Department of Mathematical Sciences

Homepage: http://mathsci.kaist.ac.kr

Office: 042-350-2702 ~ 4

▣ Introduction

Mathematics is the study of numbers, spaces, sets and functions with the basic human mental abilities such as classification, calculation, estimation and proof. It is used to abstract and quantify natural phenomena, and serves as the language of science, essential to understand the law of nature.

As human civilization develops and matures, the role of mathematics continues to increase in its use and importance, not only in the development of the natural sciences and engineering but also in the study of humanities, social studies, economics and related disciplines. In our current information society advanced mathematics is essential in many areas such as communication, computer science, information security and finance.

The Department of Mathematical Sciences has two objectives, research and education. Its research areas include algebra, analysis, geometry, probability, statistics, topology, bio-mathematics, computational mathematics, and financial mathematics. It also emphasizes contribution to the society by producing leading experts in mathematical sciences. To achieve the goal, the Department maintains the highest level of education and research, expands interdisciplinary studies with science, engineering and business administration, and stimulates interaction with other universities, research institutes and industry. To contribute to the development of new technology, the Department encourages students to pursue a minor or double major so that they can be ready for future cooperation with experts from other fields. The Department wishes, by establishing close ties between energetic faculty and creative students, to lead 21st century mathematics in Korea with an effective transfer of mathematical knowledge from faculty to students.

Recently the demand for KAIST graduates majoring in mathematical sciences is increasing. Graduates with bachelor's degree find various career paths, those with master's degree go mostly into research institutes or areas related to finance, computer science and information, and those with Ph.D. take positions in universities, research institutes and industry.

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▣ Research Areas

➢ Analysis and Applied Mathematics

In this area, real analysis, harmonic analysis, complex variables, ordinary differential equations, partial differential equations, integral equations, operator theory and all analytical problems originating from applied science are studied. Applications of the research results are employed to solve concrete problems that arise in natural science, engineering, and financial mathematics. Computerized tomography(CT) using the Radon transform and image processing using the wavelets are conspicuous applications of analysis.

➢ Topology

Here, the structures and the properties of manifolds are studied using algebraic, geometric, and combinatorial methods. Active research areas include (i) knots, links, braids, and 3-manifolds (ii) the geometric structures on low-dimensional manifolds including hyperbolic and discrete group theory (iii) 4-manifolds through Seiberg-Witten theory, symplectic and contact structures, and (iv) symmetries of manifolds in terms of group actions on differential manifolds, algebraic varieties, and semi-algebraic sets. In addition applications are effectively being made to computer graphics and non-commutative cryptography, in which braid groups are used.

➢ Algebra and Number Theory

Work in these areas often involves theoretical problems in algebraic number theory and algebraic geometry, class field theory, modular forms, and representations. Applicable problems in cryptography, coding theory and game theory are also studied using methods in algebraic geometry, number theory and linear algebra.

➢ Geometry

Using differential manifold theory and Riemannian manifolds, those working in geometry study such topics as curvature pinching problems, curvature and group actions, closed geodesics, finiteness theorems, comparison theorems, geometric structure and isometric immersions, harmonic maps and non-linear problems.

➢ Computational Mathematics and Scientific Computing

Computational mathematics involves the study of methods of expressing complex phenomena as mathematical models and discovering techniques of numerically solving the models. Research is also directed towards theoretical studies based on the analysis and developments of new techniques applicable to science and engineering.

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➢ **Combinatorics**

Combinatorics is an area of mathematics that studies mathematical objects having discrete or combinatorial structures. It involves combinatorial problems from various fields of mathematics and allows for the development of theories about diverse combinatorial objects. Emphasis is put on enumerative combinatorics, graph theory, algebraic combinatorics and combinatorial/discrete geometry.

➢ **Information Mathematics**

Topics studied in this field include Shannon's information theory, computation theory, complexity theory, Hoffman code, entropy, data compression, error correcting codes, cryptography, and information security.

➢ **Financial Mathematics**

The area of financial mathematics involves the study and design of mathematical models of financial derivatives and markets using stochastic integral equations or stochastic differential equations. Real data from the markets are used to test mathematical models and the techniques to predict the market movements are studied.

➢ **Probability and Statistics**

In probability, random phenomena in nature and society are studied rigorously in terms of measure theory. Research emphasis is on stochastic process, martingale, Markov chain, stochastic differential equations, queueing theory for the analysis of telecommunication systems, stochastic control theory and optimization. In statistics, emphasis is on multivariate statistical analysis, data analysis, learning theory, neural network models, graphic models, time series analysis, Bayesian analysis, parameter estimation, hypothesis verification, regression analysis, etc.