

◆Department of Mathematics (Mathematics Graduate Program) (プログラム名)

1. Program Outline (プログラム概要)

The Tokyo Institute of Technology Department of Mathematics, located near the center of one of the most vibrant cities of the world, offers a highly reputed graduate program in mathematics. Our graduates find employment at research universities, liberal arts colleges, government labs, major corporations, and startup companies. Both PhD and Master's degrees are available, with the possibility of fulfilling all requirements in English. Most PhD students receive financial support through teaching assistantships, research assistantships, and fellowships. Teaching assistantships are available to Master's students.

2. Degree Outlines and Aim of Study (コース概要及び学習目標)

Our faculty members have varied research interests that together cover the whole spectrum of modern mathematics. We aim to give a solid grounding to our Master's students in their chosen area of specialization, as we prepare them for cutting-edge new research to be carried out in the PhD program. Our department has its own world-class library and provides top-of-the-line computing support.

3. Guide to Study in the Mathematics Graduate Program (学習内容)

Incoming students are assigned an advisor early on and start attending a research seminar, however the focus is initially on formal coursework. That gradually gives way to reading and presenting more advanced material and, for those who continue after completing their master's thesis, original research under the advisor's guidance. The results of the research are summarized in the doctoral dissertation.

4. Graduation Requirements (修了要件)

【Master's degree】

- 30 credits or more from courses offered by the Graduate School (大学院授業科目). This includes
 - Research Courses (研究科目群)
 - 16 credits from Seminar Courses (講究科目).
 - Courses by Departments (専門科目群)
 - 12 credits, 10 of which are to be from Mathematics Departmental Courses (専攻専門科目).
 - 2 credits from Liberal Arts and General Education Courses (大学院教養・共通科目群).
- Writing a master's thesis (in English or Japanese).
- Passing the thesis examination and the final examination.

Obtaining a Master's degree typically takes two years.

【Doctoral degree】

For a Doctoral degree a candidate must satisfy, beyond the Master's degree requirements, the following:

- (1) Research seminar (Seminar in Mathematics V-X) in each term must be taken.
- (2) The publication of one research paper in a refereed journal is required.
- (3) The candidate must complete and orally defend a dissertation.

The minimum period of study is three years in total, including time spent as a Master's student. However it typically takes five years to complete a PhD.

5. Faculty list

Professors

Kazuo AKUTAGAWA	(Differential Geometry, Geometric & Global Analysis)
Hisaaki ENDO	(Low Dimensional Topology)
Takao FUJITA	(Algebraic Geometry)
Nobuhiro HONDA	(Complex Geometry)
Nobushige KUROKAWA	(Number Theory)
Satoshi NAITO	(Representation Theory)
Hiroshige SHIGA	(Complex Analysis)
Kohei UCHIYAMA	(Probability Theory)
Kotaro YAMADA	(Differential Geometry)
Eiji YANAGIDA	(Nonlinear Analysis)

Associate Professors

Toshiaki HATTORI	(Differential Geometry)
Takeshi ISOBE	(Variational Methods, Partial Differential Equations)
Tamas KALMAN	(Low Dimensional Topology)
Kazumasa KUWADA	(Probability, Stochastic Analysis)
Shohei MA	(Algebraic Geometry)
Shin-ichiro MIZUMOTO	(Number Theory)
Mitsutaka MURAYAMA	(Algebraic Topology)
Masatoshi SUZUKI	(Number Theory)
Tsuyoshi YONEDA	(Partial Differential Equations, Fluid Dynamics)

6. Tables of Course Subjects

Research Courses (研究科目群)

Course Number	Remarks* (See footnotes)	Subject	Credit	Chair	Semester S: Spring A: Autumn	Opening year a: Annually e: Even o: Odd
11701 11703	MP	Seminar in Mathematics I, III	0-4-0	Academic Advisor	S	a
11702 11704	MP	Seminar in Mathematics II, IV	0-4-0	Academic Advisor	A	a
11801 11803 11805	DP	Seminar in Mathematics V, VII, IX	0-2-0	Academic Advisor	S	a
11802 11804 11806	DP	Seminar in Mathematics VI, VIII, X	0-2-0	Academic Advisor	A	a

* MP: Master's Program, DP: Doctoral Program

Courses by the Mathematics Department (専攻専門科目群)

Course Number	Remarks (See footnotes)	Subject	Credit	Chair	Semester S: Spring A: Autumn	Opening year a: Annually e: Even o: Odd
11001 11039 11041		Advanced Algebra I, III, V	1-0-0	S. Naito Y. Nitta	S	a
11002 11040 11042		Advanced Algebra II, IV, VI	2-0-0		A	a
11017 11019 11058		Special Lectures on Analysis I, III, V	1-0-0	E. Yanagida T. Kan	S	a
11018 11057 11059		Special Lectures on Analysis II, IV, VI	1-0-0	K. Akutagawa M. Shibata	A	a
11047 11049 11051		Special Lectures on Geometry I, III, V	2-0-0		S	a
11048 11050 11052		Special Lectures on Geometry II, IV, VI	1-0-0	H. Endo M. Tanabe	A	a
11011		Algebraic Topology I	2-0-0	T. Kalman	S	a
11012		Algebraic Topology II	2-0-0			a
11070		Global Analysis I	2-0-0		S	a
11071		Global Analysis II	2-0-0	H. Shiga	A	a
11074		Theory of Stochastic Processes I	2-0-0		S	a
11075		Theory of Stochastic Processes II	2-0-0	K. Uchiyama	A	a
11511 11517 11523	I	Special Lectures on Mathematics A/D/G I	2-0-0	Y. Naito	S	a
11512 11515 11524	I	Special Lectures on Mathematics A/D/G II	2-0-0	M. Masumoto	A	a
11513 11519 11525	I	Special Lectures on Mathematics B/E/H I	2-0-0	J. Shiraishi	S	a
11514 11520 11526	I	Special Lectures on Mathematics B/E/H II	2-0-0	Y. Yamada	A	a

11515 11521	I	Special Lectures on Mathematics C/F/I I	2-0-0	R. Kobayashi	S	a
11516 11522	I	Special Lectures on Mathematics C/F/I II	2-0-0	T. Fukui	A	a
11601	E	Exercise in Algebra I	0-2-0	N. Kurokawa	S	a
11602	E	Exercise in Algebra II	0-2-0	S. Mizumoto	A	a
11611	E	Exercise in Geometry I	0-2-0	T. Hattori	S	a
11612	E	Exercise in Geometry II	0-2-0	N. Honda	A	a
11621	E	Exercise in Analysis I	0-2-0	K. Kuwada	S	a
11622	E	Exercise in Analysis II	0-2-0	T. Isobe	A	a

* I: Intensive Course, E: Consultation (with advisor's consent)

Liberal Arts and General Education (大学院教養・共通科目群)

	Remarks
	Refer to VI.Liberal Arts and General Education
International Communication (大学院国際コミュニケーション科目) Interdisciplinary Courses (大学院総合科目) Interdepartmental Courses (大学院広域科目) Arts and Humanities (大学院文明科目) Career Development Courses (大学院キャリア科目) Courses for Developing Creativity (大学院創造性育成科目) Courses for International Students (大学院留学生科目)	

7. Course Syllabi

11052

Special Lectures on Geometry VI

Autumn Semester (1-0-0)

Masaharu TANABE and Hisaaki ENDO

Several objects related to simplicial cochains of triangulated manifolds can be viewed as combinatorial analogues of objects in differential geometry. In particular, some of them converge to their smooth counterparts as the mesh of the triangulation becomes small. The goal of this course is to describe some of the approaches to this topic.

In the first part of the course, we will cover foundational material in differential geometry and several algebraic structures on simplicial cochains. Topics will include differential forms, the Hodge star operator, the Laplace operator, the Hodge decomposition, and their combinatorial analogues.

In the second part of the course we will discuss several convergence theorems. Important tools include the de Rham map from differential forms to cochains given by integration, and the Whitney map from cochains to differential forms.

Basic knowledge of manifolds will be assumed.

11059

Special Lectures on Analysis VI

Autumn Semester (1-0-0)

Masataka SHIBATA and Kazuo AKUTAGAWA

The aim of this course is to study variational methods for singularly perturbed semi-linear elliptic problems. First, we introduce the variational structure to obtain some nontrivial solution. Then we use an energy estimate to obtain information about the shape of the solution. Topics include Sobolev spaces, the mountain pass theorem, and energy estimates.

11071

Global Analysis II

Autumn Semester (2-0-0)

Hiroshige SHIGA

Elliptic functions and elliptic curves are classical but still important topics in modern mathematics. In these lectures, we give a comprehensive view of them from complex analysis. Students attending the lectures are supposed to understand fundamental facts of complex analysis and topology.

11075

Theory of Stochastic Processes II

Autumn Semester (2-0-0)

Kohei UCHIYAMA

In this lecture series, I will explain the basic concept of a stochastic process and its interaction with analysis, especially the theory of partial differential equations. As basic and important examples, random walks and heat equations will be discussed in detail.

11526

Special Lectures on Mathematics H II (Intensive Course)

Autumn Semester (2-0-0)

Yasuhiko YAMADA

We will present recent developments in the theory of discrete Painlevé equations. Topics include the geometric aspects (Sakai theory), Lax formulation, Padé method, and quantization.