Postgraduate Track Program: Chemistry and Materials Science

1. Olympiad Winner's Skill Set

To win the Olympiad, you should have a firm grasp of a range of concepts related to chemistry and materials science, specifically:

- fundamentals of general, inorganic, analytical, and organic chemistry; basics of chemical thermodynamics, kinetics, and theory of solutions; theory of phase equilibria; materials science;
- prospects and trends in the development of science; current issues; latest advances in chemical science and technology;
- fundamentals and principles of modern methods for studying the composition, structure, and properties of materials.

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

- apply acquired knowledge in solving practical and theoretical problems; find and analyze necessary data;select and apply adequate research methods; analyze the results obtained;
- freely navigate fundamental science;
- operate with large amounts of scientific information; independently work with its various sources;
- analyze the effectiveness of interim solutions; make decisions regarding changes to the work plan.

2. List of Eligible Study Programs

2.1. List of Master's Programs

18.04.01 Chemical Technology
22.04.01 Materials Science and Technology
04.04.01 Chemistry
18.04.02 Energy and Resource-Saving Processes in Chemical Technology, Petrochemistry, and Biotechnology
28.04.04 Nanosystems and Nanomaterials
22.04.02 Metallurgy

2.2. List of Doctoral Programs

1.4.2 Analytical Chemistry
1.3.20 Crystallography, Physics of Crystals
1.4.1 Inorganic Chemistry
1.4.3 Organic Chemistry
1.4.4 Physical Chemistry
2.6.17 Materials Science
2.6.2 Metallurgy of Ferrous, Non-Ferrous, and Rare Metals
2.6.1 Metallurgy and Heat Treatment of Metals and Alloys

3. Program Content

Inorganic and Nuclear Chemistry

1. Main types of chemical bonds and the geometry of polyatomic molecules.
2. Acid-base balance. Strong and weak electrolyte solutions.
3. Heterogeneous equilibria in the solid-state systems: solutions of insoluble electrolytes.
4. Redox equation. Standard, real, and formal redox potentials.
5. Structure and isomerism of coordination compound, equilibria in solutions of coordination compounds.
6. Typical valence; degrees of oxidation; resultant compound; their physical and chemical properties; industrial application**s.**

Organic Chemistry

1. Structure of organic molecules: nature of the chemical bond, distribution of electron density in a molecule, types of isomerism of organic compound molecules.
2. Main classes of organic compounds, main methods for compound synthesis, chemical transformation.
3. Reaction mechanisms: electronic and spatial structure of reagents and substrates.
4. Natural sources of organic compounds, principal methods for synthesizing key substances, transformations by laboratory and industrial methods.
5. Key practical applications of organic compounds.
6. Interactions of organic substances with living organisms; environmental aspects of organic chemical production.
7. Basics of molecular spectroscopy (IR, UV, NMR), mass spectrometry, X-ray diffraction.

Analytical Chemistry

1. Protolytic theory. Application of mass action law to acid-base equilibria. Calculation of pH of aqueous solutions. Buffer solutions.
2. Complexation reactions. Basic concepts, types of coordination complexes. Equilibrium in complexation reactions. Stability of coordination complexes.
3. Qualitative chemical analysis. Methods for carrying out reactions; concept of analytical signal. Main analytical groups of cations and anions.
4. Titrimetric methods of analysis. Methods for expressing solution concentrations. Titration curves. Calculating substance mass in an analyzed solution. Techniques for performing titrimetric analysis.
5. Types of titrimetric analysis. Acid-base titration. Complexometric titration. Oxidation-reduction titration. Precipitation titration.

Physical Chemistry

1. First law of thermodynamics and its application (internal energy, enthalpy, heat and work, equilibrium and non-equilibrium processes).
2. Thermochemistry, heat capacity, Hess's law, Kirchhoff equation.
3. Second law of thermodynamics (entropy, thermodynamic potentials and characteristic functions).

4. Fundamental Gibbs equation, Gibbs-Helmholtz equations, Nerst theorem, Planck's postulate, chemical potential.

5. Phase equilibria: heterogeneous systems, Gibbs phase rule, Clapeyron-Clausius equation. Thermodynamic properties of solutions. Raoult's law, Henry's law, Sievert's law.

6. Phase equilibria in two-component liquid-vapor systems. Phase equilibria in condensed systems.

7. Surface phenomena, thermodynamics of surface phenomena, adsorption, Gibbs and Langmuir adsorption isotherms. Aggregative, kinetic, and phase stability of dispersed systems.

8. Thermodynamics of electrochemical systems: electrochemical potential and equilibrium conditions, EMF of an electrochemical element, electrode potential. Nernst equation.

9. Electrical conductivity of electrolyte solutions, ion mobility and transfer numbers, Debye–Huckel theory.

10. Chemical kinetics and catalysis: effect of temperature on reaction rate, Arrhenius equation, activation energy and methods of its determination.

11. Chemical equilibria: law of acting masses and equilibrium constant, equations of isotherms, isobars, and isochores of a chemical reaction.

Crystallography

1. structure of periodic crystals: basic principles. Symmetry elements and symmetry operations, choice of a unit cell, point and space symmetry groups, close-packed structures, coordination polyhedra in crystal structure description, polymorphism.

2. Point defects in crystals and the relationship between impurity concentration and intrinsic point defects, nonstoichiometry, environment of the sample.

3. Extended defects: dislocations, disclinations, and packing defects. Interaction between point and extended defects.

4. First-order phase transitions and second-order phase transitions, Gibbs phase rule, dissolution-crystallization curve, metastable crystallization zone.

5. Molecular kinetic theory of crystal growth (Kossel-Stranski model, Bravais law, Wulff construction rule, types of crystal growth, epitaxial growth of crystals, crystal twinning).

6. Properties of solids and their relationship with crystal bulk and surface structure; the presence, type, and concentration of defects and the size and shape of particles.

7. Electronic structure of solids: band theory, metals, semiconductors, and insulators, electron and hole conductivity

Metallurgy and Metallurgical Engineering

1. Ferrous metallurgy: production of iron; blast furnace smelting; steelmaking, ferroalloys.

2. Production of non-ferrous metals: production of copper, aluminum, magnesium and titanium, powder metallurgy.

3. Fe-C diagram (transformations in steels; structure and properties of steels).

4. Solid solutions: types and structure; alloys and intermetallic compounds.

5. Crystal structure, mechanical and physical properties of metals.

Materials Science: Evaluation and Testing

1. Characteristics of materials microstructure; effect of grain size on the mechanical and physical properties of metals and ceramics (Hall-Petch relationship).

2. Composite materials: structure and mechanical properties, strengthening mechanisms of metals, combination of various strengthening principles in composites with metal matrices, rules for using mixtures for calculating the mechanical and physical characteristics of composites.

3. Strain diagram (σ–ε) for solids (yield, elasticity, and strength limits).

4. Fatigue of materials: fatigue limit, cycles requiring stress and their characteristics, fatigue curve.

4. Recommended References

4.1. Reading List

Inorganic and Nuclear Chemistry

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Metallurgy and Metallurgical Engineering

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4.2. Recommended Online Courses

Inorganic and Nuclear Chemistry

Online courses in English	**Link**	**Summary**
Introduction to Chemistry: Structures and Solutions	https://ru.coursera.org/learn/basic-chemistry	This course focuses on basic concepts such as atomic and molecular structure, solutions, phases of matter, and quantitative problem-solving.
General Chemistry: Concept Development and Application	https://ru.coursera.org/learn/general-chemistry	This course provides a comprehensive exploration of fundamental concepts in chemistry, beginning with atomic molecular theory and the determination of atomic masses. Students will delve into the structure of the atom, including the electron shell model, and examine bonding and structures in covalent molecules. The course covers various types of bonding, including those in non-metals, metals, and salts, and explores energy changes and reaction energies. Key principles such as the ideal gas law, the kinetic molecular theory, and phase transitions are

		discussed in the context of phase equilibrium. Additionally, the course introduces the essential topics of chemical kinetics, chemical equilibrium, and chemical thermodynamics.
Introduction to Chemistry: Reactions and Ratios	https://ru.coursera.org/learn/intro-chemistry	This course focuses on the basic concepts related to chemical reactions, stoichiometry, the periodic table, periodic trends, nomenclature, and chemical problem-solving.
Chemistry	https://ru.coursera.org/learn/chemistry-1	Areas covered in this course include atomic structure, periodicity, compounds, reactions and stoichiometry, bonding, and thermochemistry.
Advanced chemistry	https://www.coursera.org/learn/advanced-chemistry	This course offers an in-depth study of key concepts in chemical reactions and their dynamics, focusing on kinetics, acid-base equilibria, and aqueous equilibria. Students will also delve into the principles of thermodynamics.
INTRODUCTION TO COORDINATION CHEMISTRY	https://stepik.org/course/171575	This course provides foundational knowledge about coordination compounds, which play crucial roles in everyday life.
Online courses in Russian	**Link**	**Summary**
Химия. Часть 1 (Chemistry. Part 1)	https://openedu.ru/course/mephi/mephi_chemistry/	The course is devoted to the study and application of scientific knowledge about substances and their transformations.
Химия. Часть 2 (Chemistry. Part 2)	https://openedu.ru/course/mephi/mephi_chemistry2/	The course explores the basic patterns in chemical separation, electrochemical and bioorganic processes, which are crucial for predicting the impact of environmental factors on technological and chemical-biological systems.
Неорганическая химия. Часть 1 (Inorganic chemistry. Part 1)	https://teach-in.ru/course/neorgchem1	The course aims to provide basic theoretical knowledge in inorganic chemistry and develop skills in practical work with chemicals.

Organic Chemistry

Online courses in English	**Link**	**Summary**
Basics of Chemistry of Heterocycles	https://stepik.org/course/137467/promo	The course provides an extensive introduction to heterocyclic chemistry. Particular attention is paid to the main heterocyclic systems, such as 5-membered

		heterocycles (pyrrole, furan, thiophene), indole, pyridine, quinoline, and isoquinoline. Electronic structure, ring synthesis methods, chemical properties, and characteristic reactions are discussed for each heterocycle type.
Chemicals and Health	https://ru.coursera.org/learn/chemicals-health	This course focuses on chemicals in the environment and in our bodies and how they affect our health. The course examines the policies and practices related to chemicals, particularly how they get into our bodies (exposure), what they do when they get there (toxicology), how we measure them (biomonitoring), and how they influence our health.
Green Chemistry	https://openedu.ru/course/misis/GRCHM/?session=spring_2024	The course covers an introduction to green chemistry, green nanomaterials, green technologies in environmental protection and unconventional chemical processes.
Organic Chemistry	https://www.youtube.com/playlist?list=PL0o_zxa4K1BXP7TUO7656wg0uF1xYnwgm	This is a series of video presentations covering the main topics of organic chemistry.
Online courses in Russian	**Link**	**Summary**
Органическая химия. Часть 1 (Organic Chemistry. Part 1)	https://teach-in.ru/course/organic-chemistry-p1?ysclid=lm9a1bxnnk25825917	The course covers organic chemistry, including the classification of reagents and reactions, modern concepts of reaction mechanisms, and optical isomerism. It emphasizes modern physical and chemical methods for studying organic compounds, such as NMR, mass spectrometry, chromatographic mass spectrometry, GLC, and LC. Additionally, it explores basic classes of compounds: hydrocarbons (alkanes, alkenes, alkadienes, alkynes, arenes), halogen derivatives, magnesium and organolithium compounds, alcohols, ethers, carbonyl compounds, carboxylic acids and their derivatives, nitro compounds, amines, azo compounds, heterocyclic compounds, and natural compounds (sugars, amino acids, proteins, terpenes, steroids).
Органическая химия. Часть 1 (Organic Chemistry. Part 1)	https://openedu.ru/course/hse/ORGCHEM1/?session=2022	The primary goal of this online course is to establish a foundation for understanding, classifying, and utilizing organic transformations. A key objective is to teach how to use concepts and approximations to predict phenomena that cannot be precisely calculated with current computational methods.

Органическая химия. Часть 2 (Organic Chemistry. Part 2)	https://openedu.ru/course/hse/ORGCHEM2/?session=2022	Drawing significantly from discoveries made during the latter half of the 20th century, this course explores aromaticity, electrophilic aromatic substitution, and reactions of aromatic compounds. It also covers radical reactions, protective groups, and various rearrangements such as alkyl and hydride shifts. Additionally, the course examines palladium-catalyzed cross-coupling reactions and reactions involving copper, zinc, and titanium. It includes a detailed study of pericyclic reactions and cycloadditions, while also introducing students to retrosynthetic analysis

Analytical Chemistry

Online courses in English	**Link**	**Summary**
Advanced Chemistry - Organic and Analytical Chemistry	https://alison.com/course/advanced-chemistry-organic-and-analytical-chemistry?utm_source=googleandutm_medium=cpcandutm_campaign=Performance-Max_Tier-4_Careersandgad_source=1andgclid=Cj0KCQjwvb-zBhCmARIsAAfUI2shCcr73QiEkyByyYwYngBDjeAauHvwoy02TtT4n8kXCGWBktBoCD4aAoz5EALw_wcB	The course offers a thorough overview of a number of areas in the field, such as organic and analytical chemistry, elements, electrons, nuclear fusion and fission, energy conversion, electrochemistry, and food chemistry.
Basic Analytical Chemistry	https://www.classcentral.com/course/chemistry-the-university-of-tokyo-basic-analytica-10332	This course examines the principles of analytical chemistry and how these principles are applied in chemistry and related disciplines, especially the life sciences, environmental sciences, and geochemistry.

Analytical Chemistry	https://www.mooc-list.com/course/analytical-chemistry-saylororg	This course begins with a review of general chemistry and an introduction to analytical terminology. It introduces terms related to the process of measuring chemical compounds, such as sensitivity and detection limit.
Analytical Chemistry	https://www.classcentral.com/course/swayam-analytical-chemistry-13895	This course provides a theoretical and practical understanding of specialized instrumentation and specialized techniques to separate, identify, and quantify an unknown substance.
Online courses in Russian	**Link**	**Summary**
Аналитическая химия. Химические методы (Analytical Chemistry. Chemical Methods)	https://openedu.ru/course/ssau/Analytical_chemistry/	This course introduces basic concepts in analytical chemistry, focusing on chemical methods. Some lectures were filmed in a chemical laboratory to demonstrate sampling techniques. The course covers analytical reactions and their applications in detecting and separating components of mixtures.
Разработка методик аналитического контроля (Developing Methods for Analytical Control)	https://openedu.ru/course/misis/METCON/?session=spring_2024	The course is aimed at gaining knowledge and skills in developing methods for analytical control of substances and materials. Special attention is paid to the specifics of quantitative chemical analysis methods.
Аналитическая химия. Химические методы (Analytical Chemistry. Chemical Methods)	https://openedu.ru/course/ssau/Analytical_chemistry/	This course covers the basic rules for carrying out sampling procedures and preparation for analysis. It also explores reactions underlying chemical methods of analysis. Additionally, the course looks at the process of obtaining information about the composition of the object of analysis as a sequence of individual stages.
Аналитическая химия. Часть 2. Инструментальные методы анализа (Analytical Chemistry. Part 2.	https://openedu.ru/course/urfu/ANALYTCHEM2/	This online course presents the methods of chemical and instrumental analysis, as well as metrological assessment of its results. It also develops skills in conducting research in control and analysis.

Instrumental Methods of Analysis)		
Аналитическая химия. Титриметрия и гравиметрия (Analytical Chemistry. Titrimetry and gravimetry)	https://openedu.ru/course/ssau/Analytical_chemistry_2/	The course introduces students to theoretical concepts and demonstrates how titrimetry can determine analyte content in samples such as milk, drinking water, and medicines. It also covers individual steps of gravimetric analysis.

Physical Chemistry

Online courses in English	**Link**	**Summary**
Phase Transformations	https://openedu.ru/course/spbstu/PHTRANS/	The course introduces phase transformations occurring in alloys with binary phase diagrams.
Basics of thermodynamics	https://www.classcentral.com/course/thermo-dynamics-23740	While focusing on fundamental topics, this course explores unusual phenomena like distended fluids and includes engaging experiments.
Thermodynamics of Materials	https://www.classcentral.com/course/edx-thermodynamics-of-materials-21137	This course explores the fundamental balance between energy and disorder that dictates the state of materials at equilibrium. It covers the laws of thermodynamics, the concept of equilibrium, and thermodynamic potentials, presenting both classical and statistical interpretations.
StanfordOnline: Thermodynamics and Phase Equilibria	https://www.edx.org/course/thermodynamics-and-phase-equilibria	This course introduces students to thermodynamics and how it governs phase equilibria.
Colloids and Surfaces	https://www.classcentral.com/course/swayam-colloids-and-surfaces-19822	This course introduces the fundamentals of colloids and nanoparticle science and discusses possible applications of these concepts.
Physical Chemistry: Help and Review	https://study.com/academy/course/physical-chemistry-help-review.html	The course reviews basic physical chemistry topics for exams, homework, or continuing education purposes.
Online courses in Russian	**Link**	**Summary**

Физическая химия. Кинетика (Physical Chemistry. Kinetics)	https://openedu.ru/course/misis/CHKIN/	This course provides knowledge in the basic laws and concepts of kinetics, introducing the main experimental and theoretical approaches to the description of kinetic processes. It also develops practical skills in using physical and chemical principles in nanotechnology and nanoelectronics.
Физическая химия. Термодинамика (Physical Chemistry. Thermodynamics)	https://openedu.ru/course/misis/CHTHER/	The course covers the basic concepts, methods, and laws of thermodynamics and their application to chemical reaction equilibria, phase equilibria, and electrochemical phenomena.
Физическая химия дисперсных систем (Physical Chemistry of Dispersed Systems)	https://stepik.org/course/Физическая-химия-дисперсных-систем-51631	The course covers dispersed systems, including their classification and molecular-kinetic and optical properties. It also explores electrochemical phenomena and the applications of electrophoresis and electroosmosis in pharmacy and medicine, with a focus on dispersed systems used as forms of medicine.

Crystallography

Online courses in English	**Link**	**Summary**
Fundamentals of Materials Science	https://www.coursera.org/learn/fundamentals-of-materials-science	This course takes an integrated approach to combining metallic, ceramic, and polymer materials, allowing students to gain a deep understanding of the relationships between composition, microstructure, processing, and properties in materials science.
Transmission Electron Microscopy for Materials Science	https://www.coursera.org/learn/microscopy	This course explores the fundamentals of transmission electron microscopy in materials science, providing participants with an understanding of papers that have used transmission electron microscopy and the necessary theoretical foundation for hands-on training in transmission electron microscopy.
Microscopy: Methods for Visualization on the Micro- and Nanoscale	https://stepik.org/course/64582/promo	This course explores the capabilities and fundamental limitations of various modern research microscopes while examining the physical principles behind their operation. The program covers wide-field transmission light microscopes, wide-field and laser scanning fluorescence microscopes, ultra-high-resolution optical instruments of different designs, as well as transmission and scanning electron microscopes.

Solid state chemistry, x-ray crystallography	https://www.youtube.com/playlist?list=PLsmoITyNe7QB0x0XM-JPWlqlY4sqG80Qa	This course comprises a series of lectures on the fundamentals of crystallography.
Online courses in Russian	**Link**	**Summary**
Основы кристаллографии (Basics of Crystallography)	https://openedu.ru/course/mephi/PHISCR/?session=spring_2024	The course presents the fundamentals of geometric crystallography, while describing the symmetry of crystals. It also covers the physical properties of crystals, crystallography of plastic deformation of single and polycrystals, grain boundaries, and martensitic transformations.
Основы физического материаловедения (Fundamentals of Physical Materials Science)	https://openedu.ru/course/mephi/mephi_ofm/	The course describes defects in the crystal structure of materials and their impact on macroscopic properties, including the diffusion mobility of defects and substance transfer. It covers multicomponent materials, phase equilibrium conditions, the driving forces behind phase transitions, and the principles of thermodynamics. Additionally, it explores the theory of impurity diffusion in materials under various external factors and presents analytical solutions to diffusion equations.
Введение в материаловедение (Introduction to Materials Science)	https://openedu.ru/course/misis/MATSC1/?session=spring_2024	The course explores the scientific principles underlying materials science and the methods used for researching materials.
Современные методы исследования металлических материалов (Contemporary Methods for Metallic Material Study)	https://openedu.ru/course/misis/SMIMM/	This course explores how modern methods for studying the structure and properties of metallic materials are applied to investigate amorphous and nanocrystalline alloys.

Metallurgy and Metallurgical Engineering

Online courses in English	**Link**	**Summary**

Blank Production in Mechanical Engineering	https://stepik.org/course/107397/promo?search=4733444298	The course covers the basics of manufacturing technical workpieces using methods such as casting, metal forming and welding.
Design of Bulk Nanostructured Metal Materials	https://openedu.ru/course/spbstu/DBNMM/?session=spring_2024	The course analyzes existing types of bulk metallic nanostructured materials. It studies the technological features of methods for producing nanostructures in carbon steels, as well as the structure and properties of these materials. It also covers trends in the development of technologies for obtaining bulk metallic nanostructured materials.
Advanced Composite Materials: Chemistry and Applications	https://stepik.org/course/107500	The course begins with an introduction and discussion of the main concepts. It also covers the thermal and mechanical properties of materials and explores modern methods for their identification. The course addresses the molecular weight characteristics of polymers and the thermodynamic properties of their solutions. Additionally, it focuses on developing new food coatings using nanoparticle-enhanced polysaccharides with intelligent and active properties.
Iron-Carbon Phase Diagram	https://fliphtml5.com/fzih/bbvd/basic	This course familiarizes students with the Fe-Fe3C diagram, transformations, and types of microstructures.
Online courses in Russian	**Link**	**Summary**
Технология конструкционных материалов (Technology of Structural Materials)	https://openedu.ru/course/urfu/TECO/?session=spring_2024	The course explores the properties of structural materials, methods for their production, and the manufacturing processes for blanks and machine parts based on these materials. It pays special attention to the manufacturing of products made from metal alloys, also covering methods for producing non-metallic structural materials and products.
Материаловедение для инженеров-конструкторов (Materials Science for Construction Engineers)	https://openedu.ru/course/mephi/mephi_material/?session=spring_2024	This course provides knowledge in materials science, examining the structure of materials, their classification, production, properties, modification and scope of application. Particular attention is paid to structural materials (ferrous and non-ferrous metals) and methods for modifying their properties.
Основы физического материаловедения	https://openedu.ru/course/mephi/mephi_ofm/	The course describes defects in the crystal structure of materials and their effects on macroscopic properties. It examines the diffusion mobility of defects and substance transfer, multicomponent materials, phase

(Fundamentals of Materials Science)		equilibrium conditions, and the driving forces of phase transitions. The course also explores thermodynamics and considers the theory of impurity diffusion in matter under various external factors, providing analytical solutions to diffusion equations.
Основы металлургического производства (Fundamentals of Metallurgical Production)	https://urait.ru/author-course/osnovy-metallurgicheskogo-proizvodstva-543624	The course covers metallurgical terminology and concepts essential to industries related to metallurgy. It places special emphasis on ferrous metallurgy technologies. Non-ferrous metallurgy is addressed more briefly, focusing on various methods for separating non-ferrous metals from relatively poor ores.

Materials Science: Evaluation and Testing

Online courses in English	**Link**	**Summary**
Design of Bulk Nanostructured Metal Materials	https://openedu.ru/course/spbstu/DBNMM/?session=spring_2024	The course analyzes existing types of bulk metallic nanostructured materials. It studies the technological features of methods for producing nanostructures in carbon steels, as well as the structure and properties of these materials. It also covers trends in the development of technologies for obtaining bulk metallic nanostructured materials.
Basics of Materials Engineering	https://www.youtube.com/watch?v=2rxbxNem1iIandlist=PLyqSpQzTE6M_ON8uXt-PP8uX6hMWJeYSJ	This course is a series of lectures covering the crystal structure of materials, crystal structure defects, mechanical properties, fracture theory, fatigue failure, phase diagrams, and other topics.
Mechanics Of Materials	https://ocw.mit.edu/courses/3-11-mechanics-of-materials-fall-1999/	The course reviews the mechanical properties of ceramics, metals, and polymers, emphasizing how processing and microstructure influence these properties. It covers fundamental topics in the mechanics of materials, including continuous stresses and strains, forces on trusses, torsion of circular bars, and bending of beams.
Mechanical Behavior Of Materials	https://ocw.mit.edu/courses/3-22-mechanical-behavior-of-materials-spring-2008/	The course explores the mechanical behavior of structures and materials, from detailed descriptions of properties to the atomistic and molecular mechanisms that give these properties to all materials. It also covers elastic and plastic deformation, creep, fracture and fatigue of materials including crystalline and amorphous metals, semiconductors, ceramics and

		(bio)polymers. Additionally, the course focuses on the design and processing of materials from the atomic to the macroscale to achieve desired mechanical properties.
Online courses in Russian	**Link**	**Summary**
Введение в материаловедение (Introduction to Materials Science)	https://openedu.ru/course/misis/MATSC1/?session=spring_2024	The course covers the research foundations of materials science and methods for researching materials.
Материаловедение в машиностроении (Materials Science and Mechanical Engineering)	https://stepik.org/course/61481/promo?search=4733391533	The course describes strategies for selecting materials for specific mechanical engineering products. It covers the structure and properties of major classes of modern materials, methods for controlling these properties, and criteria for choosing materials to address specific problems.
Материаловедение для инженеров-конструкторов (Materials Science for Construction Engineers)	https://openedu.ru/course/mephi/mephi_material/?session=spring_2024	This course provides knowledge in materials science, examining the structure of materials, their classification, production, properties, modification, and scope of application. Particular attention is paid to structural materials (ferrous and non-ferrous metals) and methods for modifying their properties.