APPROVED
by HSE University Academic Council
minutes No. 1, dated February 2, 2018

Profile for the Academic Field "Mathematics"

Mathematics focuses on the study of natural and societal phenomena through the use of mathematical methods, that is, through the study of numerical characteristics, randomness, geometry of various spaces, structures, and changes in research objects, as well as the application of logical conclusions.

Mathematics includes the following subject areas:

Real, complex, and functional analysis are areas of mathematics that study respective functions and their generalizations (functionals, operators).

This includes works underpinned by the following focus of research:
1. Real analysis, which studies local and global properties of functions of real variables, their representations and approximations. Real analysis includes:
   a). metric theory of functions, which studies the properties of functions and their derivatives and functional (including orthogonal) series and their applications through the concepts of integrals and measures;
   b). theory of function spaces; study of the classes of functions occurring in mathematics and its applications;
   c). approximation theory.
2. Complex analysis, which studies: analytic functions with one or more complex variables and their properties; analytic continuation; boundary properties of analytic functions; various classes and spaces of analytic functions; representations of analytic functions (series, continued fractions, integral representations, etc.); questions on approximation by analytic functions (polynomials, rational functions, exponential polynomials, etc.); geometric theory of functions with one or more complex variables; conformal maps and their generalizations (quasi-conformal, biholomorphic, etc.); boundary value problems for analytic functions; applications of potential theory in complex analysis; and complex potential theory (including subharmonic and plurisubharmonic functions).
3. Functional analysis, which studies mappings of infinite-dimensional spaces (functionals, operators). Functional analysis includes: the theory of vector spaces, geometry of normed spaces, integration and measures on function spaces, integral representations and integral transformations, operator theory (including the theory of differential operators), perturbation theory for operators, scattering theory, theory of Banach algebras, theory of representations of groups and algebras, theory of generalized functions, dynamical systems theory, and calculus of variations.

Differential equations, dynamical systems, and optimal control belong to the area of mathematics concerned with the study of differential equations. The main components of this field of study are ordinary differential equations and partial differential equations. Its primary research objectives are the study of the solvability of differential equations, the qualitative and quantitative characteristics of solutions, and their applications.

Works containing research on the following belong to this area:

1. General theory of differential equations and systems of differential equations.
2. Initial-boundary value and spectral problems in differential equations and systems of differential equations.

3. Qualitative theory of differential equations and systems of differential equations.
4. Dynamical systems and differential equations on manifolds.
5. Non-linear differential equations and systems of non-linear differential equations.
6. Analytic theory of differential equations.
7. Theory of pseudo-differential operators.
8. Theory of differential-operator equations.
9. Theory of functional differential equations.
10. Asymptotic theory of differential equations and systems.
11. Theory of differential inclusions and differential variational inequalities.
12. Differential equations and systems of differential equations in optimal control and calculus of variations problems.

Mathematical physics is an area of mathematics dedicated to the study of mathematical problems in mechanics, theoretical physics, and other natural sciences using mathematical methods. This field of study focuses on mathematical problems in: the mechanics of particles and systems, solid mechanics, mechanics of liquids and gases, optics and electrodynamics, quantum field theory, thermodynamics, kinetics and statistical physics, theories of relativity, gravity, and astrophysics, and geophysics. The primary research objectives of the field of study: the study of mathematical problems in the aforementioned areas using mathematical methods, the application of results to mathematics, mechanics, theoretical physics, and other natural sciences, and the development of suitable mathematical tools.

Works containing research on the following belong to this area:

1. Mathematical problems in the mechanics of particles and systems.
2. Mathematical problems in continuum mechanics.
3. Mathematical problems in the mechanics of liquids and gases (fluid mechanics).
4. Mathematical problems in optics and electrodynamics.
5. Mathematical problems in quantum field theory.
6. Mathematical problems in thermodynamics, kinetics, and statistical physics.
7. Mathematical problems in the theories of relativity, gravity, and astrophysics.
8. Mathematical problems in geophysics.

Geometry and topology belong to an area of mathematics dedicated to the study of geometric structures, topological spaces, and their mapping. This field's primary components are geometry (including discrete), and general, algebraic, and differential topology. The main research objectives are the study of geometric and topological structures and their applications.

Works containing research on the following belong to this area:

1. Geometry of manifolds and various geometric structures.
2. Discrete and combinatorial geometry.
3. Differential geometry and its applications.
4. Integral geometry.
5. Symplectic, contact, and Poisson geometry.

6. General topology.
7. Algebraic topology.
8. Topology of smooth manifolds.
9. Low-dimensional topology, including braid and knot theory.
10. Topology and feature geometry.
11. Theory of mapping spaces and moduli spaces of various geometric structures.
12. Topology and group geometry and the geometry of homogeneous spaces.

Probability theory and mathematical statistics belong to the area of mathematics that studies mathematical models of random phenomena and objects. The objective of probability theory is the study of universal mathematical laws that serve as the basis for models of random phenomena and the application of these laws to the study of the properties of specific probability models. The objective of mathematical statistics is to build and study methods for selecting mathematical models that best reflect the essential properties of random data, as well as methods for collecting, classifying and processing random data.

Works containing research on the following belong to this area:

1. Axiomatic models of random phenomena.
2. Probability distributions and limit theorems.
3. Problems in geometric probability and combinatorics.
4. Random processes and fields.
5. Problems in algorithmic probability and the optimization of probability functions.
6. Methods of statistical analysis and conclusion. Estimation of parameters. Testing statistical hypotheses.
7. Statistics of random processes and fields.
8. Quantum probability.
9. Methods of statistical modelling.

Mathematical logic, algebra, and number theory belong to the area of mathematics that studies: the properties of integers; sets operations and relations; properties of solution sets of algebraic equations; and the general structure of mathematical theories, their models and algorithmic properties. The aim of algebra is to study algebraic structures within mathematics and their applications. The aim of mathematical logic is to study: the syntactic and semantic properties of formal mathematical theories and the structural properties of their semantic models; algorithmic processes with desired properties and the relationship between provability, truth, and computability. The aim of number theory is the study of the arithmetic properties of mathematical objects.

Works containing research on the following belong to this area:

1. Theory of algebraic structures (semigroups, groups, rings, fields, modules).
2. Algebraic geometry.
3. Algebraic and analytic number theory.
4. Geometry of numbers.

5. Group algebra and Lie algebra.
6. Representation theory.
7. Category theory and functors.
8. Model theory: the study of properties of semantic models for mathematical theories.
9. Theory of evidence (including non-classical logic).
10. Theory of algorithms and computable functions (including algorithmic information theory and complexity theory).
11. Axiomatic set theory and non-standard analysis.

Discrete mathematics and mathematical cybernetics cover six fields of study:
1. Discrete mathematics.
2. Control theory.
3. Mathematical programming.
4. Mathematics of operations research and game theory.
5. Mathematical theory of recognition and classification.
6. Optimal control theory.

The first and second fields include the following areas of research: theory of functional systems and problems of completeness; theory of automata; graph theory and combinatorial analysis; coding theory (algebraic and combinatorial questions); synthesis and complexity of control systems (in particular, the complexity of algorithms and calculations); equivalent transformations of control systems; and monitoring the functioning of control systems.

The third and fourth fields include the following research areas: methods for minimizing functions (in particular, minimizing discrete functions and graph algorithms); game theory; and operations research theory.

The fifth field is related to the previous four, as well to problems in probability theory, mathematical statistics, and mathematical analysis.

The sixth field deals with problems in differential equations.