
	Algorithm complexity assessment
	Sorting algorithms
	Search algorithms
	Graph Algorithms
	Functionality of the SciPy library and features of working with them

Python libraries for solving scientific and applied problems	Functionality of the SymPy library and features of working with them
Operating Systems Basics	History of development and main functions of operating systems
	Command Sheet Basics
	Architectural features of operating systems
	Process and memory management
	I/O Management
Version control systems (VCS)	History of the development of SLE. Basic concepts and terms. Classification and modern SLE
	Using Git and organizing your software creation workflow
C Programming Language Basics	History of development, features and scope of the C language
	Declaration and definition of variables. Variable types. Type conversion.
	Arithmetic and logical operators. Bitwise operators. Priority and order of calculation.
	Control structures. Branching and looping, unconditional branch and multiple choice operators
Functions and structure of the program	Functions. Syntactic constructions for working with functions: declaration, definition, call. Recursion. Call stack. Block program structure
	External variables and scope. Static and register variables. Header files.
	The process of compiling programs. Preprocessor, file inclusion, macro substitution, conditional compilation
Pointers and Arrays	Pointers and addresses. Pointers and Function Arguments
	Arrays. Address arithmetic
	Pointers to pointers. Multidimensional arrays
	Command line arguments. Function pointers. Complex declarations
Structures	Basics of working with structures. Structures and functions. Pointers to structures
	Defining New Types
	Unions and bitfields
I/O Operations	Standard I/O
	Variable length argument lists. Formatted input
	Reading and writing files
	Error processing
Standard Library	Operations with strings. Analysis, classification and transformation of symbols
	Executing commands. Memory management
	Mathematical functions. Random number generator
Basics of the C++ programming language	History of development, features and scope of the C language. Differences between the C and C++ languages
	Types and declarations. Namespaces. Pointers, references, arrays and structures
	Expressions and operators. Functions
	Exceptions. Keywords throw, catch
	Source files and programs. Separate compilation
Abstraction mechanisms (OOP)	Classes and objects. Class members. Constructors and destructors. Composition of classes. Access modifiers. Overloading class methods.
	Operation overload. Functions-operations. Type conversion operations. Class friends
	Class inheritance. Derived classes. Virtual functions. Class hierarchies and abstract classes
	Templates. Definition of a template. Specification of templates. Type checking. Function templates. Specialization
Exception Handling	Error processing. Grouping exceptions
	Catching exceptions. Resource management
	Exception Specification
	Exceptions and efficiency. Error Handling Alternatives
Class hierarchies	Designing a class hierarchy. Traditional class hierarchies
	Multiple inheritance and access control
Standard STL Library	Standard containers
	Algorithms and classes of functional objects

	Iterators and allocators
	Strings and Streams
	Math classes
Programming technology	Basic concepts and approaches
	Problems of developing complex software systems
	Block-hierarchical approach to creating complex systems
	Life cycle and development stages
	Assessing the quality of software creation processes
Techniques for ensuring the manufacturability of software products	Software manufacturability. Modules and their properties
	Top-down and bottom-up development
	Structural and "non-structural" programming. Tools for describing structured algorithms
	Program design style. Efficiency and technology
Defining Software Requirements	Classification of software products based on functionality. Basic Operational Requirements
	Development of technical specifications. Fundamental solutions for the initial stages of design
Structural approach	Requirements analysis and specification determination using a structured approach. State transition diagrams, functional diagrams, data flow diagrams. Data structures and data component relationship diagrams. Mathematical models of problems
	Software design using a structured approach. Structural and functional diagrams. Step by step detailing. Maps of Constantine. Designing data structures. Design based on data decomposition. Case technologies
Object approach	Requirements analysis and specification determination using an object-based approach. UML. Define use cases. Construction of a conceptual model of the subject area. Description of behavior
	Software design using an object-based approach. Development of the structure. Define relationships between objects and classes. Designing classes. Layout. Hosting distributed software systems. Spiral development model
Software Product Testing	Types of quality control. Manual control. Structural and functional testing
	Unit, end-to-end and evaluation testing

Course Title	Theoretical Mechanics
Course Workload	8/288

Course contents	
Course Module Title	**Brief Description of the Module Content**
Introduction	Introduction
	Vector theory. Projections and coordinates of vectors. Operations on vectors in coordinate representation. Differentiation of a vector function by a scalar argument.
Kinematics	Kinematics
	The simplest motions of a rigid body
	Plane motion of a rigid body
	Rotation of a rigid body around a fixed axis
	General case of rigid body motion
	Complex point movement
	Complex rigid body motion
Statics	Statics
	Balance of bodies
	Friction
	Center of gravity
Dynamics	Dynamics
	Geometry of masses
	General theorems of dynamics
	Rigid body dynamics
	D'Alembert's principle. Dynamic reactions of connections

	Fundamentals of Analytical Mechanics

Course Title	Space Flight Mechanics
Course Workload	25/900

Course contents	
Course Module Title	**Brief Description of the Module Content**
Introduction	Mechanics of space flight in the structure of scientific and technical knowledge. Structure of the discipline. Areas of application of space flight mechanics methods
	Dynamics of bodies of variable mass. The law of universal gravitation. Basic laws of mechanics.
	Spherical trigonometry
Unperturbed motion of the spacecraft	Basic concepts and definitions. Equations of motion in a gravitational field
	Integrals of the equations of unperturbed motion
	Trajectory equation. Types of orbits. Geometric characteristics of orbits
	Kinematic motion parameters
	Kepler's equation
	Determination of Keplerian orbital elements from the initial conditions of motion
	Determination of kinematic parameters of motion using Keplerian orbital elements
	Spacecraft flight path
	Determination of Keplerian orbital elements from two positions of the spacecraft
Disturbed motion of the spacecraft center of mass	General characteristics of disturbances and basic methods for studying disturbed motion
	Osculating element method
	Analysis of perturbed motion in near-circular orbits
	The influence of the non-centrality of the Earth's gravitational field
	Influence of the Earth's atmosphere
	The influence of the attraction of celestial bodies
	Effect of light pressure
Dynamics of spacecraft motion relative to the center of mass	Moments of forces acting on a spacecraft
	Differential equations of rotational motion of a spacecraft
	Kinematic Poisson relations. Energy integral
	Energy integral. Relative equilibrium of the spacecraft. Equilibrium stability
	Limits of fluctuations. Conditions for non-turnover
	Methods for orienting and stabilizing a spacecraft
Orbital maneuvers in the central gravitational field	Basic principles of the theory of maneuvers
	Transition maneuvers
	Meeting in coplanar orbits
	Meeting on non-coplanar orbits
	Numerical methods for optimizing and increasing the accuracy of maneuver parameters
	Maneuvering with an engine having limited constant thrust
Coordinate systems	Celestial coordinate system. Heliocentric coordinate system
	Geocentric coordinate systems. Connected coordinate systems
	Transition between coordinate systems
Time scales	Solar, sidereal and atomic time
	Dynamic and coordinated time
	Transition between time scales
Methods for predicting the motion of a spacecraft	Forms of representation of the Earth's gravitational field
	Mathematical modeling of disturbing forces
	Analytical methods for motion forecasting
	Representation of the right-hand sides of the equations of motion as functions of orbital elements
	Numerical methods for motion prediction
	Methods of the theory of special perturbations in spacecraft dynamics problems

Determination of spacecraft motion parameters based on trajectory measurements	Characteristics and classification of measurements. Conversion of measurement information.
	Lambert problem
	Least square method
	Kalman filters
Dynamics of launching a spacecraft into low-Earth orbit	Starting coordinate systems. Determining the optimal start time
	Rocket engines. Forces and moments acting on the launch vehicle
	Mathematical modeling of launch vehicle motion
Dynamics of spacecraft descent to Earth	General scheme of descent. Requirements for the descent trajectory
	Mathematical modeling of the movement of the descent vehicle in the atmosphere
Interplanetary flights	Methods for calculating sections of interplanetary trajectories
	Flight diagrams of interplanetary vehicles. Start windows.
	Mathematical modeling of the movement of interplanetary vehicles
	Optimization of interplanetary trajectories

Course Title	Analysis of Geoinformation Data
Course Workload	12/432

Course contents

Course Module Title	Brief Description of the Module Content
Fundamental concepts of geoinformatics	Basic concepts and definitions: cartography, geoinformatics, GIS, remote sensing.
	Main tasks of geoinformatics
	Software and hardware of modern geographic information systems
Spatial data	Review of various spatial data sources.
	Types and sources of spatial data
	Concept of vector and raster data. Basic data formats
	The concept of layered data organization
	Operations with raster and vector data
	Visualization of spatial data

Course Title	Numerical Methods
Course Workload	3/108

Course contents

Course Module Title	Brief Description of the Module Content
Numerical optimization methods	Optimization concept
	Statement of the optimization problem
	Numerical approach to solving the optimization problem
One-dimensional optimization methods	Svenn's algorithm for finding the uncertainty interval
	One-dimensional optimization methods
	Halving method
	Dichotomy method
	Golden ratio method
	Fibonacci method
Multidimensional optimization methods	Zero-order multidimensional optimization methods
	Hooke–Jeeves configuration method
	Nelder–Mead deformable polyhedron method
	Rosenbrock method
	Powell's conjugate directions method
	Random Search Methods
	Adaptive random search method
	Random search method with return if step fails
	Best sample method
	Statistical gradient method
	Random search method with guiding hypersquare
	Numerical methods for approximate calculation of derivatives
	Difference formula for calculating the first partial derivative
	Difference formula for calculating the second derivative

Numerical methods of differentiation and integration	Numerical methods for solving ODEs
	Cauchy problem
	Numerical solution of the Cauchy problem
	Euler method
	Improved Euler Methods
First order optimization methods	First order optimization methods
	Gradient descent method with constant step
	Coordinate-wise gradient descent method
	Steepest gradient descent method
	Gauss–Seidel method
	Fletcher–Reeves method
Second order optimization methods	Second order optimization methods
	Newton's method
	Newton–Raphson method
	Marquardt method
Conditional optimization methods	Penalty function methods for conditional optimization
	Method of penalty functions (method of external penalties)
	Barrier function method (internal penalty method)
	Combined penalty function method
Linear programming problems	Statement of the linear programming problem
	Canonical form of writing a linear programming problem and methods of reduction to it
	Simplex method for solving a linear programming problem
	Algorithm for obtaining an admissible initial basis when solving a linear programming problem using the simplex method
Discrete optimization problems	Concept and class of discrete optimization problems
	Classic discrete optimization problems
	Methods for solving discrete optimization problems
	Heuristic algorithms
	Branch and bound method
	Dynamic programming method
Modern metaheuristic algorithms for global optimization	Class of metaheuristic global optimization algorithms
	Evolutionary and population optimization methods
	Evolutionary algorithms
	Genetic algorithm
	Crossing and mutation operations in a genetic algorithm
	Population algorithms
	Particle swarm method
	Scheme for modifying a possible solution in the particle swarm method
	Bee algorithm
	Gray wolf algorithm
	Cat Optimization Algorithm
	Bat-inspired method
	Whale optimization algorithm

Course Title	Automatic Control Theory
Course Workload	Credits and academic hours
Course contents	
Course Module Title	**Brief Description of the Module Content**

Course Title	Optimal Control Methods
Course Workload	10/360

Course contents	
Course Module Title	**Brief Description of the Module Content**
Optimal control theory. Maximum principle L.S. Pontryagin.	Statement of optimal control problems. Basic concepts. Examples of optimal control problems.
	Problems with a free right end of the trajectory. Formula for increasing functionality.
	Maximum principle L.S. Pontryagin for problems with a free right endpoint. Formulation and proof.
	Linear problems with a free right end. The maximum principle as a necessary and sufficient condition.
	Formulation of the maximum principle for various classes of optimal control problems: a) two-point problems; b) optimal performance problem; c) problems with boundary conditions, transversality conditions; d) autonomous and non-autonomous systems; e) tasks with fixed and non-fixed process completion time; e) tasks with integral and terminal functionality; g) problems with parameters.
	Examples of optimal control problems. Performance problem.
	The concept of synthesis of optimal control.
	Relationship between the maximum principle and classical calculus of variations. Derivation of the Euler equation and the Legendre-Clebsch conditions from the maximum principle. Jacobi condition.
Dynamic programming	Managed multi-step processes. The principle of optimality.
	Dynamic programming method for multi-step control processes.
	Dynamic programming method for optimal control problems.
	Bellman differential equation. Statement of problems for the Bellman equation. Examples.
	Relationship between the dynamic programming method and the maximum principle. Derivation of transversality conditions using the dynamic programming method.
	Linear control systems with quadratic functionality. Construction of a synthesis of optimal control.
Numerical methods for optimal control	Numerical methods based on reducing optimal control problems to boundary value problems using the maximum principle.
	Using methods for solving systems of algebraic equations to solve boundary value problems. Newton's method and its modifications.
	Numerical methods for minimizing functions of several variables. The concept of linear and nonlinear programming. Gradient method. Method of penalty functions.
	Numerical methods based on varying control functions. Gradient method in control space. Accounting for restrictions on executive functions. Accounting for boundary conditions and phase restrictions using the penalty function method. Accounting for boundary conditions using the gradient design method.
	Method of successive approximations in the space of control functions. Ways to improve convergence and modify the method. Examples.
	Small parameter method for weakly controllable systems.
	Numerical methods based on varying phase coordinates in space. Dynamic programming method. Full and partial search. "Wandering tube" method.
	The concept of an elementary operation and methods of its construction. Construction of an elementary operation for flight dynamics problems.
	Method of local variations. Application of the method of local variations to various variational problems. Variational problems with non-additive functionals. Variational problems in partial derivatives.

Course Title	Professional Russian (as a foreign language)
Course Workload	6/216
Course contents	
Course Module Title	**Brief Description of the Module Content**
Russian language as a means of mastering a profession.	Prestigious and in-demand professions in the engineering and technical field.
	Professional portrait of a specialist. Qualities, properties, abilities.
	Familiarity with texts from professional magazines and websites, texts and information from recruitment agencies.
Reading professionally oriented texts	Reading authentic texts on professional topics using various strategies (studying, viewing, informative).
	Structural and semantic analysis of texts in the specialty: highlighting keywords, information center; basic and additional information.
	The concept of text compression. Formulas for expanding and compressing text material.
	Transformation of texts in the specialty: comprehension, processing of content, presentation of basic information. Preparing messages for a project on the topic.
Speech etiquette in professional activities	The content of the concept of "speech etiquette". Basic standards of business etiquette

Course Title	Foreign Language in professional activities
Course Workload	6/216
Course contents	
Course Module Title	**Brief Description of the Module Content**
Academic/scientific text: syntax	Features of academic/scientific text. Scientific style of speech. The main features and linguistic means of the scientific style of speech.
	Syntactic structures, general scientific and special vocabulary of academic/scientific text. Comparison of constructions in the native and target languages.
	Design of academic/scientific text. Types of references and bibliographies. Design of footnotes, list of sources and title. Plagiarism.
Preparation of an academic/scientific presentation in English	Purpose of academic/scientific presentation. General recommendations and training requirements. Designing slides for a scientific presentation. Final slide. Preparing a computer presentation.
	The structure of the presentation and its elements. Main goals. Relevance, scientific novelty and research results. Content part. The structure of a public scientific speech.
	Working on the presentation. Preparing a report for presentation. Phrases and cliches for oral presentation. Stylistic techniques of scientific presentation. Decor.
Scientific text: genres and their features	Model of academic/scientific text. Types, primary and secondary genres of academic texts. Construction of a scientific text. Introduction, discussion, conclusion. Key terms and concepts.
	Writing/composing scientific text. Types and types of paragraphs. Structure of a scientific essay. Structure of a scientific article. Requirements for registration.

Course Title	Applied Physical Education
Course Workload	Credits and academic hours
Course contents	
Course Module Title	**Brief Description of the Module Content**
Module 1 Methodical and practical	1.1. Track And Field Athletics 1.2. Sport Games 1.3. Gymnastics 1.4. Winter Sports 1.5. Combat techniques and movement without weapons

	Students self-studies

Course Title	Discrete Mathematics
Course Workload	2/72

Course contents	

Course Module Title	**Brief Description of the Module Content**
Set theory	Basic concepts. Operations on sets and their properties. Venn diagrams. Binary relation and equivalence relation
	Mappings, properties of mappings. Product of mappings, inverse mapping. nth order permutations
	Algebraic laws. Internal law of composition. Generalized associativity. External law of composition
Propositional logic	Statements and logical connectives. Truth table. Conditional statements
	Equivalent statements. Laws of propositional logic
	Axiomatic systems: inferences and proofs. Completeness in propositional logic
	Carnot maps. Switching circuits
	Predicate calculus
	Basic provisions of the theory of evidence. Mathematical induction
Graph theory	Basic concepts. Methods for specifying graphs. Incidence and adjacency matrices
	Paths and cycles. Graph connectivity. Euler paths and cycles
	Directed and weighted graphs
	Hypercubes and Gray code
	Breadth-first and depth-first graph traversal, path recovery with the least number of intermediaries
	Finding the shortest path, Dijkstra's algorithm

Course Title	Fundamentals of information security and cyber resilience
Course Workload	2/72

Course contents	

Course Module Title	**Brief Description of the Module Content**
The essence, tasks and problems of information security	Introduction. The role of information in the life of modern society. Development of the information industry. The objective need for information security and information protection.
	Definition of information. Documented information. Electronic message. Assets. Resources. Various definitions of information security, information protection, cybersecurity, cyber resilience
	Modern formulation of the information security problem. Purpose and structure of the discipline. Recommended basic and additional reading. Internet sources. Information security specialists. Licensing of information security activities.
The concept of national security, types of security. Information security of the Russian Federation	Bodies ensuring the national security of the Russian Federation, goals, objectives.
	National interests of the Russian Federation in the information sphere. Priority areas in the field of information security in the Russian Federation.
	Trends in the development of information policy of states and departments. State secret.
	General provisions. Conceptual documents in the field of information security. The most important federal regulatory legal acts. Laws relating to the protection of intellectual property. Provisions of the Civil Code of the Russian Federation on information protection.

International, national and departmental regulatory legal framework in the field of information security	The international cooperation. Code of Administrative Offences. Criminal code and information protection. Basic by-laws in the field of information security. Decrees of the President of the Russian Federation, resolutions of the Government of the Russian Federation, departmental regulatory framework.
Information security threats. Management of risks.	The concept of threat. Types of threats. The nature of the origin of threats: intentional factors, natural factors. Sources of threats. ¶Threat model and information security violator model. ¶
	General characteristics of risk analysis, assessment and management. Scales. Assessment based on identifying the weak link. Risk assessment based on consideration of the stages of an invasion. Software tools used for risk analysis.
Information and automated systems	Definitions of information (IS) and automated information processing systems (AS). GOST standards for speakers. Typical types of AC structure. Types of influence on information in IS and AS. NPP safety threats and their classification.
	Measures to counter threats to nuclear power plant safety. AS vulnerabilities. Principles of constructing a nuclear power plant protection system. Automated process control systems (APCS).
Technical channels of information leakage	Technical channels of information leakage (TCIL) and methods of blocking them. Passive and active protection against information leakage through technical channels. Definition, classification and general characteristics of TKUI.
	Visual and acoustic channels. Protection of information in telephone channels. Protection against spurious electromagnetic radiation and interference (PEMIN). Technical bookmarks.
	Methods for detecting TKUI. Ways and methods of covering TKUI. Requirements for the selection and equipment of premises for automated data processing according to the conditions of protection from TKUI. The concept of controlled territory and methods for determining its size. Features of protecting personal computer equipment from information leakage through technical channels.
Technical means to ensure the safety of the facility.	Definition and main goals of protecting modern facilities. Technical means of ensuring the protection of an object: definition, system classification, general analysis. Technical means and systems for protecting territory, buildings and premises.
	Technical means of monitoring and controlling the movement of people and objects. Technical means and systems for identifying people. Technical means and access control systems to the territory, buildings and premises, to information processing and storage facilities. Methods for selecting technical equipment, general information about the market for technical security equipment.
Methods for controlling access to information	Methods for identifying and authenticating users. Password method. Biometric authentication. Methods of access control, methods and means of their implementation.
	Brief description of modern access control tools. Mathematical models of information access control. Subject-object access model.
	Security policy and access model. Electronic keys. ID cards, key rings. Types of cards. Unified biometric system of Russia.
Malware	Malicious bookmarks (BW): definition, types. Destructive effects of bookmarks. Systems for access control and protection against airborne threats. Prevention and minimization of the consequences of exposure to air pollution.
	Brief description of protection measures: legal, administrative and organizational, hardware and software. Computer viruses. Classification
	The main channels for the spread of viruses and other malware. Anti-virus tools: a brief description of popular anti-virus programs. Copy protection tools. Examples of tools and technologies
Network Security Fundamentals	Introduction to the Internet and Intranet. Methods of attacking networks and protecting against internetwork access. Features for different levels of the ISO/OSI model.

	Firewall technologies. ME functions. Formation of internetworking policy. Criteria for evaluating firewalls
	Construction of secure virtual VPN networks. VPN Security Tools. Protection at the channel and session levels. Protocols PPTP, L2TP, SSL/TLS, SOCKS. Protection at the network level. IPSEC protocol
	Security of remote access to the local network. Centralized control. Access control based on single sign-on with authorization. Attack detection technologies. Classification of attack detection and prevention systems (IDS/IPS). Threats and vulnerabilities of wireless networks.
Organizational and legal support for information protection	The essence and role of organizational and legal aspects of information security. Regulatory legal framework for information security. Law of the Russian Federation "On information, information technologies and information protection". ¶Types and categories of restricted access information: state and other types of secrets. Law of the Russian Federation "On State Secrets", "On Commercial Secrets", "On Personal Data", "On the National Payment System", "On the Security of Critical Information Infrastructure of the Russian Federation". State system of licensing and certification of activities in the field of information security. Decree of the President of the Russian Federation "On measures to comply with the law in the field of development, production, sale and operation of encryption tools, as well as the provision of services in the field of information encryption." Law of the Russian Federation "On Electronic Digital Signature". Criminal legal regulation of information protection.
Information Security Standards	Historical outline of the development of foreign information security standards. GOST R ISO/IEC 15408-2002, as an authentic version of the general IT security criteria. Functional safety requirements. Security assurance requirements. Standards ISO/IEC 17799: 2002 (BS 7799:2000).
	Information security management standards ISO/IEC 27001-27040. German BSI standards. SysTrust, SCORE, GIAC standards. Standards for wireless networks. Domestic information security standards. Standards for ensuring information security of organizations of the banking system of the Russian Federation. GOST R 57580.1-2017 and GOST R 57580.2 – 2018. Internet information security standards (IETF, RFC).
Certification and certification in the field of information security	Purpose and general characteristics. Voluntary certification. Mandatory confirmation of compliance. Declaration of conformity. Mandatory certification.
	Conducting certification tests: principles of testing, documents of certification tests. Certification of products imported from abroad of the Russian Federation. Certification at regional and international levels.

Course Title	Business Communications
Course Workload	2/72
Course contents	
Course Module Title	**Brief Description of the Module Content**
General characteristics of business communication	Communication, its functions and main types. Features of business communication. Types of business communication according to content. Typology of types of business communication by purpose of communication
Language means of communication. Speech etiquette	Etiquette status of participants in business communication. Speech etiquette. You-and you-communication. Address in business communication
	Speech formulas for greeting, introduction, request, agreement, objection, refusal, ending a conversation
Nonverbal means of business communication	Kinesics. Influencing your interlocutor using kinesics.
	Proxemic means: distance, positions at the table. Spatial zones.
	Takesic means. Prosodic means
Listening ability as a condition for effective business communication	Listening styles. Types of listening. Active (reflective) listening techniques
	Rules for effective listening. Mistakes that prevent you from hearing and understanding your interlocutor: criticism, advice, etc.

Course Title	Virtual and Augmented Reality Technology
Course Workload	3/108

Course contents	
Course Module Title	**Brief Description of the Module Content**
Principles of constructing virtual reality systems (virtual reality, VR)	Review of VDR systems.
	History of the development of VDR systems.
	Interaction between a human user and a reality model.
	Simulation of operations possible with real objects.
	Immersive perception of a model of reality.
Principles of building augmented reality (AR) systems	Three-dimensional models of objects used to complement real scenes.
	Establishing a correspondence between the user's real space and the data of three-dimensional models.
	Tracking the user's position to determine his observation point in real space.
	Display real-time images of real scenes combined with computer graphics generated from the model.
Remote control	Sensors, effectors, communication channels for virtual reality systems.
Devices for virtual and augmented reality systems	Head display.
	Stereoscopic image output device.
	Audio input/output devices.
	Sensors for the spatial location of human body parts or tools.
	Input/output devices for tactile information.
	Motion information input/output devices.
Generation of 3D models and images	Types of three-dimensional models. Rendering – creating images based on object models.
	Defining model surfaces. Calculation of pixel values of the generated image.
Combination of real and artificial images	Texture mapping.
	Image-based rendering
Examples of applications of virtual reality systems	Inspection of architectural structures. Flight simulation. Interactive segmentation of anatomical structures.
Examples of applications of augmented reality systems	Augmented reality systems used in surgery. Inspection of printed circuit boards. Projecting a car dashboard onto the windshield.
Psychophysiological aspects of human-machine interface in virtual and augmented reality systems	Providing an immersive experience of the virtual environment. The need for individual configuration of devices and parameters of virtual and augmented reality systems.
	Side effects of virtual and augmented reality systems on humans.

Developers:

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