Undergraduate track program: Engineering and Technology

This document outlines the scope of topics that may be included in the Olympiad tests. The topics are grouped by areas and are followed by the list of recommended sources in the Russian and English languages.

1. Olympiad winner's skill set

To win the Olympiad, you should have a firm grasp of engineering and technology concepts, namely:

- basic principles of control in technical systems;
- probability theory and combinatorics;
- information coding and logical operations;
- algorithming and programming;
- trigonometry and vector calculus;
- methods of solving algebraic equations;
- basics of engineering graphics;
- laws of mechanics;
- kinematics;
- electrostatics;
- electricity;
- electromagnetism;
- harmonic oscillations;
- thermodynamics;
- quantum physics;
- structure of solids;
- types of chemical bonding;
- gas laws;
- physical bases of methods of analyzing matter;

You should also have a solid command of the following skills:

- calculating the probability of dependent and independent events;
- understanding principles of using trigonometric functions
- translating numbers between number systems
- developing algorithms with branching
- determining the geometric shapes of simple parts from their images
- calculating electrical circuits
- solving problems on mechanics kinematics, electromagnetic and electrical phenomena, electrostatics, the laws of thermal radiation, atomic physics, quantum mechanics, radioactive decay;
- understanding principles of the processes of transformation and energy conservation;
- identifying the regularities of changes in the properties of substances.

2. List of degree programs covered by subject area

2.1 List of bachelor's 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

ONE CLICK TO OPEN ALL DOORS

15.03.03. Applied Mechanics
15.03.06. Mechatronics and Robotics
14.03.01. Nuclear Power Engineering and Thermal Physics
28.03.01. Nanotechnology and Microsystems Engineering

3. Content

Automation & Control Systems
Topics in Physics:
1. Electricity, basic laws. Types of connections of elements.
2. Kinematics. Fundamentals of dynamics.
Topics in Maths:
1. Fundamental principles of control.
2. Mathematical description of linear continuous systems.
3. Random events and probability. Mathematical description of events.
Topics in Computer Science:
1. Coding of information. Number systems.

Robotics
Topics in Physics:
1. Electricity, basic laws. Types of connections of elements.
2. Newton's laws. Equations of motion of a solid body.
Topics in Maths:
1. Trigonometry. Vector calculus.
Topics in Computer Science:
1. Coding of information. Number systems.
2. Fundamentals of algorithms and programming.

Telecommunications
Topics in Maths:
1. Random events and probability. Mathematical description of events. Conditional probability, independent events.
2. Basic rules and principles of combinatorics.
Topics in Computer Science:
1. Coding of information. Number systems.
2. Basic principles of logic algebra, logical operations and elements.

Electrical & Electronic Engineering
Topics in Physics:
1. Electrostatics, basic laws. Capacitors, concept of electrical capacitance.
2. Electricity, basic laws. Types of connections of elements.
3. Electromagnetism, basic laws. The concept of inductance.

Mechanical Engineering
Topics in Physics:
1. Equilibrium of a solid body. Newton's laws. Equations of motion of a solid body.
2. Thermodynamics and hydrogasodynamics. Types of energies, parameters of state of matter. Thermodynamic cycles.
Topics in Engineering Drawing:
1. Engineering Drawing. Basic concepts of descriptive geometry. Projection drawing. Classification of drawings.

Topics in Maths:
1. Methods of solving algebraic equations and vector calculus.

Nuclear Science & Technology
Topics in Physics:
1. Kinematics. Fundamentals of dynamics. Laws of conservation in mechanics. Mechanics of liquids and gases. Statics.
2. Molecular physics. Thermal phenomena. Fundamentals of molecular kinetic theory. Ideal gas model of real gas Thermal phenomena. Liquid and solid bodies.
3. Mechanical vibrations and waves.
4. Quantum physics. Light quanta. Atom and atomic nucleus.

Materials Science, Characterization & Testing
Topics in Chemistry:
1. Structure of atom. Periodic system of chemical elements. Quantum numbers.
2. Classification of substances in relation to magnetic field.
3. Types, characteristics and mechanisms of chemical bond formation.
Topics in Physics:
1. Classification of electronic materials (conductors, semiconductors, dielectrics).
2. Basic electrical, magnetic and optical properties of solids.

4. Recommended references
4.1. Reading list

Automation & Control Systems

Sources in English	Topic
1. Barry Ph. Overview of Computer Science. URL: https://www-users.cse.umn.edu/~barry/book1.2.pdf	− Coding of information. Number systems.
2. Dorf R.C., Bishop R.H. Modern Control Systems, Pearson, 2017. URL: https://files.crazt.moe/temp/Modern%20Control%20Systems%2013th.pdf	− Fundamental principles of control. − Mathematical description of linear continuous systems.
3. Grinstead, C.M. & Snell, J.L. Introduction to Probability. URL: https://math.dartmouth.edu/~prob/prob/prob.pdf	− Random events and probability. Mathematical description of events.
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	− Electricity, basic laws. Types of connections of elements. − Kinematics. Fundamentals of dynamics.
5. Tore Hägglund Authomatic control. Lectures Notes. Department of Automatic Control Lund University, Faculty of Engineering, 2009. URL: https://www.control.lth.se/fileadmin/control/Education/EngineeringProgram/FRTF05/engforel.pdf	− Fundamental principles of control. − Mathematical description of linear continuous systems.

Sources in Russian	Topic

1. Бесекерский В.А., Попов Е.П. Теория систем автоматического управления. ТНТ. 2003. – 224 с. URL: https://obuchalka.org/20200124117973/teoriya-sistem-avtomaticheskogo-upravleniya-besekerskii-v-a-popov-e-p-2003.html	− Fundamental principles of control. − Mathematical description of linear continuous systems.
2. Втюрин В.А. Основы АСУТП. Учебное пособие для студентов специальности 220301 «Автоматизация технологических процессов и производств» (по отраслям)». Санкт-Петербург. 2006. — 154 с. URL: https://staff.tiiame.uz/storage/users/489/books/cFhHxu63ewrU1wWQ3y9KoVLVakahfGE7LENIUNkZ.pdf	− Fundamental principles of control. − Mathematical description of linear continuous systems.
3. Информатика. Системы счисления. МЕТОДИЧЕСКОЕ ПОСОБИЕ / Л.В. Щильдяева. – Тамбов: Изд-во ООО Орион, 2020. – 32 с. URL: https://tkskt.ru/wp-content/uploads/2017/09/shildyaeva_l_v_informatika.pdf	− Coding of information. Number systems.
4. Информатика. 10 класс. Учебник. Базовый уровень / Л.Л. Босова, А.Ю. Босова. - М.: БИНОМ, Лаборатория знаний, 2017. - 288 с. URL: https://shkola8kuznetsck.narod.ru/uchebniki/informatika10Bosova.pdf	− Coding of information. Number systems.
5. Ким Д. П. Теория автоматического управления. Т. 1. Линейные системы — 2-е изд., испр. и доп. — М.: ФИЗМАТЛИТ, 2016. — 312 с. URL: https://lib.tau-edu.kz/wp-content/uploads/2022/04/Ким-Д.П.Теория-автоматического-управления.pdf	− Fundamental principles of control. − Mathematical description of linear continuous systems.
6. Мякишев Г.Я., Буховцев Б.Б., Сотский Н.Н. Физика. 10 класс. – М.: Просвещение, 2014, 416 с. URL: https://www.utgt73.ru/uploads/biblioteka/fizika%2010.pdf	− Kinematics. Fundamentals of dynamics.
7. Теория вероятностей и статистика / Ю. Н. Тюрин, А. А. Макаров, И. Р. Высоцкий, И. В. Ященко. — М.: МЦНМО: АО «Московские учебники», 2004. — 256 с. URL: https://binst.hse.ru/data/2015/01/15/1107271616/%D0%9C%D0%B0%D0%BA%D0%B0%D1%80%D0%BE%D0%B2%D0%90.%D0%90._%D0%A1%D1%82%D0%B0%D1%82%D0%B8%D1%81%D1%82%D0%B8%D0%BA%D0%B0%20%D0%B8%20%D1%82%D0%B5%D0%BE%D1%80%D0%B8%D1%8F%20%D0%B2%D0%B5%D1%80%D0%BE%D1%8F%D1%82%D0%BD%D0%BE%D1%81%D1%82%D0%B8.pdf	− Random events and probability. Mathematical description of events.

Robotics

Sources in English	Topic
1. Barry Ph. Overview of Computer Science. URL: https://www-users.cse.umn.edu/~barry/book1.2.pdf	− Coding of information. Number systems. − Fundamentals of algorithms and programming.
2. Hugh D. Young Roger A. Freedman. University	− Electricity, basic laws.

	Types of connections of elements. Newton's laws.
Physics with Modern Physics. Pearson; 15th edition. 2019. 1586 p. URL: https://zlib.pub/book/university-physics-with-modern-physics-6beut9ub0mp0	Types of connections of elements. Newton's laws. − Equations of motion of a solid body.
3. Online Textbook | Classical Mechanics - MIT OpenCourseWare. https://ocw.mit.edu/courses/8-01sc-classical-mechanics-fall-2016/pages/online-textbook	− Equations of motion of a solid body.
4. Trigonometry (Gelfand Mathematical Seminar) Paperback – Illustrated, 8 Jun. 2001. URL: https://www.cimat.mx/ciencia_para_jovenes/bachillerato/libros/trigonometria_gelfand.pdf	− Trigonometry. Vector calculus.

Sources in Russian	Topic
1. Информатика. Системы счисления. МЕТОДИЧЕСКОЕ ПОСОБИЕ / Л.В. Щильдяева. – Тамбов: Изд-во ООО Орион, 2020. – 32 с. URL: https://tkskt.ru/wp-content/uploads/2017/09/shildyaeva_1_v_informatika.pdf	− Coding of information. Number systems.
2. Информатика. 10 класс. Учебник. Базовый уровень / Л.Л. Босова, А.Ю. Босова. - М.: БИНОМ, Лаборатория знаний, 2017. - 288 с. URL: https://shkola8kuznetsck.narod.ru/uchebniki/informatika10Bosova.pdf	− Coding of information. Number systems.
3. Информатика : пособие для подготовки к ЕГЭ : учебно-методическое пособие / под ред. Е. Т. Вовк. – 5-е изд. – Москва : Лаборатория знаний, 2018. – 352 с. URL: https://informika-e.ru/S2/Podgotovka_ege.pdf	− Coding of information. Number systems. − Fundamentals of algorithms and programming.
4. И. М. Гельфанд, С. М. Львовский, А. Л. Тоом. Тригонометрия. М.: МЦНМО, 2002. — 199 с. URL: https://old.mccme.ru/free-books/lvovski/trig.pdf	− Trigonometry. Vector calculus.
5. Мякишев Г.Я., Буховцев Б.Б., Сотский Н.Н. Физика. 10 класс. – М.: Просвещение, 2014, 416 с. URL: https://www.utgt73.ru/uploads/biblioteka/fizika%2010.pdf	− Electricity, basic laws. Types of connections of elements.Newton's laws. − Equations of motion of a solid body.
6. Решение геометрических задач векторным методом: учебное пособие для учащихся 10-11 классов / Г.А. Клековкин. – Самара: СФ ГАОУ ВО МГПУ, 2016. – 180 с. URL: https://samara.mgpu.ru/files/library_elektron/VM_INF/Klekovkin_reshenie_geom_zadach.pdf	− Trigonometry. Vector calculus.

Telecommunications

Sources in English	Topic
7. Barry Ph. Overview of Computer Science. URL: https://www-users.cse.umn.edu/~barry/book1.2.pdf	− Coding of information. Number systems. − Basic principles of logic algebra, logical operations and elements.

8. Combinatorics: A Guided Tour (MAA Textbooks) book by David R. Mazur. Volume: 55; 2010; 390 pp. URL: https://books.google.ru/books?id=yI4Jx5Obr08C	− Basic rules and principles of combinatorics.
9. Grinstead, C.M. & Snell, J.L. Introduction to Probability. URL: https://math.dartmouth.edu/~prob/prob/prob.pdf	− Random events and probability. Mathematical description of events. Conditional probability, independent events.
10. Magnus P.D. An Introduction to Formal Logic. URL: https://milneopentextbooks.org/download/forallx-pdf/?tmstv=1672247070	− Basic principles of logic algebra, logical operations and elements.

Sources in Russian	Topic
11. Дискретная математика для программистов: Учебник для вузов. 3-е изд. — СПб.: Питер, 2009. — 384 с. URL: https://stugum.wordpress.com/wp-content/uploads/2014/03/novikov.pdf	− Basic rules and principles of combinatorics.
12. Информатика. Системы счисления. МЕТОДИЧЕСКОЕ ПОСОБИЕ / Л.В. Щильдяева. – Тамбов: Изд-во ООО Орион, 2020. – 32 с. URL: https://tkskt.ru/wp-content/uploads/2017/09/shildyaeva_1_v_informatika.pdf	− Coding of information. Number systems.
13. Информатика. 10 класс. Учебник. Базовый уровень / Л.Л. Босова, А.Ю. Босова. - М.: БИНОМ, Лаборатория знаний, 2017. - 288 с. URL: https://shkola8kuznetsck.narod.ru/uchebniki/informatika10Bosova.pdf	− Coding of information. Number systems. − Basic principles of logic algebra, logical operations and elements.
14. Теория вероятностей и статистика / Ю. Н. Тюрин, А. А. Макаров, И. Р. Высоцкий, И. В. Ященко. — М.: МЦНМО: АО «Московские учебники», 2004. — 256 с. URL: https://binst.hse.ru/data/2015/01/15/1107271616/%D0%9C%D0%B0%D0%BA%D0%B0%D0%B0%D1%80%D0%BE%D0%B2%D0%90.%D0%90._%D0%A1%D1%82%D0%B0%D1%82%D0%B8%D1%81%D1%82%D0%B8%D0%BA%D0%B0%20%D0%B8%20%D1%82%D0%B5%D0%BE%D1%80%D0%B8%D1%8F%20%D0%B2%D0%B5%D1%80%D0%BE%D1%8F%D1%82%D0%BD%D0%BE%D1%81%D1%82%D0%B8.pdf	− Random events and probability. Mathematical description of events. Conditional probability, independent events. − Basic rules and principles of combinatorics.

Electrical & Electronic Engineering

Sources in English	Topic
1. Edward M. Purcell, David J. Morin. Electricity and Magnetism. Third edition. 2013. 863 p. URL: https://zlib.pub/book/electricity-and-magnetism-1ihhambrut60	− Electrostatics, basic laws. Capacitors, concept of electrical capacitance. − Electricity, basic laws. Types of connections of elements. − Electromagnetism, basic laws. The concept of inductance.

	Topic
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	− Electrostatics, basic laws. Capacitors, concept of electrical capacitance. − Electricity, basic laws. Types of connections of elements. − Electromagnetism, basic laws. The concept of inductance.
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	− Electrostatics, basic laws. Capacitors, concept of electrical capacitance. − Electricity, basic laws. Types of connections of elements. − Electromagnetism, basic laws. The concept of inductance.

Sources in Russian	Topic
1. В.И. Барсуков, О.С. Дмитриев. Физика. Электричество и магнетизм. Тамбов: Изд-во Тамб. гос. техн. ун-та, 2009. – 252 с. URL: https://tstu.ru/book/elib/pdf/2009/barsukov-a.pdf	− Electrostatics, basic laws. Capacitors, concept of electrical capacitance. − Electricity, basic laws. Types of connections of elements. − Electromagnetism, basic laws. The concept of inductance.
2. Мякишев Г.Я. Физика. 11 класс : учеб. для общеобразоват. организаций : базовый и углубл. уровни - 7е изд., перераб. – М.: Просвещение, 2019. – 432 с. URL: https://go.11klasov.net/14446-fizika-11-klass-klassicheskij-uroven-mjakishev-gja-buhovcev-bb-charugin-vm-parfenteva-na.html	− Electrostatics, basic laws. Capacitors, concept of electrical capacitance. − Electricity, basic laws. Types of connections of elements. − Electromagnetism, basic laws. The concept of inductance.
3. Мякишев Г.Я. Физика. Электродинамика. 10-11 кл. Профильный уровень: учеб. для общеобразоват. учреждений. – 10-е изд., стереотип. – М. : Дрофа, 2010. – 416, [4] с. URL: https://fizmat.space/library-files/Физика-Электродинамика-Мякишев.pdf	− Electrostatics, basic laws. Capacitors, concept of electrical capacitance. − Electricity, basic laws. Types of connections of elements. − Electromagnetism, basic laws. The concept of inductance.
4. Савельев И.В. Курс общей физики: Учеб. пособие. В 3-х т. Т. 2. Электричество и магнетизм. Волны. Оптика. – 3-е изд., испр. – М.: Наука, 1988. – 496 с. URL: https://djvu.online/file/nBp7VrqDetevT	− Electrostatics, basic laws. Capacitors, concept of electrical capacitance. − Electricity, basic laws. Types of connections of elements. − Electromagnetism, basic laws. The concept of inductance.

Mechanical Engineering

Sources in English	Topic
1. Brian Griffiths. "Engineering Drawing for Manufacture". 2002. – 169 p. URL: https://www.mongroupsydney1.com/CE111AGeneralDrawing.pdf	− Engineering Drawing
2. Online Textbook | Classical Mechanics - MIT OpenCourseWare. https://ocw.mit.edu/courses/8-01sc-classical-mechanics-fall-2016/pages/online-textbook	− Equilibrium of a solid body. Newton's laws. Equations of motion of a solid body. − Thermodynamics and hydrogasodynamics. Types of energies, parameters of state of matter. Thermodynamic cycles.
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	− Equilibrium of a solid body. Newton's laws. Equations of motion of a solid body. − Thermodynamics and hydrogasodynamics. Types of energies, parameters of state of matter. Thermodynamic cycles.

Sources in Russian	Topic
1. А. И. Лысков, С. В. Воробьев, Б. М. Перлов. Решение типовых задач по инженерной графике: учеб. -метод. пособие. СПбГЭТУ «ЛЭТИ», 2016, 32с. URL: https://studfile.net/preview/16438773/	− Engineering Drawing
2. Попова Г.Н., Алексеев С.Ю. Машиностроительное черчение: Справочник. – 4-е изд., перераб. и доп. – СПб.: Политехника, 2006. – 445 с. URL: https://xn--5-ctbskp.xn--p1ai/upload/uf/f36/mashinostroitelnoe_cherchenie.pdf	− Engineering Drawing
3. Савельев И. В. Курс общей физики: учебное пособие для вуза: в 5 томах / И. В. Савельев. — 6-е изд., стер. — Санкт-Петербург: Лань, 2021. — Т. 1: Механика. — 340 с. URL: https://vk.com/doc16214643_672374826	− Equilibrium of a solid body. Newton's laws. Equations of motion of a solid body. −
4. Савельев И. В. С 12 Курс общей физики. В 5 тт. Т. 3. Молекулярная фи/ зика и термодинамика: Учебное пособие. 5/е изд., испр. — СПб.: Издательство «Лань», 2021. — 224 с.: URL: https://vk.com/doc16214643_672374836	− Thermodynamics and hydrogasodynamics. Types of energies, parameters of state of matter. Thermodynamic cycles.
5. Яковлев И.В. Молекулярная физика и термодинамика. Учебное пособие. URL: https://mathus.ru/phys/mt.pdf	− Thermodynamics and hydrogasodynamics. Types of energies, parameters of state of matter. Thermodynamic cycles.

Nuclear Science & Technology

Sources in English	Topic
7. Conceptual physics by Hewitt, Paul G., Pearson Education Limited, 2014, 848 p. URL:	− Kinematics. Fundamentals of dynamics.

	Laws of conservation in mechanics. Mechanics of liquids and gases. Statics. − Molecular physics. Thermal phenomena. Fundamentals of molecular kinetic theory. Ideal gas model of real gas Thermal phenomena. Liquid and solid bodies. − Mechanical vibrations and waves. − Quantum physics. Light quanta. Atom and atomic nucleus.
https://archive.org/details/conceptualphysic0000hewi_h6p5	
8. 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	− Kinematics. Fundamentals of dynamics. Laws of conservation in mechanics. Mechanics of liquids and gases. Statics. − Molecular physics. Thermal phenomena. Fundamentals of molecular kinetic theory. Ideal gas model of real gas Thermal phenomena. Liquid and solid bodies. − Mechanical vibrations and waves. − Quantum physics. Light quanta. Atom and atomic nucleus.
9. Schaum's Outline of Theory and Problems of Applied Physics. URL: https://kishorekaruppaswamy.wordpress.com/wp-content/uploads/2011/10/applied-physics.pdf	− Kinematics. Fundamentals of dynamics. Laws of conservation in mechanics. Mechanics of liquids and gases. Statics. − Molecular physics. Thermal phenomena. Fundamentals of molecular kinetic theory. Ideal gas model of real gas Thermal phenomena. Liquid and solid bodies. − Mechanical vibrations and waves. − Quantum physics. Light quanta. Atom and atomic nucleus.

Sources in Russian	Topic
10. Механика и молекулярная физика; Л. Д. Ландау; А. И. Ахиерзер; Е. М. Лифшиц. URL: https://obuchalka.org/20200906124586/kurs-obschei-	− Kinematics. Fundamentals of dynamics. Laws of conservation in

fiziki-mehanika-i-molekulyarnaya-fizika-landau-l-d-ahiezer-a-i-lifshic-e-m-1969.html	mechanics. Mechanics of liquids and gases. Statics. – Molecular physics. Thermal phenomena. Fundamentals of molecular kinetic theory. Ideal gas model of real gas Thermal phenomena. Liquid and solid bodies.
11. Мякишев Г.Я., Буховцев Б.Б., Сотский Н.Н. Физика. 10 класс. – М.: Просвещение, 2014, 416 с. URL: https://www.utgt73.ru/uploads/biblioteka/fizika%2010.pdf	– Kinematics. Fundamentals of dynamics. Laws of conservation in mechanics. Mechanics of liquids and gases. Statics. – Molecular physics. Thermal phenomena. Fundamentals of molecular kinetic theory. Ideal gas model of real gas Thermal phenomena. Liquid and solid bodies. – Mechanical vibrations and waves. – Quantum physics. Light quanta. Atom and atomic nucleus.
12. Мякишев Г.Я., Буховцев Б.Б., Чаругин В.М. Физика. 11 класс. – М.: Просвещение, 2010, 399 с. URL: http://www.vixri.ru/d/Mjakishev%20G.Ja.%20_11%20klass.%20FIZIKA(Klassicheskij%20kurs),%202010,%20374s.pdf	– Kinematics. Fundamentals of dynamics. Laws of conservation in mechanics. Mechanics of liquids and gases. Statics. – Molecular physics. Thermal phenomena. Fundamentals of molecular kinetic theory. Ideal gas model of real gas Thermal phenomena. Liquid and solid bodies.

Materials Science, Characterization & Testing

Sources in English	Topic
1. Callister W.D., Rethwisch D.G. Materials Science and Engineering. An Introduction. 9E. URL: https://anupturnedworld.wordpress.com/wp-content/uploads/2016/06/callister-materials-science-and-engineering.pdf	– Classification of substances in relation to magnetic field. – Types, characteristics and mechanisms of chemical bond formation. – Classification of electronic materials (conductors, semiconductors, dielectrics).
2. Hutagalung S.D. Materials Science and Technology. URL:	– Basic electrical, magnetic and optical properties of solids.

http://www.issp.ac.ru/ebooks/books/open/Materials_Science_and_Technology.pdf	
3. Serway R.A., Jewett J.W. Physics for Scientists and Engineers with Modern Physics, Seventh Edition. URL: https://salmanisaleh.wordpress.com/wp-content/uploads/2019/02/physics-for-scientists-7th-ed.pdf	− Structure of atom. Periodic system of chemical elements. Quantum numbers. − Basic electrical, magnetic and optical properties of solids.

Sources in Russian	Topic
1. Рудзитис Г.Е. Химия. Основы общей химии. 11 класс: учеб. для общеобразоват. учреждений с прил. на электрон. носителе: базовый уровень. 14-е изд. М.: Просвещение, 2012. 159 с.: ил. URL: https://kstu.kg/fileadmin/user_upload/khimija_01.pdf	− Structure of atom. Periodic system of chemical elements. Quantum numbers. − Basic electrical, magnetic and optical properties of solids.
2. Сорокин В.С., Антипов Б.Л., Лазарева Н.П. Материалы и элементы электронной техники. Проводники, полупроводники, диэлектрики: Учебник. Т. 1. 2-е изд., испр. СПб.: Издательство «Лань», 2015. 448 с.: ил. URL: http://library.lgaki.info:404/2020/Сорокин%20В.%20С_Материалы_T1.pdf	− Structure of atom. Periodic system of chemical elements. Quantum numbers. − Types, characteristics and mechanisms of chemical bond formation. − Classification of electronic materials (conductors, semiconductors, dielectrics). − Basic electrical, magnetic and optical properties of solids.
3. Сорокин В.С., Антипов Б.Л., Лазарева Н.П. Материалы и элементы электронной техники. Активные диэлектрики, магнитные материалы, элементы электронной техники: Учебник. Т. 2. 2-е изд., испр. СПб.: Издательство «Лань», 2016. 384 с.: ил. URL: http://library.lgaki.info:404/2020/Сорокин%20В.%20С_Материалы_T2.pdf	− Classification of substances in relation to magnetic field. − Classification of electronic materials (conductors, semiconductors, dielectrics). − Basic electrical, magnetic and optical properties of solids.

4.2.   Recommended Online courses
Automation & Control Systems

Online courses in English	Link	Summary
1. Introduction to Engineering Mechanics	https://www.coursera.org/learn/engineering-mechanics-statics	The course is an introduction to the fundamentals of engineering mechanics, a fundamental field of engineering. During the course, students will learn the basic principles and concepts of mechanics that play an important role in the design and analysis of various engineering systems.
2. Course: Middle School Physics	https://www.khanacademy.org/science/ms-physics/x1baed5db7c1bb50b:movement-and-	This course will provide students with insights into the physical laws that shape our universe.

	forces/x1baed5db7c1bb50b:representing-motion/v/introduction-to-middle-school-physics	
3. Introduction to Automatic Control Systems	https://www.coursera.org/learn/automata	This course from Stanford University is designed for those who are interested in the field of automatic control and want to understand the basic principles and concepts of the field. In the course, students will learn the basic concepts, principles, and methods of automatic control systems and how to apply them in practice.
4. Mathematics for Computer Science	https://www.coursera.org/learn/mathematics-for-computer-science	In Stanford University's Mathematics for Computer Science course, students learn various mathematical concepts such as discrete mathematics, linear algebra, probability theory, and many more.

Online courses in Russian	Link	Summary
1. ЕГЭ по информатике на Python, 2024. Школа ХТМ (Uniform state exam in Computer Science in Python)	https://stepik.org/course/106871/promo	The course includes basic information about computer science: coding, number systems, elements of algorithm theory, numerical information processing, programming in the Python language.
2. Кинематика (Kinematics)	https://www.lektorium.tv/kinematics	The course covers the basic principles of motion description.
3. Онлайн-школа абитуриента ТГУ (TSU online school for university applicants)	https://ido.skills.tsu.ru/course/view.php?id=123	The course is an update and systematization of the knowledge of the main sections of school mathematics.
4. Основы теории автоматического управления (Basics of automatic control theory)	https://stepik.org/course/115666/promo	The course covers basic concepts and methods of automatic control theory of technical objects.
5. Теория вероятностей (Probability theory)	https://stepik.org/course/3089/promo	This course is an introduction to the basic concepts of probability theory.
6. Физические эксперименты. Электричество и магнетизм.	https://stepik.org/course/93868/promo?search=4651787285	This course is a study of electrostatics, DC circuits, and magnetism.

(Physics experiments. Electricity and Magnetism.)		

Robotics

Online courses in English	Link	Summary
1. Computer Architecture	https://www.coursera.org/learn/comparch	Princeton University's Computer Architecture course is a study of the basic principles and concepts of computer architecture.
2. Digital Circuits	https://www.coursera.org/learn/digital-systems	Stanford University's Digital Circuits 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, and methods for designing and analyzing digital systems.
3. MITx: Circuits and Electronics 1: Basic Circuit Analysis	https://www.edx.org/learn/circuits/massachusetts-institute-of-technology-circuits-and-electronics-1-basic-circuit-analysis	MITx: Circuits and Electronics 1: Basic Circuit Analysis 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's course of General Physics Mechanics	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	https://www.coursera.org/learn/mathematics-for-computer-science	In Stanford University's Mathematics for Computer Science course, students learn various mathematical concepts such as discrete mathematics, linear algebra, probability theory and others.

6.　Trigonometry	https://www.khanacademy.org/math/trigonometry	The course provides lessons in trigonometry, including videos and exercises. Courses cover all the major topics in trigonometry.

Online courses in Russian	Link	Summary
1.　ЕГЭ по информатике на Python, 2024. Школа ХТМ (Uniform state exam in Computer Science in Python)	https://stepik.org/course/106871/promo	The course contains basic information on computer science: coding, number systems, elements of the theory of algorithms, numerical information processing, programming in the Python language.
2.　Онлайн-школа абитуриента ТГУ (TSU online school for university applicants)	https://ido.skills.tsu.ru/course/view.php?id=123	The course updates and systematises knowledge of the main sections of school mathematics.
3.　Тригонометрия (Trigonometry)	https://oxfordmath.org/course/trigonometriya	A course for high school students in trigonometry of intermediate difficulty.
4.　Кинематика (Kinematics)	https://www.lektorium.tv/kinematics	The course covers the basic principles of motion descriptions.
5.　Физические эксперименты. Электричество и магнетизм. (Physics experiments. Electricity and Magnetism.)	https://stepik.org/course/93868/promo?search=4651787285	The course covers electrostatics, DC circuits, and magnetism.

Telecommunications

Online courses in English	Link	Summary
1.　Computer Architecture	https://www.coursera.org/learn/comparch	Princeton University's Computer Architecture course is a study of the basic principles and concepts of computer architecture.
2.　Digital Circuits	https://www.coursera.org/learn/digital-systems	Stanford University's Digital Circuits 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, and methods for designing and analyzing digital systems.
3. Discrete Mathematics University	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. During the course, students will learn the basic concepts of discrete mathematics such as set theory, logic, combinatorics, graphs and algorithms.
4. Introduction to Logic	https://www.coursera.org/learn/logic-introduction	Stanford University's Introduction to Logic course is an introduction to the basics 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	https://www.coursera.org/learn/mathematics-for-computer-science	In Stanford University's Mathematics for Computer Science course, students learn various mathematical concepts such as discrete mathematics, linear algebra, probability theory and others.

Online courses in Russian	Link	Summary
1. Дискретная математика (Discrete Mathematics)	https://www.lektorium.tv/diskretnaya-matematika	This course covers basic definitions and properties of objects in number theory, combinatorics, Boolean functions, and binary relations on sets.
2. ЕГЭ по информатике на Python, 2024. Школа ХТМ (Uniform state exam in Computer Science in Python)	https://stepik.org/course/106871/promo	The course contains basic information on computer science: coding, number systems, elements of the theory of algorithms, numerical information processing, programming in the Python language
3. Онлайн-школа абитуриента ТГУ (TSU online school for university applicants)	https://ido.skills.tsu.ru/course/view.php?id=123	The course updates and systematizes the knowledge of the main sections of school mathematics.
4. Теория вероятностей (Probability theory)	https://stepik.org/course/3089/promo	This course is an introduction to the basic concepts of probability theory.

Electrical & Electronic Engineering

Online courses in English	Link	Summary
1. RICEx: Electricity and Magnetism, Part 1	https://www.edx.org/learn/magnetism/rice-university-electricity-and-magnetism-part-1	The course serves as an introduction to the concepts of charge, electric field, electric potential, electric current, resistance, and direct current circuits.
2. MITx: Circuits and Electronics 1: Basic Circuit Analysis	https://www.edx.org/learn/circuits/massachusetts-institute-of-technology-circuits-and-electronics-1-basic-circuit-analysis	MITx: Circuits and Electronics 1: Basic Circuit Analysis 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. Georgetown X: Preparing for the AP* Physics C: Electricity and Magnetism Exam	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	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.

Online courses in Russian	Link	Summary
1. Электричество и магнетизм (Electricity and magnetism)	https://www.lektorium.tv/ehlektrichestvo-i-magnetizm	The course introduces students to the basic sections and concepts of electrostatics and magnetostatics.
2. Физические эксперименты. Электричество и магнетизм. (Physics experiments. Electricity and magnetism.)	https://stepik.org/course/93868/promo?search=4651787285	The course covers electrostatics, DC circuits, and magnetism.
3. Электричест	https://stepik.org/course/91026/pro	The course covers basic concepts

во. Магнетизм. Оптика. Атомная физика (Electricity. Magnetism. Optics. Atomic physics)	mo?search=4651787287	and laws related to general physics such as electricity, magnetism, optics, and atomic physics.

Mechanical Engineering

Online courses in English	Link	Summary
1. Particle dynamics	https://www.coursera.org/learn/particle-dynamics	The course consists of lecture videos explaining the dynamics of particles. Lectures include practical problems.
2. Nihar Ranjan Patra. Engineering Graphics	https://www.classcentral.com/course/swayam-engineering-graphics-5305	The goal of this course is to teach students how to read and draw blueprints using a variety of tools.
3. Introduction to middleschool physics	https://www.khanacademy.org/science/ms-physics/x1baed5db7c1bb50b:movement-and-forces/x1baed5db7c1bb50b:representing-motion/v/introduction-to-middle-school-physics	This course will provide students with insights into the physical laws that shape our universe. From forces and motion to energy and waves, learn the principles that explain how and why things work the way they do.
4. Tutorial's course of General Physics Mechanics	https://www.video-tutor.net/physics-basic-introduction.html	This 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.

Online courses in Russian	Link	Summary
1. Инженерная графика. Азбука инженера (Engineering Graphics. Engineer's handbook)	https://stepik.org/course/52643/promo	The course covers the basic standards of design documentation and drawing schematics.
2. Инженерная графика для машиностроителя (Engineering graphics for a mechanical	https://stepik.org/course/56468/promo	This course aims to equip students with essential skills in drawing and interpreting technical drawings. It will also teach them how to address a range of engineering and geometric challenges that may

engineer)		arise during the design, construction, manufacturing, and operation of various engineering and technical projects.
3. Основы работы в Solidworks (Solidworks basic training course)	https://stepik.org/course/96333/promo	The aim of the course is to study and master the methods of building three-dimensional models of real structures.
4. Динамика (Dynamics)	https://www.lektorium.tv/dinamika	This course concentrates on the fundamental concepts of Newton's classical dynamics, which explains the motion of objects moving at speeds from fractions of millimeters per second to kilometers per second.
5. Онлайн-школа абитуриента ТГУ: Математика (TSU online school for university applicants: mathematics)	https://ido.skills.tsu.ru/course/view.php?id=123	The course refreshes and organizes the key topics of school mathematics.

Nuclear Science & Technology

Online courses in English	Link	Summary
1. Course: Middle School Physics	https://www.khanacademy.org/science/ms-physics/x1baed5db7c1bb50b:movement-and-forces/x1baed5db7c1bb50b:representing-motion/v/introduction-to-middle-school-physics	This course will provide students with insights into the physical laws that shape our universe.
2. Tutorial's course of General Physics Mechanics	https://www.video-tutor.net/physics-basic-introduction.html	This course concentrates on the fundamental concepts of Newton's classical dynamics, which explains the motion of objects moving at speeds from fractions of millimeters per second to kilometers per second
3. Mostly Physics	https://www.youtube.com/@mostlyphysics	A collection of videos designed for students enrolled in general physics and introductory physics courses, suitable for those with or without a focus on mathematical analysis.

Online courses in Russian	Link	Summary
1. Кинематика	https://www.lektorium.tv/kinematic	The course covers the basic

(Kinematics)	s	principles of motion descriptions.
2. Термодинамика и молекулярная физика (Thermodynamics and molecular physics)	https://stepik.org/course/67117/promo	The course covers sections of thermodynamics and molecular physics.
3. Дополнительные главы физики: термодинамика и молекулярная физика. 10 класс. v1.1 (Additional chapters of physics: thermodynamics and molecular physics. Grade 10. v1.1)	https://edu.sirius.online/#/course/1904	The course focuses on the basic principles and methods of thermodynamics and molecular physics.
4. Атомная физика (Atomic physics)	https://www.youtube.com/playlist?list=PL1Us50cZo25lp_THVzLpY4-m5NrlODwhh	A series of video lectures on atomic physics tailored for school students..

Materials Science, Characterization & Testing

Online courses in English	Link	Summary
1. Advanced Composite Materials: Chemistry and Applications	https://stepik.org/course/107500	The course emphasizes the thermal and mechanical properties of materials, exploring contemporary techniques for their identification. It also covers the molecular weight characteristics of polymers and the thermodynamic properties of their solutions.
2. Basics of chemistry of heterocycles	https://stepik.org/course/137467	The course offers a comprehensive overview of the chemistry surrounding heterocyclic compounds.
3. Electricity and magnetism	https://stepik.org/course/176257	This course is tailored for recent high school graduates seeking to enhance their understanding of electricity and magnetism.

Online courses in Russian	Link	Summary
1. Химия. Часть 1 (Chemistry. Part 1)	https://openedu.ru/course/mephi/mephi_chemistry/	The course, titled 'Chemistry,' delves into the exploration and practical application of chemical principles concerning substances

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		and their transformations in professional settings. Its aim is to build on existing knowledge while fostering new skills in chemistry, which are crucial for enhancing both general cultural understanding and professional competencies in the field.
2. Химия. Часть 2 (Chemistry. Part 2)	https://openedu.ru/course/mephi/mephi_chemistry2/	This course focuses on the fundamental principles of chemical separation processes, as well as electrochemical and bioorganic processes. It aims to equip students with the knowledge needed to predict how environmental factors influence technological and chemical-biological systems.
3. Введение в теорию ферромагнетизма (Introduction to ferromagnetism theory)	https://openedu.ru/course/mephi/mephi_ittf/	This course explores the fundamental physical principles governing second-order phase transitions, focusing on the transition from paramagnetic to ferromagnetic states as a key example. Key topics include the classification of materials by their magnetic properties, the use of mean-field approximation to analyze different magnetic characteristics, an introduction to phenomenological Landau theory, and a study of antiferromagnetism.