Open Doors Bachelor's Track Program: Engineering and Technology

1. Open Doors winner's skill set

The winner is expected to demonstrate the knowledge of the basic principles of control, probability theory and combinatorics, information coding and logical operations, algorithmization and programming, trigonometry and vector calculus, methods of solving algebraic equations, laws of mechanics, kinematics, electrostatics, electricity, electromagnetism, harmonic oscillations, thermodynamics, quantum physics, structure of solids, types of chemical bonding, and gas laws.

The winner can calculate the probability of dependent and independent events, use trigonometric functions, translate numbers between number systems, develop algorithms with branching, determine the geometric shapes of simple parts from their images, calculate electrical circuits, solve problems on mechanics, kinematics, electromagnetic and electrical phenomena, electrostatics, on the laws of thermal radiation, on atomic physics, quantum mechanics, and on radioactive decay. The winner can explain the processes of transformation and conservation of energy and identify patterns of change in the properties of substances.

2. List of degree programs covered by the subject area

2.1 List of bachelor's degree programs

27.03.04. Control in technical systems
11.03.02. Info-communication technologies and communication systems
11.03.04. Electronics and Nanoelectronics
13.03.02. Electroenergetics and Electrical Engineering
15.03.01. Mechanical engineering
15.03.06. Mechatronics and Robotics
14.03.01. Nuclear Power Engineering and Thermal Physics

3. Content

Field of Science 1. Automation and Control Systems
Mathematics

1. Sine, cosine, and tangent of a numerical argument. Arcsine, arccosine, arctangent of a numerical argument.
2. A power with a rational exponent. Properties of exponents.
3. Logarithm of a number. Common (base 10) and natural (base e) logarithms.
4. Identities and identity transformations.
5. Transformation of trigonometric expressions. Basic trigonometric formulas.
6. Equation, root of an equation. Inequality, solution of an inequality. The method of intervals (sign analysis).
7. Solving trigonometric equations.
8. Function, methods of defining a function. Graph of a function. Inverse functions.
9. Domain and range of a function. Zeros (roots) of a function. Intervals of sign constancy. Even and odd functions.
10. Trigonometric functions, their properties, and graphs.
11. Using function graphs to solve equations and linear systems.

12. Continuous functions. The method of intervals for solving inequalities.
13. First-order differential equations.

Physics

14. Uniform and uniformly accelerated rectilinear motion. Graphs of position, velocity, acceleration, distance, and displacement of a material point as functions of time.
15. Newton's Second Law for a material point in an inertial frame of reference (IFR). Newton's Third Law for material points.
16. Momentum of a material point and a system of material points. Impulse of a force and change in momentum of a body.
17. Law of conservation of momentum in an IFR. Jet propulsion.
18. Conservative and non-conservative forces. Relationship between the work of non-conservative forces and changes in the mechanical energy of a system of bodies. Law of conservation of mechanical energy.
19. Oscillatory circuit (LC circuit). Free electromagnetic oscillations in an ideal LC circuit. Analogy between mechanical and electromagnetic oscillations. Thomson's formula.
20. Forced mechanical oscillations. Resonance and resonance curves. Forced electromagnetic oscillations.
21. AC power. Peak and RMS (root mean square) values of current and voltage.
22. Inductance. Self-induction phenomenon. Self-induced EMF (electromotive force).

Computer Science

23. Computer operation principles. Personal computers. Selecting a computer configuration based on task requirements.
24. Information, data, and knowledge. Universality of discrete information representation. Binary encoding.
25. Systems and their components. System components and their interactions. Control systems. Control as an information process. Feedback.
26. Models and simulation. Goals of modeling. Model accuracy in representing objects or processes. Formalization of applied problems.
27. Mathematical and computer models. Stages of mathematical and computer modeling: problem statement, model development, model testing, computer experiment, and the analysis of modeling results.
28. Numeral systems. Expanded notation of integers and fractions in positional numeral systems. Properties of positional notation: number of digits in representation, divisibility test by the base of the numeral system. Conversion algorithm: from base-P to decimal (for integers and finite fractions), from decimal to base-P. Binary, octal, and hexadecimal systems. Arithmetic operations in positional numeral systems.
29. Representation of integers and real numbers in computer memory.
30. Determining possible outcomes of simple control and computational algorithms. Identifying input conditions for desired algorithm results.
31. Stages of problem-solving on a computer. Programming languages (Pascal, Python, Java, C++, C#). Basic programming constructs. Data types (integer, floating-point, character, Boolean). Conditional statements (branching). Compound conditions. Loops (conditional and counter-based).

Field of Science 2. Electrical Engineering and Electronics
Mathematics

1. A power with an integer exponent. Standard form of a real number.
2. Arithmetic root of a natural degree. Operations with arithmetic roots of a natural degree.
3. Solving integer and fractional-rational equations and inequalities.
4. Examples of trigonometric inequalities.
5. Trigonometric circle, definition of trigonometric functions of a numerical argument.
6. Basic concepts of solid geometry. Point, line, plane, space. The concept of axiomatic construction of solid geometry: axioms of solid geometry and their consequences.
7. Relative position of lines in space: intersecting, parallel and skew lines. Parallelism of lines and planes in space: parallel lines in space, parallelism of three lines, parallelism of a line and a plane. Angles with codirectional sides, the angle between lines in space. Parallelism of planes: parallel planes, properties of parallel planes. Simple spatial figures on a plane: tetrahedron, cube, parallelepiped, construction of cross-sections.
8. Perpendicularity of a line and a plane: perpendicular lines in space, lines parallel and perpendicular to a plane, criterion of perpendicularity of a line and a plane, theorem about a line perpendicular to a plane. Angles in space: angle between a line and a plane, dihedral angle, linear angle of a dihedral angle. Perpendicular and oblique lines: distance from a point to a plane, distance from a line to a plane, projection of a figure onto a plane. Perpendicularity of planes: criterion of perpendicularity of two planes. The theorem of three perpendiculars.

Physics

9. Conditions for the existence of direct electric current. Current sources. Current strength. Direct current.
10. Voltage. Ohm's law for a circuit section.
11. Electrical resistance. Resistivity of a material.
12. Series, parallel, and mixed connections of conductors.
13. Work done by electric current. Joule-Lenz law.
14. Power of electric current.
15. EMF and internal resistance of a current source. Ohm's law for a complete (closed) electric circuit. Short circuit.
16. Law of electromagnetic induction.
17. Electronic conductivity of solid metals. Dependence of metal resistance on temperature. Superconductivity.
18. Semiconductors. Intrinsic and extrinsic conductivity of semiconductors. Properties of p-n junction. Semiconductor devices.
19. Electrical capacitance. Capacitor. Capacitance of a parallel-plate capacitor. Energy of a charged capacitor.
20. Ampere force, its magnitude and direction.
21. Electric current in electrolytes. Electrolytic dissociation. Electrolysis.
22. Electric current in gases. Self-sustained and non-self-sustained discharge. Various types of self-sustained discharge. Lightning. Plasma.

Field of Science 3. Robotics
Mathematics

1. Systems of linear equations. Solving applied problems using systems of linear equations.
2. Systems and combinations of rational equations and inequalities.
3. Power function with natural and integer exponents. Its properties and graph. Properties and graph of the nth root.
4. Function. Periodic functions. Intervals of monotonicity of a function. Maxima and minima of a function. Greatest and least values of a function on an interval.

5. Derivative of a function. Geometric and physical meaning of the derivative.
6. Derivatives of elementary functions. Formulas for finding derivatives of sums, products, and quotients of functions.
7. Vectors in the plane and in space. Coordinates of a vector. Scalar product of vectors.
8. Concept of a polyhedron, basic elements of polyhedrons, convex and non-convex polyhedrons, nets of polyhedrons. Prism: n-gonal prism, faces and bases of a prism, right and oblique prisms, lateral and total surface area of a prism. Parallelepiped, rectangular parallelepiped and its properties. Pyramid: n-gonal pyramid, faces and base of a pyramid, lateral and total surface area of a pyramid, regular and truncated pyramid. Elements of prisms and pyramids. Regular polyhedrons: concept of a regular polyhedron, regular prism and regular pyramid, regular triangular pyramid and regular tetrahedron, cube. Introduction to regular polyhedrons: octahedron, dodecahedron and icosahedron. Sections of prisms and pyramids.
9. Symmetry in space: symmetry about a point, line, plane. Elements of symmetry in pyramids, parallelepipeds, and regular polyhedrons.

Physics

10. Displacement, velocity (average velocity, instantaneous velocity) and acceleration of a material point, their projections on coordinate axes. Composition of displacements and composition of velocities.
11. Friction force. Dry friction. Sliding friction force and static friction force. Coefficient of friction. Drag force when a body moves in a liquid or gas.
12. Moment of force about an axis of rotation. Lever arm. Conditions for equilibrium of a rigid body in an inertial frame of reference.
13. Momentum of a material point, system of material points. Impulse of force and change in momentum of a body.
14. Elastic and inelastic collisions.
15. Translational and rotational motion of an absolutely rigid body.
16. Lorentz force, its magnitude and direction. Motion of a charged particle in a uniform magnetic field. Work done by the Lorentz force.
17. Magnetic field of a current-carrying conductor. Field line patterns of a long straight conductor and a closed loop conductor, current-carrying coil. Oersted's experiment. Interaction of current-carrying conductors.

Computer Science

18. Algebra of logic. Propositions. Logical operations. Truth tables for logical operations, disjunction, conjunction, negation, implication, and equivalence. Logical expressions. Calculating the truth value of a compound proposition given the truth values of its elementary propositions. Truth tables for logical expressions. Logical operations and operations on sets. Examples of laws of logical algebra. Equivalent transformations of logical expressions. Logical functions. Constructing a logical expression from a given truth table. Computer logic elements. Flip-flop. Adder. Building a logic circuit from a logical expression. Writing a logical expression from a logic circuit.
19. Development and software implementation of algorithms for solving standard basic-level problems. Example problems: algorithms for processing finite numerical sequences (calculating sums, products, counting elements with given properties), algorithms for analyzing number representations in positional numeral systems, algorithms for solving problems by exhaustive search (finding the greatest common divisor of two natural numbers, checking if a number is prime).
20. Tabular data (arrays). Algorithms for working with array elements in a single pass through the array: summing array elements, counting the number (sum) of array elements satisfying a given condition, finding the maximum (minimum) value of array elements, finding the second largest (smallest) value, linear search for an element, reversing the order of array elements.

Field of Science 4. Telecommunications

Mathematics

1. Natural and integer numbers. Divisibility criteria for integers.
2. Transformation of expressions containing logarithms.
3. Logarithmic equations and inequalities.
4. Sequences, methods of defining sequences. Monotonic sequences.
5. Arithmetic and geometric progressions. Infinitely decreasing geometric progression. Sum of an infinitely decreasing geometric progression. Compound interest formula. Using progressions to solve real-world applied problems.
6. Sets, operations on sets. Euler-Venn diagrams. Application of set theory apparatus for describing real processes and phenomena, when solving problems from other academic subjects.
7. Data representation using tables and diagrams. Arithmetic mean, median, maximum and minimum values, range, variance and standard deviation of numerical datasets.
8. Random experiments (trials) and random events. Elementary events (outcomes). Probability of a random event. Relationship between frequency and probability of events. Random experiments with equally likely elementary events. Probabilities of events in experiments with equally likely elementary events.
9. Operations on events: intersection, union, complementary events. Euler diagrams. Probability addition formula.
10. Combinatorial multiplication rule. Permutations and factorials. Number of combinations. Pascal's triangle. Binomial theorem.
11. Examples of continuous random variables. Concept of probability density. Problems leading to normal distribution. Concept of normal distribution.

Physics

12. Electromagnetic waves. Conditions for electromagnetic wave emission. Mutual orientation of vectors E, B, and υ in an electromagnetic wave in vacuum.
13. Properties of electromagnetic waves: reflection, refraction, polarization, diffraction, and interference. Speed of electromagnetic waves.
14. Electromagnetic wave spectrum. Applications of electromagnetic waves in technology and everyday life.
15. Principles of radio communication and television. Radar. Electromagnetic pollution of the environment.
16. Light interference. Coherent sources. Conditions for observing maxima and minima in interference patterns from two in-phase coherent sources.
17. Light diffraction. Diffraction grating. Condition for observing principal maxima when monochromatic light falls on a diffraction grating.
18. Light dispersion. Complex composition of white light. Color.
19. Light polarization.
20. Transformer. Generation, transmission, and consumption of electrical energy. Environmental risks in electrical energy production. Safe and responsible use of electricity in everyday life.

Computer Science

21. Principles of construction and hardware components of computer networks. Network protocols. The Internet. Internet addressing. Domain Name System.
22. Information processes. Information transmission. Source, receiver, communication channel, signal, encoding. Information distortion during transmission. Data transmission speed over a communication channel. Information storage, memory capacity.
23. Text encoding. ASCII encoding. Single-byte encodings. UNICODE standard. UTF-8 encoding. Determining the information volume of text messages.

24. Image encoding. Estimating the information volume of a raster graphic image at a given resolution and color encoding depth. Sound encoding. Estimating the information volume of audio data at a given sampling rate and bit depth of encoding.

Field of Science 5. General Mechanical Engineering
Mathematics
1. Rational numbers. Common and decimal fractions, percentages, and infinite periodic fractions. Arithmetic operations with rational numbers, transformations of numerical expressions. Application of fractions and percentages to solve applied problems from various fields of knowledge and real life.
2. Real numbers. Rational and irrational numbers. Arithmetic operations with real numbers. Approximate calculations, rounding rules, estimation and evaluation of computation results.
3. Application of equations, systems, and inequalities to solve mathematical problems and problems from various fields of science and real life.
4. Use of function graphs to study processes and dependencies arising when solving problems from other academic subjects and real life.
5. Application of the derivative to study functions for monotonicity and extrema. Finding the maximum and minimum values of a function on a segment.
6. Application of the derivative to find the optimal solution in applied problems, to determine the speed of a process defined by a formula or graph.
7. Calculation of polyhedron elements: edges, diagonals, angles. Lateral surface area and total surface area of a right prism, base areas, and the theorem on the lateral surface of a right prism. Lateral surface area and total surface area of a regular pyramid, theorem on the area of a truncated pyramid. Concept of volume. Volume of a pyramid, prism.
8. Similar solids in space. Ratios between surface areas and volumes of similar solids.
9. Principles of engineering drawing according to ESKD/ISO: principal views, cuts, sections, and dimensioning.

Physics
10. Elastic force. Hooke's law.
11. Solid state. Crystalline and amorphous solids. Anisotropy of crystal properties. Liquid crystals. Modern materials.
12. Work done by a force.
13. Power of a force.
14. Vaporization and condensation. Evaporation and boiling. Specific heat of vaporization. Dependence of boiling temperature on pressure.
15. Models of the structure of gases, liquids, and solids and explanation of the properties of matter based on these models.
16. Types of heat transfer: thermal conduction, convection, radiation.
17. Heat capacity of a body. Specific heat capacity of a substance. Calculation of the amount of heat during heat transfer.
18. The first law of thermodynamics. Application of the first law of thermodynamics to isoprocesses. Graphical interpretation of gas work.
19. Heat engines. Principles of operation of heat engines. Energy transformations in heat engines. Efficiency of a heat engine. Carnot cycle and its efficiency.
20. The second law of thermodynamics. Irreversibility of processes in nature. Heat engines. Environmental issues of thermal power engineering.

Field of Science 6. Nuclear Science and Technology
Mathematics
1. Solving irrational equations and inequalities.

2. Transforming expressions containing powers with rational exponents.
3. Exponential equations and inequalities.
4. Exponential and logarithmic functions, their properties and graphs.
5. Antiderivative. Table of antiderivatives.
6. Integral, its geometric and physical meaning. Calculating integrals using the Newton-Leibniz formula.
7. Definition, theorem, corollary, proof.
8. Conditional probability. Multiplication of probabilities. Tree diagram of a random experiment. Law of total probability. Independent events.
9. Binary random trial (experiment), success and failure. Independent trials. Series of independent trials until the first success. Bernoulli trials.
10. Random variable. Probability distribution. Distribution diagram. Examples of distributions, including geometric and binomial distributions.
11. Numerical characteristics of random variables: expected value (mean), variance, and standard deviation. Examples of applying expected value, including in real-life problems. Expected value of a binary random variable. Expected value of the sum of random variables. Expected value and variance of geometric and binomial distributions.
12. Law of large numbers and its role in science, nature, and society. Sampling method in research.

Physics

13. Curvilinear motion. Uniform motion of a material point along a circle. Angular velocity, linear velocity. Period and frequency. Centripetal acceleration.
14. Sound. Speed of sound. Loudness. Pitch. Timbre.
15. Basic principles of the kinetic theory of matter. Brownian motion. Diffusion. Nature of motion and interaction of particles in matter.
16. Models of the structure of gases, liquids, and solids and explanation of substance properties based on these models.
17. Clapeyron-Mendeleev equation. Dalton's law.
18. Thermodynamic system. Internal energy of a thermodynamic system and methods of its change.
19. Heat quantity and work. Internal energy of a monatomic ideal gas.
20. Photons. Planck's formula relating photon energy to its frequency. Energy and momentum of a photon.
21. Laws of thermal radiation (Stefan-Boltzmann law, Wien's law).
22. Discovery and investigation of the photoelectric effect. Experiments by A.G. Stoletov. Laws of the photoelectric effect.
23. Bohr's postulates. Emission and absorption of photons during atomic transitions between energy levels. Types of spectra. Energy level spectrum of the hydrogen atom.
24. Wave properties of particles. De Broglie waves. Wave-particle duality. Electron diffraction in crystals.
25. Methods of observation and detection of elementary particles.
26. Discovery of the proton and neutron. Heisenberg-Ivanenko nucleon model of the nucleus. Nuclear charge. Mass number. Isotopes.
27. Alpha decay. Electron and positron beta decay. Gamma radiation. Law of radioactive decay.
28. Nuclear reactions. Fission and fusion of nuclei.
29. Binding energy of nucleons in the nucleus. Nuclear forces. Mass defect of the nucleus.
30. Nuclear reactor. Thermonuclear fusion. Problems and prospects of nuclear energy. Environmental aspects of nuclear power.

4. Preparation materials

4.1. Recommended reading

Field of Science 1. Automation and Control Systems

Reading list in English
1. Barry Ph. Overview of Computer Science. URL: https://www-users.cse.umn.edu/~barry/book1.2.pdf
2. Dorf R.C., Bishop R.H. Modern Control Systems, Pearson, 2017. URL: https://files.crazt.moe/temp/Modern%20Control%20Systems%2013th.pdf
3. Grinstead, C.M. & Snell, J.L. Introduction to Probability. URL: https://math.dartmouth.edu/~prob/prob/prob.pdf
4. Hugh D. Young Roger A. Freedman. University Physics with Modern Physics. Pearson; 15th edition. 2019. 1586 p. URL: https://zlib.pub/book/university-physics-with-modern-physics-6beut9ub0mp0

Field of Science 2. Electrical Engineering and Electronics

Reading list in English
1. Edward M. Purcell, David J. Morin. Electricity and Magnetism. Third edition. 2013. 863 p. URL: https://zlib.pub/book/electricity-and-magnetism-1ihhambrut60
2. Halliday David, Resnick Robert, Walker Jearl. Fundamentals of Physics (11th ed.). 2018. 1452 p. URL: https://zlib.pub/book/halliday-resnick-fundamentals-of-physics-11th-ed-1mhhpjvddr48
3. Hugh D. Young, Roger A. Freedman. University Physics with Modern Physics. Pearson; 15th edition. 2019. 1586 p. URL: https://zlib.pub/book/university-physics-with-modern-physics-6beut9ub0mp0

Field of Science 3. Robotics

Reading list in English
1. Barry Ph. Overview of Computer Science. URL: https://www-users.cse.umn.edu/~barry/book1.2.pdf
2. Hugh D. Young Roger A. Freedman. University Physics with Modern Physics. Pearson; 15th edition. 2019. 1586 p. URL: https://zlib.pub/book/university-physics-with-modern-physics-6beut9ub0mp0
3. Online Textbook | Classical Mechanics - MIT OpenCourseWare. https://ocw.mit.edu/courses/8-01sc-classical-mechanics-fall-2016/pages/online-textbook
4. Trigonometry (Gelfand Mathematical Seminar) Paperback – Illustrated, 8 Jun. 2001. URL: https://www.cimat.mx/ciencia_para_jovenes/bachillerato/libros/trigonometria_gelfand.pdf

Field of Science 4. Telecommunications

Reading list in English
1. Barry Ph. Overview of Computer Science. URL: https://www-users.cse.umn.edu/~barry/book1.2.pdf
2. Combinatorics: A Guided Tour (MAA Textbooks) book by David R. Mazur. Volume: 55; 2010; 390 pp. URL: https://books.google.ru/books?id=yI4Jx5Obr08C
3. Grinstead, C.M. & Snell, J.L. Introduction to Probability. URL: https://math.dartmouth.edu/~prob/prob/prob.pdf
4. Magnus P.D. An Introduction to Formal Logic. URL: https://milneopentextbooks.org/download/forallx-pdf/?tmstv=1672247070
5 The physics of waves by Howard Georgi. URL: https://ocw.mit.edu/courses/8-03sc-physics-iii-vibrations-and-waves-fall-2016/ef731c1b91d77a6db003f6c27e300d25_MIT8_03SCF16_Textbook.pdf

Field of Science 5. General Mechanical Engineering

Reading list in Englishs

1. Brian Griffiths. "Engineering Drawing for Manufacture". 2002. – 169 p. URL: https://www.mongroupsydney1.com/CE111AGeneralDrawing.pdf
2. Online Textbook | Classical Mechanics - MIT OpenCourseWare. https://ocw.mit.edu/courses/8-01sc-classical-mechanics-fall-2016/pages/online-textbook
3. Physics: Principles with Applications. Global Edition by Douglas C. Giancoli. URL: https://people.vts.su.ac.rs/~ognjen/Inz_fizika2/Physics%20Principles%20with%20Applications,%20Global%20Edition%20(Douglas%20Giancoli)%20(z-lib.org).pdf

Field of Science 6. Nuclear Science and Technology

Reading list in English
1. Conceptual physics by Hewitt, Paul G., Pearson Education Limited, 2014, 848 p. URL: https://archive.org/details/conceptualphysic0000hewi_h6p5
2. Physics: Principles with Applications. Global Edition by Douglas C. Giancoli. URL: https://people.vts.su.ac.rs/~ognjen/Inz_fizika2/Physics%20Principles%20with%20Applications,%20Global%20Edition%20(Douglas%20Giancoli)%20(z-lib.org).pdf
3. Schaum's Outline of Theory and Problems of Applied Physics. URL: https://kishorekaruppaswamy.wordpress.com/wp-content/uploads/2011/10/applied-physics.pdf
4. The physics of waves by Howard Georgi. URL: https://ocw.mit.edu/courses/8-03sc-physics-iii-vibrations-and-waves-fall-2016/ef731c1b91d77a6db003f6c27e300d25_MIT8_03SCF16_Textbook.pdf

4.2. Recommended online courses

Field of Science 1. Automation and Control Systems

Online courses in English	Link	Course description
1. Introduction to Engineering Mechanics	URL: https://www.coursera.org/learn/engineering-mechanics-statics	The course is an introduction to the fundamentals of engineering mechanics, a core field in engineering. During the course, students will learn the basic principles and concepts of mechanics, which play an important role in the design and analysis of various engineering systems.
2. Introduction to middle school Physics	URL: https://www.khanacademy.org/science/ms-physics/x1baed5db7c1bb50b:movement-and-forces/x1baed5db7c1bb50b:representing-motion/v/introduction-to-middle-school-physics	This course introduces learners to the fundamental laws that govern the natural world, covering topics such as forces and motion, energy, and waves, to explain how and why physical phenomena occur.

3. Introduction to Automatic Control Systems	URL: https://www.coursera.org/learn/automata	This Stanford University course is designed for those who are interested in the field of automatic control and want to understand the basic principles and concepts of this field. Students will learn the basic concepts, principles and methods of automatic control systems and learn how to apply them in practice.
4. Mathematics for Computer Science	URL: https://www.coursera.org/learn/mathematics-for-computer-science	This Stanford University course on mathematics for computer science enables students to learn various mathematical concepts such as discrete mathematics, linear algebra, probability theory and others.

Field of Science 2. Electrical Engineering and Electronics

Online courses in English	Link	Course description
1. RICEx: Electricity and Magnetism, Part 1	URL: https://www.edx.org/learn/magnetism/rice-university-electricity-and-magnetism-part-1	The course serves as an introduction to concepts such as charge, electric field, electric potential, current, resistance, and DC circuits.
2. MITx: Circuits and Electronics 1: Basic Circuit Analysis	URL: https://www.edx.org/learn/circuits/massachusetts-institute-of-technology-circuits-and-electronics-1-basic-circuit-analysis	This course is an introduction to the fundamentals of circuit analysis and electronics. Students learn basic concepts such as Kirchhoff's Laws, node and circuit analysis techniques, and simple electronic components and their interactions in circuits.
3. GeorgetownX: Preparing for the AP* Physics C: Electricity and Magnetism Exam	URL: https://www.edx.org/learn/ap/georgetown-university-preparing-for-the-ap-physics-c-electricity-and-magnetism-exam	The course covers introductory topics in electricity and magnetism, including electrostatics, conductors, capacitors and dielectrics, electric circuits, magnetic fields and electromagnetism using mathematical analysis.
4. RICEx: AP® Physics 2 - Part 2: Electricity and Magnetism	URL: https://www.edx.org/learn/ap/rice-university-ap-r-physics-2-part-2-electricity-and-magnetism	The course covers topics such as electrostatics, electric fields and interactions, electric circuits, magnetism, electromagnetic induction, and the operation of motors and transformers.

Field of Science 3. Robotics

Online courses in English	Link	Course description
1. Computer Architecture	URL:https://www.coursera.org/learn/comparch	This Princeton University course provides a systematic introduction to the fundamental principles and essential concepts of computer architecture.
2. Digital Circuits	URL:https://www.coursera.org/learn/digital-systems	This Stanford University course is an introduction to the fundamentals of digital circuits and logic used in computer systems. Students learn the basic concepts and principles of digital circuits, including Boolean algebra, combinational and sequential logic circuits, as well as methods for designing and analyzing digital systems.
3. MITx: Circuits and Electronics 1: Basic Circuit Analysis	URL: https://www.edx.org/learn/circuits/massachusetts-institute-of-technology-circuits-and-electronics-1-basic-circuit-analysis	This course is an introduction to the fundamentals of circuit analysis and electronics. Students learn basic concepts such as Kirchhoff's Laws, node and circuit analysis techniques, and simple electronic components and their interactions in circuits.
4. Tutorial course on General Physics and Mechanics	URL: https://www.video-tutor.net/physics-basic-introduction.html	The course provides a basic introduction to physics. It covers basic concepts such as distance, displacement, velocity, acceleration, vectors, projectile motion, and Newton's laws of motion. The full version covers additional topics such as static and kinetic friction, gravitational force, normal force, centripetal force, kinetic and potential energy, and momentum.
5. Mathematics for Computer Science	URL: https://www.coursera.org/learn/mathematics-for-computer-science	This Stanford University course on mathematics for computer science enables students to learn various mathematical concepts such as discrete mathematics, linear algebra, probability theory and others.
6. Trigonometry	URL: https://www.khanacademy.org/math/trigonometry	The course offers lessons in trigonometry, including videos and practice exercises. The courses cover all the main topics of trigonometry.

Field of Science 4. Telecommunications

Online courses in English	Link	Course description
1. Computer Architecture	URL: https://www.coursera.org/learn/comparch	This Princeton University course is a study of the basic principles and concepts of computer architecture.
2. Digital Circuits	URL: https://www.coursera.org/learn/digital-systems	This Stanford University course is an introduction to the fundamentals of digital circuits and logic used in computer systems. Students learn basic concepts and principles of digital circuits such as Boolean algebra, combinational and sequential logic circuits, as well as methods for designing and analysing digital systems.
3. Discrete Mathematics	URL: https://www.coursera.org/specializations/discrete-mathematics	The Discrete Mathematics course at the University of California, San Diego is an introduction to discrete mathematics and its applications in computer science.
4. Introduction to Logic	URL: https://www.coursera.org/learn/logic-introduction	This Stanford University course is an introduction to the fundamentals of logic that underlie computer science and other disciplines. Students learn the basic concepts and techniques of logic, such as statements, reasoning, logical laws, and proof methods.
5. Mathematics for Computer Science	URL: https://www.coursera.org/learn/mathematics-for-computer-science	This Stanford University course on mathematics for computer science enables students to learn various mathematical concepts such as discrete mathematics, linear algebra, probability theory and others.

Field of Science 5. General Mechanical Engineering

Online courses in English	Link	Course description

1. Particle dynamics	URL: https://www.coursera.org/learn/particle-dynamics	The course consists of lecture videos that explain the dynamics of particles. The lectures contain practical problems.
2. Nihar Ranjan Patra. Engineering Graphics	URL: https://www.classcentral.com/course/swayam-engineering-graphics-5305	The course aims to teach students how to read and draw blueprints using a variety of tools.
3. Introduction to middle school Physics	URL: https://www.khanacademy.org/science/ms-physics/x1baed5db7c1bb50b:movement-and-forces/x1baed5db7c1bb50b:representing-motion/v/introduction-to-middle-school-physics	This course introduces learners to the fundamental laws that govern the natural world, covering topics such as forces and motion, energy, and waves, to explain how and why physical phenomena occur.
4. Tutorial course on General Physics and Mechanics	URL: https://www.video-tutor.net/physics-basic-introduction.html	The course provides a basic introduction to physics. It covers basic concepts such as distance, displacement, velocity, acceleration, vectors, projectile motion, and Newton's laws of motion. The full version covers additional topics such as static and kinetic friction, gravitational force, normal force, centripetal force, kinetic and potential energy, and momentum.

Field of Science 6. Nuclear Science and Technology

Online courses in English	**Link**	**Course description**
1. Introduction to middle school Physics	URL: https://www.khanacademy.org/science/ms-physics/x1baed5db7c1bb50b:movement-and-forces/x1baed5db7c1bb50b:representing-motion/v/introduction-to-middle-school-physics	This course introduces learners to the fundamental laws that govern the natural world, covering topics such as forces and motion, energy, and waves, to explain how and why physical phenomena occur.
2. Tutorial course on General Physics and Mechanics	URL: https://www.video-tutor.net/physics-basic-introduction.html	The course provides a basic introduction to physics. It covers basic concepts such as distance,

		displacement, velocity, acceleration, vectors, projectile motion, and Newton's laws of motion. The full version covers additional topics such as static and kinetic friction, gravitational force, normal force, centripetal force, kinetic and potential energy, and momentum.
3. Mostly Physics	URL: https://www.youtube.com/@mostlyphysics	This is a series of videos for students taking general physics and first-semester physics courses with or without mathematical analysis.