

Academic Year 2026

Course Catalog

Graduate School of Science |
Tokyo Metropolitan University

This course catalog is made for all students of Tokyo Metropolitan University. It includes general courses for all majors, notes for each major, the list of graduate courses, and the course outlines.

Abbreviations and special markings used in the course list are as follows:

Year round : The course is offered throughout the year.

1st : The course is offered in the first semester.

1st A : The course is offered in the first half of the first semester.

1st B : The course is offered in the second half of the first semester.

2nd : The course is offered in the second semester.

2nd A : The course is offered in the first half of the second semester.

2nd B : The course is offered in the second half of the second semester.

1st (Summer) I : The course is offered as an intensive course in the first semester.

2nd (Winter) I : The course is offered as an intensive course in the second semester.

*Intensive courses without a schedule will be posted on the kibaco when available.

△: The course is not offered in 2026.

General Courses for All Majors (Graduate School of Science)

Notes on course enrollment

[Graduate School of Science]

Of general courses, "Selected Topics in Physics and Chemistry I" and "Selected Topics in Physics and Chemistry II" are considered to be courses for Physics and Chemistry majors.

All other courses are considered to be general courses for all majors.

Students may retake the same course for the following courses if respective courses provide different subject matter.

- Selected Topics in Physics and Chemistry I
- Selected Topics in Physics and Chemistry II

2026 Graduate School Course Catalog
General courses of the Graduate School of Science

* M = master's courses, D = doctoral courses
 * NA 2026 = Courses not offered in the academic year 2026

Course outline No.	M	D	NA 2026	Semester	Day	Time	Course Number	Course Name	Credit Hours	Instructor(s)	Note (enrollment requirements, subject matter, etc.)
1		○		Summer intensive	Other		M(R0005) D(R0006)	Radiation Science I (lecture)	2	(Chemistry)KUBUKI Siro * Part-time	For all majors A retake is not allowed for students who took this course in the undergraduate program.
2		○		Summer intensive	Other		M(R0007) D(R0008)	Radiation Science II (experiment)	1	(Chemistry)KUBUKI Siro	For all majors A retake is not allowed for students who took this course in the undergraduate program.

Program	Course Name	Course Number	Semester	Day	Time	Credit Hours
Master's program	Radiation Science I (lecture)	R0005	Summer intensive	-	-	2
Doctoral program	Radiation Science I (lecture)	R0006				
Instructor(s)		Note				
(Chemistry) KUBUKI Shiro, *Part-time lecturer		For all majors, a retake is not allowed for students who took this course in the undergraduate program.				
(1) Course policies and topics	This subject fosters the scientific literacy for handling radioisotopes (RI) and radiation. The lectures are composed of physics, chemistry, biology and legal affairs regarding RI and radiation, which instructors give in specialized fields.					
(2) Knowledge/skills to be acquired and learning objectives/course goals	The goal of this lecture is that the students who take this lecture can handle RI and radiation properly in terms of scientifically and legally.					
(3) Course schedule, subject matter, and classroom activities	<ol style="list-style-type: none"> 1. Physics related to RI and Radiation 2. Chemistry related to RI and Radiation 3. Biology related to RI and Radiation 4. Legal affairs related to RI and Radiation 5. Control techniques of RI and Radiation 					
(4) Outside-class activities and assignments	Assigned reports are given to attending students at each end of the experiments. They should be submitted by the deadline.					
(5) Textbooks and course materials	No textbooks are required because each instructor provides the lecture materials.					
(6) Assessment and grading	The assigned reports for each subject evaluate the assessment of this lecture.					
(7) Questions to the instructor (Office hours, etc.)	Each instructor answer students' questions at the end of each experiment because this is a subject of a summer intensive course.					
(8) Special note	The students who took this lecture in the bachelors' course cannot retake this lecture.					

Program	Course Name	Course Number	Semester	Day	Time	Credit Hours
Master's program	Radiation Science II (experiment)	R0007	Summer intensive	-	-	1
Doctoral program	Radiation Science II (experiment)	R0008				
Instructor(s)			Note			
(Chemistry) KUBUKI Shiro			For all majors, a retake is not allowed for students who took this course in the undergraduate program.			
(1) Course policies and topics	This subject aims to understand how to handle isotopes and radiations.					
(2) Knowledge/skills to be acquired and learning objectives/course goals	This lecture aims to learn how to handle radioisotopes and radiations properly in terms of scientifically and legally correct.					
(3) Course schedule, subject matter, and classroom activities	1. Experiments in physics related to RI and Radiation (Measurement of radiation dose) 2. Experiments in chemistry related to RI and Radiation (Measurement of half-life time of α -ray emitting radioisotope) 3. Experiments in biology related to RI and Radiation (In-vitro protein synthesis by using ^{35}S)					
(4) Outside-class activities and assignments	Assigned reports are given to attending students at each end of the experiments. They should be submitted them by the deadline.					
(5) Textbooks and course materials	No textbooks are required because each instructor provides the lecture materials.					
(6) Assessment and grading	The assigned reports for each subject evaluate the assessment of this lecture.					
(7) Questions to the instructor (Office hours, etc.)	Each instructor answer students' questions at the end of each experiment because this is a subject of a summer intensive course.					
(8) Special note	The students who took this lecture in the bachelors' course cannot retake this lecture.					

2026 Graduate School Course Catalog
Graduate School of Science (Mathematical Sciences)

* M = master's courses, D = doctoral courses
* NA 2026 = Courses not offered in the academic year 2026
*☆: Students may retake the same course if respective courses provide different subject matter.
*◎ : Required course for the major

Course outline No.	M	D	NA 2026	Semester	Day	Time	Course Number	Course Name	Credit Hours	Instructor(s)	Note (enrollment requirements, subject matter, etc.)
1	○			1st Semester	Thu.	2	M(R0011)	☆Special Lectures in Algebra	2	TOKUNAGA Hiro-o	This course is also offered in the undergraduate program
2	○			1st Semester	Tue.	2	M(R0012)	☆Special Lectures in Algebra	2	KURODA Shigeru	This course is also offered in the undergraduate program
3	○			2nd Semester	Fri.	3	M(R0013)	☆Special Lectures in Algebra	2	KANEMITSU Akihiro	This course is also offered in the undergraduate program
4	○			1st Semester	Tue.	3	M(R0014)	☆Special Lectures in Geometry	2	FUKAYA Tomohiro	This course is also offered in the undergraduate program
5	○			2nd Semester	Thu.	3	M(R0015)	☆Special Lectures in Geometry	2	KOBAYASHI Masanori	This course is also offered in the undergraduate program
6	○			1st Semester	Fri.	4	M(R0016)	☆Special Lectures in Geometry	2	KAZUKAWA Daisuke	This course is also offered in the undergraduate program
7	○			1st Semester	Fri.	2	M(R0017)	☆Special Lectures in Analysis	2	SVADLENKA Karel	This course is also offered in the undergraduate program
8	○			1st Semester	Mon.	3	M(R0018)	☆Special Lectures in Analysis	2	ISHITANI Kensuke	This course is also offered in the undergraduate program
9	○			2nd Semester	Mon.	2	M(R0019)	☆Special Lectures in Analysis	2	SHIMOJO Masahiko	This course is also offered in the undergraduate program
10	○			1st Semester	Wed.	4	M(R0020)	☆Special Lectures in Applied Mathematics	2	SUZUKI Toshio	This course is also offered in the undergraduate program
11	○			2nd Semester	Tue.	3	M(R0021)	☆Special Lectures in Applied Mathematics	2	UCHIDA Yukihiko	This course is also offered in the undergraduate program
12	○			2nd Semester	Fri.	2	M(R0022)	☆Special Lectures in Applied Mathematics	2	UCHIYAMA Shigenori	This course is also offered in the undergraduate program
13	○	(○)		1st Semester	Thu.	3	M(R0023)	☆Advanced Topics in Algebra 1	1	TOKUNAGA Hiro-o	
14	○	(○)		2nd Semester	Thu.	2	M(R0053)	☆Advanced Topics in Algebra 1	1	UEHARA Hokuto	
	○	(○)	△	1st Semester	Mon.	2	M(R0095)	☆Advanced Topics in Algebra 2	2	TSUMURA Hirofumi	
15	○	(○)		2nd Semester	Mon.	4	M(R0025)	☆Advanced Topics in Geometry 1	1	FUKAYA Tomohiro	
16	○	(○)		2nd Semester	Tue.	4	M(R0027)	☆Advanced Topics in Geometry 2	2	TBA	
	○	(○)	△				M(R0029)	☆Advanced Topics in Analysis 1	1		
17	○	(○)		1st Semester	Mon.	4	M(R0031)	☆Advanced Topics in Analysis 2	2	MIURA TatsuHiko	
18	○	(○)		2nd Semester	Fri.	4	M(R0049)	☆Advanced Topics in Applied Mathematics 1	1	SUZUKI Toshio	
19	○	(○)		1st Semester	Fri.	3	M(R0051)	☆Advanced Topics in Applied Mathematics 2	2	SATO Shun	
	○	(○)						☆Intensive Lectures in Algebra 1	1		
	○	(○)						☆Intensive Lectures in Algebra 2	2		
	○	(○)						☆Intensive Lectures in Geometry 1	1		
	○	(○)						☆Intensive Lectures in Geometry 2	2		
	○	(○)						☆Intensive Lectures in Analysis 1	1		
	○	(○)						☆Intensive Lectures in Analysis 2	2		
	○	(○)						☆Intensive Lectures in Applied Mathematics 1	1		
	○	(○)						☆Intensive Lectures in Applied Mathematics 2□	2		
	○	(○)						☆Intensive Lectures in Mathematical Sciences 1	1		
	○	(○)						☆Intensive Lectures in Mathematical Sciences 2	2		
20	○	(○)		1st Semester	Wed.	3	M(R0033)	◎Exercises in Mathematical Sciences	1	SAKAI Takashi	Searching and collecting information on mathematics
21	○			Summer intensive			M(R0034)	◎Seminar in Mathematical Sciences 1	3	Multiple instructors	
21	○			Winter intensive			M(R0035)	◎Seminar in Mathematical Sciences 2	3	Multiple instructors	
21	○			Summer intensive			M(R0036)	◎Seminar in Mathematical Sciences 3	3	Multiple instructors	
21	○			Winter intensive			M(R0037)	◎Seminar in Mathematical Sciences 4	3	Multiple instructors	
23	○			Intensive course (period TBD)			M(R0045) 1 unit M(R0047) 2 units	☆External Experience in Mathematical Sciences	1 or 2	Multiple instructors	
24	○			Intensive course (period TBD)			M(R0817) 1 unit M(R0819) 2 units	☆Internship	1 or 2	Multiple instructors	
13	(○)	○		1st Semester		3	D(R0024)	☆Advanced Topics in Algebra 1	1	TOKUNAGA Hiro-o	
14	(○)	○		2nd Semester		2	D(R0054)	☆Advanced Topics in Algebra 1	1	UEHARA Hokuto	

Course outline No.	M	D	NA 2026	Semester	Day	Time	Course Number	Course Name	Credit Hours	Instructor(s)	Note (enrollment requirements, subject matter, etc.)
	(○)	○	△	1st Semester	Mon.	2	D(R0096)	☆Advanced Topics in Algebra 2	2	TSUMURA Hirofumi	
15	(○)	○		2nd Semester	Thu.	4	D(R0026)	☆Advanced Topics in Geometry 1	1	FUKAYA Tomohiro	
16	(○)	○		2nd Semester	Tue.	4	D(R0028)	☆Advanced Topics in Geometry 2	2	TBA	
	(○)	○	△				D(R0030)	☆Advanced Topics in Analysis 1	1		
17	(○)	○		1st Semester	Mon.	4	D(R0032)	☆Advanced Topics in Analysis 2	2	MIURA TatsuHiko	
18	(○)	○		2nd Semester	Fri.	4	D(R0050)	☆Advanced Topics in Applied Mathematics 1	1	SUZUKI Toshio	
19	(○)	○		1st Semester		3	D(R0052)	☆Advanced Topics in Applied Mathematics 2	2	SATO Shun	
	(○)	○						☆Intensive Lectures in Algebra 1	1		
	(○)	○						☆Intensive Lectures in Algebra 2	2		
	(○)	○						☆Intensive Lectures in Geometry 1	1		
	(○)	○						☆Intensive Lectures in Geometry 2	2		
	(○)	○						☆Intensive Lectures in Analysis 1	1		
	(○)	○						☆Intensive Lectures in Analysis 2	2		
	(○)	○						☆Intensive Lectures in Applied Mathematics 1	1		
	(○)	○						☆Intensive Lectures in Applied Mathematics 2	2		
20		○		1st Semester	Wed.	3	D(R0038)	Special Exercises in Mathematical Sciences	1	SAKAI Takashi	Searching and collecting information on mathematics
22		○		Summer intensive			D(R0039)	©Advanced Seminar in Mathematical Sciences 1	4	Multiple instructors	
22		○		Winter intensive			D(R0040)	©Advanced Seminar in Mathematical Sciences 2	4	Multiple instructors	
22		○		Summer intensive			D(R0041)	©Advanced Seminar in Mathematical Sciences 3	3	Multiple instructors	
22		○		Winter intensive			D(R0042)	©Advanced Seminar in Mathematical Sciences 4	3	Multiple instructors	
22		○		Summer intensive			D(R0043)	©Advanced Seminar in Mathematical Sciences 5	2	Multiple instructors	
22		○		Winter intensive			D(R0044)	©Advanced Seminar in Mathematical Sciences 6	2	Multiple instructors	
23		○		Intensive course (period TBD)			D(R0046) 1 unit D(R0048) 2 units	☆External Experience in Mathematical Sciences	1 or 2	Multiple instructors	
24		○		Intensive course (period TBD)			D(R0818) 1 unit D(R0820) 2 units	☆Internship	1 or 2	Multiple instructors	

Program	Course Name	Course Number	Semester	Day	Time	Credit Hours
Master's program	Special Lectures in Algebra (1)	M(R0011)	First Semester	.Thu	2	2
Doctoral program						
Instructor(s)			Note			
Hiroo Tokunaga			This course is also offered in the undergraduate program.			
(1) Course policies and topics	This course can be considered as a continuation of Algebra C (Introduction to field theory). We learn Galois theory and its application including solvability of polynomial equations with n-th power roots.					
(2) Knowledge/skills to be acquired and learning objectives/course goals	We learn the proof of the fundamental theorem of Galois theory, and its application.					
(3) Course schedule, subject matter, and classroom activities	1-5 Review of field theory: Basic facts on field theory, a normal extension and a separable extension. 6-9 The Galois fundamental theorem and cyclotomic extensions 10-15 Applications					
(4) Outside-class activities and assignments	Assignments will be given.					
(5) Textbooks and course materials	None. "Field theory" by M. Nagata is one of reference books.					
(6) Assessment and grading	Assignments and mini exams (app. 40%), exams (mid-term 20 %, final app 40%)					
(7) Questions to the instructor (Office hours, etc.)	Send an e-mail to tokunaga[at]tmu.ac.jp					
(8) Special note	Those who took a credit on Daisugaku Tokubetsu Kogi in their undergrad are not allowed to register this course.					

Program	Course Name	Course Number	Semester	Day	Time	Credit Hours
Master's program	☆Special Lectures in Algebra	M(R0012)	1st Semester	Tue	2	2
Doctoral program						
Instructor(s)			Note			
KURODA Shigeru			This course is also offered in the undergraduate program			
(1) Course policies and topics	(Multivariate) polynomial rings are fundamental objects in algebra, but they are also very profound commutative rings, and many problems remain unsolved to this day. Many of these problems are closely related to automorphisms of polynomial rings and automorphism groups. This lecture will focus on the automorphisms and automorphism groups of polynomial rings and discuss related interesting topics in an easy-to-understand manner.					
(2) Knowledge/skills to be acquired and learning objectives/course goals	We will consider the algebraic structure of polynomial rings from various angles to deepen our understanding. To this end, we will also study elementary theories such as amalgamated free products in group theory, commutative ring theory, and derivations.					
(3) Course schedule, subject matter, and classroom activities	<ol style="list-style-type: none"> 1. Introduction 2. Elementary transformations 3. Substitution mapping and subalgebra generation 4-5. Automorphisms of polynomial rings 6. Nilpotent elements of rings 7. Locally nilpotent derivations and group actions 8. Stably tame automorphisms 9-10. Amalgamated free products 11. Linearization and diagonalization 12. The case of positive characteristic 13-14. Elementary reductions 15. Summary (Subject to change depending on the student's situation)					
(4) Outside-class activities and assignments	[Class method] Explanations will be given based on materials, and assignments will be given to check understanding. Homework will be assigned. From the second class onwards, students are required to attend classes after thoroughly reviewing the content of the previous class.					
(5) Textbooks and course materials	Materials related to the lecture content will be distributed via kibaco.					
(6) Assessment and grading	Students will be evaluated based on homework, term papers, and class participation (total 100%). Homework and term papers will assess whether students have an understanding of specialized knowledge, can utilize this knowledge comprehensively, consider problems from multiple perspectives, identify the essence of the problem to be solved, and construct their own thoughts logically.					
(7) Questions to the instructor (Office hours, etc.)	Office hours will be explained during class. If you plan to visit with questions or for consultation, please contact the professor in advance by email, etc.					
(8) Special note	Although no significant prior knowledge is assumed, some knowledge of rings and modules, as taught in undergraduate courses, will aid understanding.					

Program	Course Name	Course Number	Semester	Day	Time	Credit Hours
Master's program	Special Lectures in Algebra	M(R0013)	2nd Semester	Fri.	3	2
Doctoral program						
Instructor(s)		Note				
KANEMITSU Akihiro		This course is also offered in the undergraduate program.				
(1) Course policies and topics	Basics on plane algebraic curves and quartic curves will be explained.					
(2) Knowledge/skills to be acquired and learning objectives/course goals	The learning objectives are to learn basic knowledge on plane algebraic curves and quartic curves, and to acquire abilities to solve problems by using this knowledge.					
(3) Course schedule, subject matter, and classroom activities	<ol style="list-style-type: none"> 1. Introduction 2. Affine spaces 3. Affine algebraic curves 4. Projective space 5. Projective plane curves 6. Divisors 7. Canonical divisors 8. Riemann-Roch theorem 9. conics 10. cubic curves 11. theta characteristics (1) 12. theta characteristics (2) 13. quartic curves (1) 14. quartic curves (2) 15. Summary 					
(4) Outside-class activities and assignments	Along with each lecture, students are expected to learn related materials from textbooks below and try to solve exercises.					
(5) Textbooks and course materials	Algebraic curves, W. Fulton Classical algebraic geometry, Igor V. Dolgachev 代数曲線入門, Kajiwara Takeshi					
(6) Assessment and grading	Other materials will be provided along the course. Assignments.					
(7) Questions to the instructor (Office hours, etc.)	Those who have questions are supposed to make appointments via email. The contact email address will be provided in the first lecture.					
(8) Special note	Students are expected to have various knowledge on groups and rings. Some knowledge on algebraic geometry will be helpful.					

Program	Course Name	Course Number	Semester	Day	Time	Credit Hours
Master's program	☆Special Lectures in Geometry	M(R0014)	1st Semester	Tue.	3	2
Doctoral program						
Instructor(s)		Note				
FUKAYA Tomohiro		This course is also offered in the undergraduate program				
(1) Course policies and topics	The purpose of this course is to introduce fundamental groups of topological spaces and show applications. The fundamental group is, as the name suggests, a most fundamental invariant together with homology groups.					
(2) Knowledge/skills to be acquired and learning objectives/course goals	The goal is to become familiar with important properties of fundamental groups and to know how to compute them. In addition, you can learn about some of closely related concepts such as group actions and covering spaces.					
(3) Course schedule, subject matter, and classroom activities	<p>The plan of this course is the following:</p> <ol style="list-style-type: none"> 1. A review of topological spaces 2. A sketch on surfaces and manifolds 3. Groups and group actions (1) definitions and basic concepts 4. Groups and group actions (2) examples 5. The fundamental group and homotopies (1) equivalences by homotopies 6. The fundamental group and homotopies (2) definition of the fundamental group 7. The fundamental group and homotopies (3) induced homomorphism between fundamental groups 8. The fundamental group and covering spaces (1) definition of covering space and examples 9. The fundamental group and covering spaces (2) relation between covering projections and group actions 10. The fundamental group and covering spaces (3) lifting of maps 11. The fundamental group and covering spaces (4) construction of covering spaces 12. Computations of the fundamental group (1) representation of groups and the Tietze transformations 13. Computations of the fundamental group (2) computation by Van-Kampen's theorem 14. Computations of the fundamental group (3) basic results on the fundamental group 15. Summary and comments 					
(4) Outside-class activities and assignments	The session time is limited and therefore self-directed learning is important. Students are required to prepare and review for each class.					
(5) Textbooks and course materials	<p>No textbooks will be used.</p> <p>Reference books: A First Course in Algebraic Topology, Czes Kosniowski, Cambridge University Press, 1980. Isokikagaku (topology), Mitsuyoshi Kato, Shokabo, 1988 (in Japanese). Algebraic Topology by William Fulton</p>					
(6) Assessment and grading	Attendance (40 per cent) Report (60 per cent)					
(7) Questions to the instructor (Office hours, etc.)	Office hours will be given at the beginning of course.					
(8) Special note	<p>It is preferable to have some basic knowledge of topological spaces and group theory</p> <p>This class is common to the undergraduate courses.</p> <p>Students who already have the unit of Undergraduate Special Lectures on Geometry (1) cannot take this class.</p>					

Program	Course Name	Course Number	Semester	Day	Time	Credit Hours
Master's program	Special Lectures in Geometry	M(R0015)	2nd Semester	Thu.	3	2
Doctoral program						
Instructor(s)			Note			
KOBAYASHI Masanori			This course is also offered in the undergraduate program			
(1) Course policies and topics	<p>Introduction to Complex Manifolds Complex manifolds are fundamental objects in modern geometry, originating from complex analysis and playing a central role in algebraic geometry. They are also widely used in various fields, including physics. In this course, we introduce the fundamental concepts and tools of complex manifold theory.</p>					
(2) Knowledge/skills to be acquired and learning objectives/course goals	<p>Students will acquire the basic concepts, tools, and examples of complex manifolds.</p>					
(3) Course schedule, subject matter, and classroom activities	<ol style="list-style-type: none"> 1. Functions of Several Complex Variables 2. Germs of Holomorphic Functions 3. Almost Complex Structures and Hermitian Inner Products 4. Holomorphic Differential Forms 5. Complex Manifolds 6. Holomorphic Vector Bundles 7. Divisors and Line Bundles 8. Projective Spaces 9. Blow-ups 10. Dolbeault Cohomology 11. Kähler Manifolds 12. Hodge Theory 13. Lefschetz Theorem 14. Examples 15. Supplementary Topics <p>Note: The schedule and content may be subject to minor changes.</p> <p>The course will be conducted in a lecture-based format. Complete short written assignments reviewing the course content; Independently study textbook material and work through examples to deepen their understanding..</p>					
(4) Outside-class activities and assignments	<p>Brief take-home assignments will be given to review and reflect on the lecture content. Students are also expected to deepen their understanding by consulting textbooks and reference materials and by working through examples independently.</p>					
(5) Textbooks and course materials	<p>Textbook D. Huybrechts, Complex Geometry — An Introduction —, Springer (UTX), 2005, Chapters 1–3. References S. Kobayashi, Complex Geometry I (Iwanami Series: Foundations of Modern Mathematics 29), Iwanami Shoten, 1997 (in Japanese). P. Griffiths and J. Harris, Principles of Algebraic Geometry, Wiley, 1978; paperback edition 1994, Chapter 0. Additional references will be announced during the course.</p>					
(6) Assessment and grading	<p>Grading breakdown: Participation and written work (100%) Evaluation will focus on students' understanding of fundamental concepts in complex manifold theory and their ability to carry out computations and proofs using basic results.</p>					
(7) Questions to the instructor (Office hours, etc.)	<p>Office Hours: Tuesday, Period 5, Room 8-670 (tentative)</p>					
(8) Special note	<p>Basic material from Manifolds (Geometry A) is assumed. Topics from Differential Forms (Geometry B) and Complex Analysis (Analysis A) will be referenced, but prior completion of these courses is not required.</p>					

Program	Course Name	Course Number	Semester	Day	Time	Credit Hours
Master's program	Special Lectures in Geometry	M(R0016)	1st Semester	Fri.	4	2
Doctoral program						
Instructor(s)			Note			
KAZUKAWA Daisuke			This course is also offered in the undergraduate program.			
(1) Course policies and topics	This course is an introduction to Riemannian geometry. The Riemannian manifold is one of the central objects in modern differential geometry. In this course, we begin with fundamental concepts and learn how to understand manifolds both locally and globally.					
(2) Knowledge/skills to be acquired and learning objectives/course goals	The goal is to understand the basics of Riemannian geometry. (Knowledge and understanding of specialized fields, Logical thinking skills) Furthermore, we aim to understand the position of Riemannian geometry in modern differential geometry and topology, and to grasp its connections to related topics. (Comprehensive problem-solving skills)					
(3) Course schedule, subject matter, and classroom activities	<p>Course schedule:</p> <ol style="list-style-type: none"> 1. Smooth manifolds 2. Vector fields, Differential forms, Tensor fields 3. Riemannian metric 4. Riemannian distance 5. Levi-Civita connection 6. Covariant derivative 7. Geodesics and the first variational formula 8. Riemann curvature tensor 9. Sectional curvature, Ricci curvature, Scalar curvature 10. Exponential map 11. Completeness and Hopf-Rinow theorem 12. Jacobi fields and the second variational formula 13. Laplacian 14. Comparison theorems 15. Summary 					
(4) Outside-class activities and assignments	Classes will be conducted in lecture form. Exercises will be given as needed during the lecture. Review each lecture.					
(5) Textbooks and course materials	<p>T. Sakai, Riemannian Geometry, AMS, Translations of Mathematical Monographs. (Originally published in Japanese by Shokabo Publishing Co., Ltd.)</p> <p>P. Petersen, Riemannian Geometry, Springer, Graduate Texts in Mathematics.</p> <p>J. Jost, Riemannian Geometry and Geometric Analysis, Springer, Universitext.</p>					
(6) Assessment and grading	Participation and activity (40%), report (60%)					
(7) Questions to the instructor (Office hours, etc.)	Let me explain about this in the first lecture.					
(8) Special note	Assumes basic knowledge of manifolds.					

Program	Course Name	Course Number	Semester	Day	Time	Credit Hours
Master's program	Special Lectures in Analysis	M(R0017)	1 st Semester	Fri.	2	2
Doctoral program						
Instructor(s)		Note				
SVADLENKA Karel		This course is also offered in the undergraduate program.				
(1) Course policies and topics	<p>Topic: Fundamentals of Functional Analysis</p> <p>This lecture will enable students to appreciate the benefits of understanding the fundamentals of functional analysis through abstract definitions and concepts, and to deepen their understanding through specific examples.</p>					
(2) Knowledge/skills to be acquired and learning objectives/course goals	<p>1. Students will be able to systematically understand the rigorous theory of functional analysis, acquire foundational knowledge of its methodology, and understand how to develop it logically.</p> <p>2. Students will be able to comprehensively utilize the ideas and methods of functional analysis and apply them to solving various problems from a multifaceted perspective.</p>					
(3) Course schedule, subject matter, and classroom activities	<p>Lecture plan and content (Some content may be omitted or added depending on the progress of the lecture.)</p> <ol style="list-style-type: none"> 1. Normed vector spaces, Banach spaces and their examples 2. Linear operators 3. Hilbert spaces 4. Orthogonal projection, Riesz representation theorem 5. Bounded operators on Hilbert spaces 6. The Hahn-Banach extension theorem, 7. Dual spaces and their examples 8. Weak and weak* topologies 9. Baire category theorem, open mapping theorem, closed graph theorem 10. Uniform boundedness principle, Banach-Steinhaus theorem 11. Locally convex spaces 12. Hahn-Banach separation theorem 13. Introduction to spectrum theory, compact operators 14. Fredholm alternative theorem 15. Spectrum of self-adjoint operators <p>Teaching method Classes will be centered around lectures, but students will also be expected to deepen their overall understanding of the course content through working on assignments.</p>					
(4) Outside-class activities and assignments	<p>Report problems will be assigned regularly. At least three hours of preparation and review per week is required.</p>					
(5) Textbooks and course materials	<p>References</p> <ul style="list-style-type: none"> • P. D. Lax, Functional Analysis, Wiley Interscience. • E. Kreyszig, Introductory Functional Analysis with Applications, John Wiley & Sons. • M. Fabian, P. Habala, P. Hajek, V. Montesinos, V. Zizler, Banach Space Theory, Springer. 					
(6) Assessment and grading	<p>Evaluation will be based on quizzes taking place every session and on final examination.</p>					
(7) Questions to the instructor (Office hours, etc.)	<p>Office hours will be announced in the first lecture. If you have any questions, please come to lecturer's office. Questions by email are also welcome. [Email] karel@tmu.ac.jp [Office] Building 8, room 625</p>					
(8) Special note	<p>Relationship with other courses Many of the examples in this lecture assume knowledge of Lebesgue integral. Therefore, it is recommended that you have taken the "Analysis C" course.</p>					

Program	Course Name	Course Number	Semester	Day	Time	Credit Hours
Master's program	☆Special Lectures in Analysis	M(R0018)	1st Semester	Mon.	3	2
Doctoral program						
Instructor(s)			Note			
ISHITANI Kensuke			This course is also offered in the undergraduate program			
(1) Course policies and topics	The first half of the lecture will cover elementary statistics, while the second half of the lecture will cover modern probability theory.					
(2) Knowledge/skills to be acquired and learning objectives/course goals	1. In this lecture, students will be able to understand various concepts of probability theory, acquire basic knowledge of probability theory, and understand how to construct the logic of probability theory. 2. In this lecture, students will be able to understand the implications of various concepts of probability theory in real-world problems. Furthermore, this lecture will enable students to apply probability theory to solve social problems.					
(3) Course schedule, subject matter, and classroom activities	1-3. Elementary Statistics. 4-15. Modern Probability Theory					
(4) Outside-class activities and assignments	In each lecture, homework will be given. One should prepare enough before each lecture.					
(5) Textbooks and course materials	Some useful references will be suggested in the class.					
(6) Assessment and grading	Test (50%), report (50%).					
(7) Questions to the instructor (Office hours, etc.)	If one has questions, make an appointment via email. (k-ishitani@tmu.ac.jp)					
(8) Special note	Check the information of this class on kibaco.					

Program	Course Name	Course Number	Semester	Day	Time	Credit Hours
Master's program	Special Lectures in Analysis	M(R0019)	2 nd Semester	Mon	2	2
Doctoral program						
Instructor(s)			Note			
SHIMOJO Masahiko			This course is also offered in the undergraduate program			
(1) Course policies and topics	This course is an introductory lecture on partial differential equations (PDEs) as applications of functional analysis. Through this course, students will acquire fundamental ideas and analytical techniques for partial differential equations that describe natural phenomena such as gravitational fields, heat conduction, and wave propagation.					
(2) Knowledge/skills to be acquired and learning objectives/course goals	<p>We begin by studying the fundamental properties of Sobolev spaces, with particular emphasis on their structure as infinite-dimensional linear spaces. Students will learn the concept of weak solutions and analytical methods based on inner product space theory.</p> <p>As an application, we establish the existence and uniqueness of solutions to the Poisson equation based on the linear structure of infinite-dimensional spaces. We then study methods for solving the wave equation and diffusion equation using separation of variables (Fourier's method). As preparation for this, eigenfunction expansions of the Laplacian are introduced.</p> <p>By mastering basic analytical methods for linear partial differential equations, students will gain a deeper understanding of the foundational ideas behind numerical methods such as the finite element method for the Poisson equation and the Galerkin method for diffusion equations.</p> <p>Another objective is to prepare students for advanced topics, such as nonlinear parabolic equations, enabling smoother comprehension of advanced lectures in the future. Students are also expected to develop the ability to anticipate the qualitative behavior of solutions from the form of a given PDE and to identify key analytical issues.</p>					
(3) Course schedule, subject matter, and classroom activities	<p>Weeks 1–3: Sobolev spaces (weak derivatives, mollifiers, Poincaré inequality)</p> <p>Weeks 4–6: Poisson equation (existence and uniqueness of weak solutions, Rellich's theorem, interior regularity)</p> <p>Weeks 7–8: Eigenvalue problems</p> <p>Weeks 9–12: Wave equation (Fourier method, Hilbert scales, existence and uniqueness of weak solutions)</p> <p>Weeks 13–14: Diffusion equation (Fourier method, existence and uniqueness of weak solutions)</p> <p>Week 15: Summary and review</p>					
(4) Outside-class activities and assignments	The course is conducted in a lecture format. Understanding of the material is reinforced through report assignments. Problem sets will be presented on the blackboard during lectures, and students are expected to work on them independently outside class.					
(5) Textbooks and course materials	Introduction to Partial Differential Equations, Mitsuru Ikawa, Shokabo					
(6) Assessment and grading	Evaluation is based entirely on report assignments (100%).					
(7) Questions to the instructor (Office hours, etc.)	Wednesday, Period 2					
(8) Special note	For this course, it is sufficient to be familiar with convergence theorems in Lebesgue integration theory. Taking a course in functional analysis (Special Lectures in Analysis: MR0017) is strongly recommended.					

Program	Course Name	Course Number	Semester	Day	Time	Credit Hours
Master's program	Special Lectures in Applied Mathematics	M(R0020)	1st Semester	Wed.	4	2
Doctoral program	---	---				
Instructor(s)			Note			
SUZUKI Toshio			This course is also offered in the undergraduate program.			
(1) Course policies and topics	This is an introduction to logic in 20th century and its application. Logical formulas defines various interesting structures across mathematics, computer science, and philosophy. Logic is a mathematical science of such structures. This year we learn the first incompleteness theorem of Gödel.					
(2) Knowledge/skills to be acquired and learning objectives/course goals	We learn Gödel's incompleteness theorem in a modern framework rather than in a manner faithful to the original paper (logical thinking skills). Historically, computability theory was born after the incompleteness theorem, but the students will learn the rudiments of computability theory first to improve their outlook. The main goal of this class is to understand exactly what the first incompleteness theorem asserts and to understand the outline of the proof (basic knowledge and understanding of the specialized field) for the system PA of Peano arithmetic.					
(3) Course schedule, subject matter, and classroom activities	1-4. Rudiments of computability theory 5-7. Formalized Peano arithmetic 8-10. Sigma-1-completeness and representability 11-13. Provability predicate and diagonalization 14-15. The first incompleteness theorem					
(4) Outside-class activities and assignments	You are expected to prepare and review each time by reading the textbook.					
(5) Textbooks and course materials	Kazuyuki Tanaka: Gödel and logic in the 20th century volume 3, University of Tokyo Press, 2007 (written in Japanese).					
(6) Assessment and grading	It is 50 percent the term paper, and 50 percent the others (including assignments)					
(7) Questions to the instructor (Office hours, etc.)	My office our is 5th period of Tuesday.					
(8) Special note	- A book in English with similar content: Wolfgang Rautenberg: A concise introduction to mathematical logic, Third edition, Springer, 2010. - Check the information of this course on kibaco.					

Program	Course Name	Course Number	Semester	Day	Time	Credit Hours
Master's program	Special Lectures in Applied Mathematics	M(R0021)	2nd Semester	Tue.	3	2
Doctoral program						
Instructor(s)			Note			
UCHIDA Yukihiro			This course is also offered in the undergraduate program.			
(1) Course policies and topics	Elliptic curves defined as plane cubic curves are one of important research subjects in modern number theory. Elliptic curves are also used in various number theoretic algorithms and have broad applications. Moreover, there are various studies on hyperelliptic curves which are generalizations of elliptic curves since we can apply to them techniques similar to ones for elliptic curves. In this course, the instructor will give lectures on elliptic curves and hyperelliptic curves as generalizations of elliptic curves with applications of these curves.					
(2) Knowledge/skills to be acquired and learning objectives/course goals	The purpose of this course is to acquire the theory of elliptic and hyperelliptic curves and to understand their applications.					
(3) Course schedule, subject matter, and classroom activities	<p>The schedule of this course is below. The following schedule may be changed according to circumstances.</p> <ol style="list-style-type: none"> 1. Introduction and guidance 2. The definition of elliptic curves 3. Points of finite order and endomorphisms 4. Division polynomials 5. Pairings and Hasse's theorem 6. Point counting on elliptic curves 7. Applications of elliptic curves 8. The definition of hyperelliptic curves and rational functions 9. Divisors on hyperelliptic curves 10. Semi-reduced and reduced divisors 11. The Jacobians of hyperelliptic curves 12. Addition algorithm of divisors 13. Jacobians over finite fields 14. Applications of hyperelliptic curves 15. Summary and supplement <p>This course will be conducted in a lecture format.</p>					
(4) Outside-class activities and assignments	The contents of each lecture should be reviewed. Some assignments will be given.					
(5) Textbooks and course materials	<p>There are no specific texts. As references, three books are suggested below, and other references will be suggested if necessary.</p> <p>S. Tsujii and M. Kasahara eds., <i>Cryptography and Elliptic Curves</i>, Morikita Publishing, 2008. (Japanese).</p> <p>N. Koblitz, <i>Algebraic Aspects of Cryptography</i>, Springer, 1998.</p> <p>L. C. Washington, <i>Elliptic Curves: Number Theory and Cryptography</i>, Chapman & Hall/CRC, 2nd ed., 2008.</p>					
(6) Assessment and grading	Participation and activity (30%), report (70%)					
(7) Questions to the instructor (Office hours, etc.)	Office hours will be announced in the first lecture and posted on the instructor's web page. Please visit the instructor's room (8-667) during the office hours if you have any questions.					
(8) Special note	<ul style="list-style-type: none"> - The prerequisite for this course is a basic knowledge of groups, rings, and fields. - Students are recommended to attend the first lecture in which detailed guidance about the overview, assessment, and grading will be given. - For information about this course and the instructor's contact details, please see kibaco and the instructor's web page: https://y-uchida.fpark.tmu.ac.jp/ 					

Program	Course Name	Course Number	Semester	Day	Time	Credit Hours
Master's program	Special Lectures in Applied Mathematics	M(R0022)	2nd	Fri.	2	2
Doctoral program						
Instructor(s)			Note			
Shigenori Uchiyama			This course is also offered in the undergraduate program			
(1) Course policies and topics	Lecture on the basic mathematics of quantum computers.					
(2) Knowledge/skills to be acquired and learning objectives/course goals	Although a large-scale practical quantum computer has not been realized yet, here we will learn the basic mathematics of a mathematical model called a quantum Turing machine and some quantum algorithms that will be used as examples. The purpose of this lecture is to learn the basic mathematics of a mathematical model called a quantum Turing machine and some quantum algorithms that can be used as concrete examples.					
(3) Course schedule, subject matter, and classroom activities	<p>The class schedule is as follows. However, it may be changed depending on the situation.</p> <ol style="list-style-type: none"> 1 Introduction and guidance 2. New computer models 3 Realization of quantum computers 4 Introduction to Computational Theory 5 Tensor Product Vector Space (Part 1) 6. Tensor product vector space (Part 2) 7 Mathematical models of quantum computers 8. Mid-term summary and report 9. Simple quantum computers 10. Discrete integral transformation 11. Deutsch-Jozsa's decision algorithm 12. Grover's search algorithm 13. Shor's prime factorization algorithm 14. Applications to cryptography 15. Summary and report 					
(4) Outside-class activities and assignments	Some practical problems will be given in a class, so be sure to solve them before the next class.					
(5) Textbooks and course materials	The textbook will not be specified, but some useful references will be introduced as necessary.					
(6) Assessment and grading	Evaluation will be based on the level of class participation (30%) and reports (70%).					
(7) Questions to the instructor (Office hours, etc.)	<p>If you have any questions, they are always welcome. Email address: uchiyama-shigenori@tmu.ac.jp</p>					
(8) Special note	<p>In the first class, detailed guidance will be given on the outline of the course and grading methods. It is recommended to attend. Important information about the class will be provided through the e-learning system, kibaco. Please be sure to check it.</p>					

Program	Course Name	Course Number	Semester	Day	Time	Credit Hours
Master's program	Advanced Topics in Algebra 1	M(R0011)	First Semester	Thu	3	1
Doctoral program	Advanced Topics in Algebra 1	D(R0024)				
Instructor(s)			Note			
Hiro-o TOKUNAGA						
(1) Course policies and topics	Among all algebraic curves, elliptic curves and its generalization hyperelliptic curves are in a special position. In this course. We discuss representation of divisors on such curves and their applications					
(2) Knowledge/skills to be acquired and learning objectives/course goals	We start from definition of hyperelliptic curves and its properties. Our goal is to understand how to represent divisors on hyperelliptic curves such as Mumford and Leitenberger representation. We then consider their application to geometry.					
(3) Course schedule, subject matter, and classroom activities	<ol style="list-style-type: none"> 1. Elliptic curves and hyperelliptic curves 2. Coordinate ring and rational function field 3. Divisors 4, 5, 6. Representation of divisors, Groebner bases and divisor class group 7, 8. Applications 					
(4) Outside-class activities and assignments	The above plan can be changed. Assignments will be given.					
(5) Textbooks and course materials	None. One of possible references is "Menezes, Wu and Zuccherato: Elementary introduction to hyperelliptic curves." It can be found at https://www.math.uwaterloo.ca/~ajmeneze/publications/hyperelliptic.pdf					
(6) Assessment and grading	Attendance and assignments.					
(7) Questions to the instructor (Office hours, etc.)	For appointment, send an e-mail to tokunaga@tmu.ac.jp					
(8) Special note	Prerequisite: 1. Some knowledge on elementary algebraic geometry, e.g., algebraic curves such as plane curves, the addition law on elliptic curves. 2. Some basic knowledge on theory of Groebner bases.					

Program	Course Name	Course Number	Semester	Day	Time	Credit Hours
Master's program	Advanced Topics in Algebra 1	M(R0053)	2nd Semester	Thu.	2	1
Doctoral program	Advanced Topics in Algebra 1	D(R0054)				
Instructor(s)			Note			
UEHARA Hokuto						
(1) Course policies and topics	This course provides an overview of Morita theory for rings. Basic knowledge of modules over rings and categories will be assumed.					
(2) Knowledge/skills to be acquired and learning objectives/course goals	Two rings R and S are said to be Morita equivalent if there is a category equivalence between the category of left R -modules, $R\text{-Mod}$, and the category of left S -modules, $S\text{-Mod}$. The study of Morita equivalence of rings was later extended by Rickard to the derived categories of abelian categories of modules over rings, and has been applied in various areas of representation theory. To understand these applications, it is important to first understand the original Morita theory over rings.					
(3) Course schedule, subject matter, and classroom activities	<ol style="list-style-type: none"> 1. Categories and functors, natural transformations 2. Projective modules and injective modules 3. Generators and cogenerators 4. Tensor products and flat modules 5, 6. Morita's theorem 7, 8. Morita invariants (Subjects may be changed according to the students' situation)					
(4) Outside-class activities and assignments	Homework and other assignments will be made. Students are expected to attend the second and subsequent classes after thoroughly reviewing the content of the previous classes.					
(5) Textbooks and course materials	Anderson, F.W.; Fuller, K.R. (1992). Rings and Categories of Modules. Graduate Texts in Mathematics. 13 (2nd ed.). New York: Springer-Verlag. Lam, T.Y. Lectures on Modules and Rings. Graduate Texts in Mathematics. 189. New York: Springer-Verlag.					
(6) Assessment and grading	Grades will be based on 80% from quizzes and 30% from regular points (assignments, etc.).					
(7) Questions to the instructor (Office hours, etc.)	Office hours, etc. will be explained in class. In principle, students who wish to visit the office for questions or consultation should contact the office in advance by e-mail or other means.					
(8) Special note						

Program	Course Name	Course Number	Semester	Day	Time	Credit Hours
Master's program	☆Advanced Topics in Geometry 1	M(R0025)	2 nd Semester	Mon.	4	1
Doctoral program	☆Advanced Topics in Geometry 1	D(R0026)				
Instructor(s)			Note			
FUKAYA Tomohiro						
(1) Course policies and topics	Topological data analysis Theoretical aspect of the persistent homology					
(2) Knowledge/skills to be acquired and learning objectives/course goals	Theoretical background of persistent homology and Rips complex. Algorithm of the computation.					
(3) Course schedule, subject matter, and classroom activities	The plan of this course is the following: 1. Overview of the topological data analysis and persistent homology 2. Simplicial complex and homology 3. Making simplicial complexes from data 4. Persistent homology 5. Persistent diagram 6. Algorithm 7. Stability: Bottle neck distance and interleaving distance 8. Stability: Statement of the Stability theorem					
(4) Outside-class activities and assignments	The session time is limited and therefore self-directed learning is important. Students are required to prepare and review for each class.					
(5) Textbooks and course materials	[course materials] Polterovich, Leonid; Rosen, Daniel; Samvelyan, Karina; Zhang, Jun Topological persistence in geometry and analysis. Univ. Lecture Ser., 74 American Mathematical Society, Providence, RI, [2020], ©2020. xi+128 pp. ISBN:978-1-4704-5495-1					
(6) Assessment and grading	Attendance (40 per cent) Report (60 per cent)					
(7) Questions to the instructor (Office hours, etc.)	Office hours will be given at the beginning of course.					
(8) Special note	It is desirable to have a solid understanding of the material covered in Linear Algebra I, II, and III. In particular, you should review in advance the definitions and properties of bases of vector spaces, representation matrices of linear maps, and elementary matrix operations.					

Program	Course Name	Course Number	Semester	Day	Time	Credit Hours
Master's program	Advanced Topics in Geometry 2	D(R0028)	2nd			2
Doctoral program	Advanced Topics in Geometry 2	M(R0027)	Semester	Tue.		
Instructor(s)			Note			
TBA						
(1) Course policies and topics	Generating family invariants and their spectrification					
(2) Knowledge/skills to be acquired and learning objectives/course goals	After covering the basics of symplectic and contact geometry, as well as the fundamentals of stable homotopy theory (i.e., the theory of spectra), we will explore recent research regarding Legendrian submanifolds and generating family invariants.					
(3) Course schedule, subject matter, and classroom activities	<p>From the 7th week onward, the course will center on groupwork and student presentations, addressing research problems and recent results. Note: Some fine details are subject to change.</p> <p>Week 1: The objects of interest in symplectic and contact geometry Week 2: Lagrangian correspondences and generating families Week 3: Invariants of generating families Week 4–6: Spectra, homotopy theory, and homology Week 7: Steenrod operations Week 8–9: The Chekanov-Theret fibration Theorem Week 10: Traynor's link examples Week 11: Relationship with sheaf theory Week 12: Examples over a point Week 13–15: Future challenges and open problems</p>					
(4) Outside-class activities and assignments	Preparation for presentations, continuation of group work, and exercises.					
(5) Textbooks and course materials	Relevant research papers will be distributed as the course progresses.					
(6) Assessment and grading	Evaluation is based on presentations/writing assignments, and active class participation.					
(7) Questions to the instructor (Office hours, etc.)	Details regarding office hours will be explained during the first session.					
(8) Special note	It is recommended to have prior knowledge of differential topology (specifically differential forms) and algebraic topology (specifically homology and cohomology).					

Program	Course Name	Course Number	Semester	Day	Time	Credit Hours
Master's program	Advanced Topics in Analysis 2	M(R0031)	1st Semester	Mon	4	2
Doctoral program	Advanced Topics in Analysis 2	D(R0032)				
Instructor(s)			Note			
MIURA TatsuHiko						
(1) Course policies and topics	This course is a lecture on a mathematical theory of the Navier-Stokes equations describing the evolution of viscous incompressible fluids. We study derivation of the equations, some abstract results on function spaces and functional analysis, and then construction of weak and strong solutions.					
(2) Knowledge/skills to be acquired and learning objectives/course goals	We understand how to analyze fluid equations mathematically by using theory of function spaces and functional analysis. Also, through the study of the Navier-Stokes equations, we learn the Galerkin and energy methods which are general-purpose analysis methods for partial differential equations.					
(3) Course schedule, subject matter, and classroom activities	1-2. Introduction, derivation of the Navier-Stokes equations 3-4. Preliminaries on function spaces and functional analysis 5. Helmholtz decomposition 6. Weak solution to the stationary Stokes equations 7. Stokes operator 8. Bochner spaces, weak derivative of vector-valued functions 9. Aubin-Lions lemma 10. Definition of a weak solution to the Navier-Stokes equations 11-12. Construction of a weak solution by the Galerkin method 13. Proof of the uniqueness of a weak solution by the energy method 14. Definition and construction of a strong solution 15. Summary, other constructions of weak and strong solutions					
(4) Outside-class activities and assignments	Review the contents of each lecture, read reference books, and solve problems raised in lectures.					
(5) Textbooks and course materials	Frank Boyer and Pierre Fabrie, <i>Mathematical Tools for the Study of the Incompressible Navier-Stokes Equations and Related Models</i> , Springer, 2013. Roger Temam, <i>Navier-Stokes Equations</i> , North-Holland Publishing Co., 1984.					
(6) Assessment and grading	Evaluation will be based on the assessment of submitted reports (100%).					
(7) Questions to the instructor (Office hours, etc.)	Office hours will be announced in the first lecture, but the instructor is available for discussion whenever present in the office.					
(8) Special note	Students are assumed to be familiar with basic facts on vector analysis, partial differential equations, and functional analysis.					

Program	Course Name	Course Number	Semester	Day	Time	Credit Hours
Master's program	Advanced Topics in Applied Mathematics 1	R0049	2nd Semester	Fri.	4	1
Doctoral program	Advanced Topics in Applied Mathematics 1	R0050				
Instructor(s)			Note			
SUZUKI Toshio			This course is also offered in the undergraduate program.			
(1) Course policies and topics	This is a 1 credit lecture on applied mathematics. This year's topics are ultraproduct and infinitesimal real numbers.					
(2) Knowledge/skills to be acquired and learning objectives/course goals	Model theory is a branch of logic in which they study sets of logical formulas by algebraic methods. Around 1960, A. Robinson succeeded in theorizing infinitesimal real numbers by means of model theory. The theory is known as nonstandard analysis. In the former half of this course we learn basic concepts of model theory, in particular ultraproducts. In the latter half we introduce infinitesimal real numbers based on ultraproducts.					
(3) Course schedule, subject matter, and classroom activities	<ol style="list-style-type: none"> 1. Structures and isomorphisms in model theory 2. Elementary maps and definable sets 3-4. Ultrafilters and ultraproducts 5. Infinitesimal real numbers 6. Continuous functions 7. Differentiation 8. Advanced topics 					
(4) Outside-class activities and assignments	In each lecture, homework will be given. One should prepare enough before each lecture. As a final task, an assignment writing a mathematical article by using LaTeX will be given.					
(5) Textbooks and course materials	The textbook in the former half is A. Tsuboi "Model theory and compactness" in: K. Tanaka (eds.) " Gödel' and logic in 20th century, volume 2", pp.111--139 (written in Japanese). A textbook in the latter half will be announced in kibaco.					
(6) Assessment and grading	It is 50 percent the term paper, and 50 percent the others (including the midterm report assignment).					
(7) Questions to the instructor (Office hours, etc.)	My office our is 5th period of Tuesday.					
(8) Special note	Check the information of this course on kibaco.					

Program	Course Name	Course Number	Semester	Day	Time	Credit Hours
Master's program	Advanced Topics in Applied Mathematics 2	M(R0051)	1st Semester	Fri.	3	2
Doctoral program	Advanced Topics in Applied Mathematics 2	D(R0052)				
Instructor(s)			Note			
Shun Sato						
(1) Course policies and topics	The topic of this course is the mathematical aspect of numerical methods for differential equations.					
(2) Knowledge/skills to be acquired and learning objectives/course goals	You will learn the mathematical aspect of numerical methods for differential equations which are specialized by using mathematical structure of the differential equations to be solved.					
(3) Course schedule, subject matter, and classroom activities	1 Brief review of general-purpose numerical methods for ordinary differential equations 2 General-purpose method 1: Runge—Kutta methods 3 General-purpose method 2: linear multistep methods 4 Finite difference methods for partial differential equations 5 Splitting and composition methods 6 Symplectic integrators for Hamiltonian systems (part 1) 7 Symplectic integrators for Hamiltonian systems (part 2) 8 Summary 1 9 Conservative/dissipative methods for conservative/dissipative systems (part 1) 10 Conservative/dissipative methods for conservative/dissipative systems (part 2) 11 Conservative/dissipative methods for conservative/dissipative systems (part 3) 12 Numerical methods for differential equations on manifolds 13 Exponential integrators for semilinear differential equations 14 Further topics 15 Summary 2					
(4) Outside-class activities and assignments	Instructions will be given in each lecture.					
(5) Textbooks and course materials	E. Hairer, C. Lubich and G. Wanner: Geometric Numerical Integration, Structure-preserving Algorithms for Ordinary Differential Equations, Springer-Verlag, Berlin, 2006.					
(6) Assessment and grading	The evaluation of this course is based on the report.					
(7) Questions to the instructor (Office hours, etc.)	Instructions will be given at the beginning of the course.					
(8) Special note						

Program	Course Name	Course Number	Semester	Day	Time	Credit Hours
Master's program	Exercises in Mathematical Sciences	M(R0033)	1st Semester	Wed.	3	1
Doctoral program	Special Exercises in Mathematical Sciences	D(R0038)				
Instructor(s)			Note			
Takashi Sakai						
(1) Course policies and topics	In the study of mathematics, one needs various skills such as collecting research information and giving research presentations. This course is an exercise class for beginners of mathematical research to train these abilities.					
(2) Knowledge/skills to be acquired and learning objectives/course goals	The purpose of this course is to acquire and improve basic skills of collecting research information and learning/studying mathematics by practical training. Moreover, this course is aimed to improve the abilities to write mathematical articles and to give presentations.					
(3) Course schedule, subject matter, and classroom activities	<ol style="list-style-type: none"> 1. Searching and collecting information of mathematical research: <ul style="list-style-type: none"> - How to use library services and electronic journals 2. Searching and collecting information of mathematical research: <ul style="list-style-type: none"> - How to utilize the database of mathematical literature and preprint servers 3-4. Introduction to LaTeX: Basics 5. Introduction to LaTeX: Practical use 6-7. Presentation: Making slides and posters, giving research presentations 8. Writing mathematical articles by using LaTeX 					
(4) Outside-class activities and assignments	In each lecture, homework will be given. Students should prepare enough before each lecture. As a final task, an assignment writing a mathematical article by using LaTeX will be given.					
(5) Textbooks and course materials	Some useful references will be suggested in the class.					
(6) Assessment and grading	LaTeX report (40%), presentation (30%), participation and activity (30%)					
(7) Questions to the instructor (Office hours, etc.)	See the following web page: https://tsakai.fpark.tmu.ac.jp/					
(8) Special note	<ul style="list-style-type: none"> - This course is a required subject in the master's program. - Check the information of this course on kibaco. 					

Program	Course Name	Course Number	Semester	Day	Time	Credit Hours
Master's program	Seminar in Mathematical Sciences 1,2,3,4	M(R0034), M(R0035), M(R0036), M(R0037)	First Semester / Second Semester	Summer intensive/ Winter intensive		3
Doctoral program						
Instructor(s)			Note			
Multiple instructors						
(1) Course policies and topics	In the seminars, students carry out their study on mathematical sciences under the guidance of the instructors.					
(2) Knowledge/skills to be acquired and learning objectives/course goals	The purpose of the seminar is to acquire highly specialized knowledge in mathematical sciences, mathematical thinking abilities, problem-solving skills, problem-finding skills, and logical communication skills. The goal is to acquire the abilities to make a research project and to carry out the research premeditatedly under the guidance of the instructors.					
(3) Course schedule, subject matter, and classroom activities	This course is a seminar-style class. Students belong to the laboratories and carry out their studies on mathematical sciences under the guidance of the instructors. Since the procedure of the seminar differs depending on the laboratory, follow the instructions by the instructor in charge. The course consists of fifteen lectures.					
(4) Outside-class activities and assignments	Make sufficient preparation before the seminar. Also, review the content of the discussions after the seminar.					
(5) Textbooks and course materials	Textbooks and references will be suggested according to the research theme. Please make contact with the instructor for details.					
(6) Assessment and grading	It will be evaluated comprehensively based on the progress of the research, presentations at the seminar, and the participation and activity in the seminar.					
(7) Questions to the instructor (Office hours, etc.)	Please make contact with the instructor in charge.					
(8) Special note	These courses are required subjects for the master's program in the Department of Mathematical Sciences, and the Department of Mathematics and Information Sciences. Take Seminar in Mathematical Sciences 1,2,3,4 according to the academic year.					

Program	Course Name	Course Number	Semester	Day	Time	Credit Hours
Master's program			First Semester / Second Semester	Summer intensive/ Winter intensive		See Graduate School Course Catalog
Doctoral program	Advanced Seminar in Mathematical Sciences 1,2,3,4,5,6	D(R0039), D(R0040), D(R0041), D(R0042), D(R0043), D(R0044)				
Instructor(s)			Note			
Multiple instructors						
(1) Course policies and topics	In the seminars, students carry out their study on mathematical sciences under the guidance of the instructors.					
(2) Knowledge/skills to be acquired and learning objectives/course goals	The purpose of the seminar is to acquire highly specialized knowledge in mathematical sciences, mathematical thinking abilities, problem-solving skills, problem-finding skills, and logical communication skills. The goal is to acquire the abilities to make a research project, to draw up a plan of the research, and to carry out the research premeditatedly by themselves.					
(3) Course schedule, subject matter, and classroom activities	This course is a seminar-style class. Students belong to the laboratories and carry out their study on mathematical sciences under the guidance of the instructors. Since the procedure of the seminar differs depending on the laboratory, follow the instructions by the instructor in charge. The course consists of fifteen lectures.					
(4) Outside-class activities and assignments	Make sufficient preparation before the seminar. Also, review the content of the discussions after the seminar.					
(5) Textbooks and course materials	Textbooks and references will be suggested according to the research theme. Please make contact with the instructor for details.					
(6) Assessment and grading	It will be evaluated comprehensively based on the progress of the research, presentations at the seminar, and the participation and activity in the seminar.					
(7) Questions to the instructor (Office hours, etc.)	Please make contact with the instructor in charge.					
(8) Special note	These courses are required subjects for the doctoral program in the Department of Mathematical Sciences, and the Department of Mathematics and Information Sciences. Take Advanced Seminar in Mathematical Sciences 1,2,3,4,5,6 according to the academic year.					

Program	Course Name	Course Number	Semester	Day	Time	Credit Hours
Master's program	External Experience in Mathematical Sciences	M(R0045) 1 unit M(R0047) 2 units	Intensive course (period TBD)			1 or 2
Doctoral program	External Experience in Mathematical Sciences	D(R0046) 1 unit D(R0048) 2 units				
Instructor(s)			Note			
Multiple instructors						
(1) Course policies and topics	The purpose of this course is to acquire a wide range of practical academic abilities by accrediting credits for the off-campus learning (work experience, research / learning experience, volunteer activities, etc.) related to mathematical sciences and information sciences, which meets the requirements.					
(2) Knowledge/skills to be acquired and learning objectives/course goals	It depends on the organization of the internship.					
(3) Course schedule, subject matter, and classroom activities	<p>(1) As a general rule, it must be carried out for several days during the off-term of the classes. It must be no compensation (however, food expenses, transportation expenses, accommodation expenses can be paid by the organization of the internship).</p> <p>(2) The content should relate to mathematical sciences and information sciences. It must be appropriate for the curriculum of the graduate school of Tokyo Metropolitan University. It should not be a requirement for accreditation for another credit or qualification.</p> <p>(3) If the university or research institute is calling for participants publicly, a copy of the information is required. In the case of a company / training school, etc., the application guidelines and the acceptance agreement with the name, affiliation, and contact information of the person in charge of the internship are required. Students must have appropriate insurance.</p> <p>(4) A certificate of completion signed by the organizer is required.</p> <p>(5) Before the internship, make a preliminary application to your academic instructor and obtain permission by attaching the document (3), the contact information of the organizer of the internship, your contact information during the internship, and materials describing the content and purpose of the internship.</p>					
(4) Outside-class activities and assignments	Make sufficient preparation before the internship.					
(5) Textbooks and course materials	It depends on the organization of the internship.					
(6) Assessment and grading	<p>After the internship, students should write a report of several pages compiling a summary of the internship, their impressions, and a practical training diary. Then they should submit it with the document (4) to the academic instructor of Tokyo Metropolitan University.</p> <p>A Credit will be accredited based on the suitability with the above purpose of the course, the organizer's evaluation, and the report.</p>					
(7) Questions to the instructor (Office hours, etc.)	Office hours is not fixed. When you have a question, please contact your academic instructor directly by e-mail.					
(8) Special note	<p>Students can take multiple credits of this course (up to 2 credits in each semester).</p> <p>The credits of this course are valid for graduation credits.</p> <p>The implementation periods are</p> <ul style="list-style-type: none"> · 30 hours or more to less than 60 hours: 1 credit · 60 hours or more: 2 credits. 					

Program	Course Name	Course Number	Semester	Day	Time	Credit Hours
Master's program	Internship	M(R0817) 1 unit M(R0819) 2 units	Intensive course (period TBD)			1 or 2
Doctoral program	Internship	D(R0818) 1 unit D(R0820) 2 units				
Instructor(s)			Note			
Multiple instructors						
(1) Course policies and topics	The purpose of this course is to acquire a wide range of practical academic abilities by accrediting credits for the off-campus learning (work experience, etc.) related to mathematical sciences and information sciences, which meets the requirements.					
(2) Knowledge/skills to be acquired and learning objectives/course goals	It depends on the organization of the internship.					
(3) Course schedule, subject matter, and classroom activities	<p>(1) As a general rule, it must be carried out for several days during the off-term of the classes. It must be no compensation (however, food expenses, transportation expenses, accommodation expenses can be paid by the organization of the internship).</p> <p>(2) The content should relate to mathematical sciences and information sciences. It must be appropriate for the curriculum of the graduate school of Tokyo Metropolitan University. It should not be a requirement for accreditation for another credit or qualification.</p> <p>(3) If the university or research institute is calling for participants publicly, a copy of the information is required. In the case of a company / training school, etc., the application guidelines and the acceptance agreement with the name, affiliation, and contact information of the person in charge of the internship are required. Students must have appropriate insurance.</p> <p>(4) A certificate of completion signed by the organizer is required.</p> <p>(5) Before the internship, make a preliminary application to your academic instructor and obtain permission by attaching the document (3), the contact information of the organizer of the internship, your contact information during the internship, and materials describing the content and purpose of the internship.</p>					
(4) Outside-class activities and assignments	Make sufficient preparation before the internship.					
(5) Textbooks and course materials	It depends on the organization of the internship.					
(6) Assessment and grading	<p>After the internship, students should write a report of several pages compiling a summary of the internship, their impressions, and a practical training diary. Then they should submit it with the document (4) to the academic instructor of Tokyo Metropolitan University.</p> <p>A Credit will be accredited based on the suitability with the above purpose of the course, the organizer's evaluation, and the report.</p>					
(7) Questions to the instructor (Office hours, etc.)	Office hours is not fixed. When you have a question, please contact your academic instructor directly by e-mail.					
(8) Special note	<p>Students can take multiple credits of this course.</p> <p>The credits of this course are valid for graduation credits.</p> <p>The implementation periods are</p> <ul style="list-style-type: none"> · 5 days (or 40 hours) or more to less than 8 days (or 60 hours): 1 credit · 8 days (or 60 hours) or more: 2 credits, <p>and the course should constitute more than half of work experience.</p>					

2026 Graduate School Course Catalog
Graduate School of Science (Physics)

* M = master's courses, D = doctoral courses
* NA 2026 = Courses not offered in the academic year 2026

Course outline No.	M	D	NA 2026	Semester	Day	Time	Course Number	Course Name	Credit Hours	Instructor(s)	Note (enrollment requirements, subject matter, etc.)
1	○			1st Semester	Thu.	2	M(R0101)	General relativity	2	MOTOHASHI Hayato	This course is also offered in the undergraduate program
2	○			1st Semester	Fri.	4	M(R0102)	Statistical physics	2	HATTORI Kazumasa	
3	○			1st Semester	Mon.	3	M(R0103)	Field theory	2	MOTOHASHI Hayato	
4	○			1st Semester	Thu.	3	M(R0105)	Nuclear physics	2	YAMAGUCHI Yasuhiro	This course is also offered in the undergraduate program
5	○			1st Semester	Wed.	2	M(R0106)	Particle physics	2	YIN Wen	This course is also offered in the undergraduate program
6	○			2nd Semester	Fri.	2	M(R0107)	Astrophysics	2	ISHISAKI Yoshitaka	This course is also offered in the undergraduate program
7	○			1st Semester	Tue.	2	M(R0108)	Selected topics in Physics and chemistry II (Atomic Physics)	2	TANUMA Hajime	This course is offered for Physics and Chemistry majors and also in the undergraduate program
8	○			1st Semester	Mon.	2	M(R0109)	Selected topics in Physics and chemistry II (Solid state Physics I)	2	ARAHATA Emiko	This course is offered for Physics and Chemistry majors and also in the undergraduate program
9	○			2nd Semester	Mon.	2	M(R0111)	Solid state physics II	2	MATSUDA Tatsuma	This course is also offered in the undergraduate program
10	○			2nd Semester	Wed.	5	M(R0114)	Computational physics	2	UEDA Masahiko	This course is also offered in the undergraduate program
11	○	○		2nd Semester II	Tue.	3	M(R0171) D(R0172)	Advanced experimental technique in physics A	1	AOKI Yuji	
12	○	○		Winter intensive			M(R0937) D(R0938)	Advanced experimental technique in physics B	1	YANAGI Kazuhiro *TSUTSUI Satoshi	Register during the 2nd semester registration period
13	○	○		2nd Semester I	Wed.	3	M(R0161) D(R0162)	Selected topics in Physics and chemistry I (Advanced experimental technique in physics C)	1	TANUMA Hajime	This course is offered for Physics and Chemistry majors
14	○	○		2nd Semester II	Mon.	3	M(R0159) D(R0160)	Selected topics in Physics and chemistry I (Advanced experimental technique in physics D)	1	TANUMA Hajime	This course is offered for Physics and Chemistry majors
15	○	○		Summer intensive			M(R0097) D(R0098)	Advanced particle physics	1	YIN Wen	Register during the 1st semester registration period
	○	○	△			2	M(R0099) D(R0100)	Advanced high energy theoretical physics	1		
	○	○	△			3	M(R0125) D(R0126)	Advanced subatomic physics	1		
16	○	○		2nd Semester I	Fri.	3	M(R0131) D(R0132)	Advanced high energy astrophysics I	1	FUJITA Yutaka	
	○	○	△			3	M(R0133) D(R0134)	Advanced high energy astrophysics II	1	FUJITA Yutaka	
	○	○	△				M(R0141) D(R0142)	Advanced nonlinear physics	1		Register during the 1st semester registration period
17	○	○		1st Semester II	Tue.	3	M(R0117) D(R0118)	Advanced statistical mechanics	1	ARAHATA Emiko	
18	○	○		1st Semester I	Wed.	3	M(R0115) D(R0116)	Advanced quantum many body system	1	NOMOTO Takuya	
	○	○	△			3	M(R0145) D(R0146)	Advanced physics of superconductivity	1	HOTTA Takashi	
19	○	○		2nd Semester I	Mon.	3	M(R0123) D(R0124)	Advanced physics of magnetism	1	HOTTA Takashi	
20	○	○		1st Semester II	Fri.	3	M(R0119) D(R0120)	Advanced high energy physics I	1	KAKUNO Hidekazu	
	○	○	△			3	M(R0121) D(R0122)	Advanced high energy physics II	1	KAKUNO Hidekazu	
21	○	○		2nd Semester II	Mon.	4	M(R0153) D(R0154)	Advanced atomic physics I	1	TANUMA Hajime	
	○	○	△			4	M(R0155) D(R0156)	Advanced atomic physics II	1	TANUMA Hajime	
22	○	○		1st Semester I	Wed.	3	M(R0127) D(R0128)	Advanced astrophysics I	1	EZOE Yuichiro	
	○	○	△			3	M(R0129) D(R0130)	Advanced astrophysics II	1	ISHISAKI Yoshitaka	
23	○	○		2nd Semester I	Thu.	3	M(R0149) D(R0150)	Advanced correlated electron physics I	1	MATSUDA Tatsuma	
	○	○	△			4	M(R0135) D(R0136)	Advanced correlated electron physics II	1	MIZUGUCHI Yoshikazu	
	○	○	△			2	M(R0147) D(R0148)	Selected topics in Physics and chemistry I (Advanced nanoscience, surface, and interface physics I)	1		This course is offered for Physics and Chemistry majors
	○	○	△			1	M(R0137) D(R0138)	Selected topics in physics and chemistry I (Advanced nanoscience, surface, and interface physics II)	1	YANAGI Kazuhiro	This course is offered for Physics and Chemistry majors
24	○	○		1st Semester II	Thu.	3	M(R0151) D(R0152)	Selected topics in physics and chemistry I (Advanced soft matter physics I)	1	KURITA Rei	This course is offered for Physics and Chemistry majors
	○	○	△			3	M(R0143) D(R0144)	Selected topics in physics and chemistry I (Advanced soft matter physics II)	1	KURITA Rei	This course is offered for Physics and Chemistry majors
25	○	○		2nd Semester I	Thu.	2	M(R0139) D(R0140)	Advanced English for science	1	MORI Hiroyuki	
26	○	○		2nd Semester	Wed.	1	M(R0163) D(R0164)	Advanced Molecular Spectroscopy	2	KANYA Reika	This course is offered for Physics and Chemistry majors
27	○	○		1st Semester	Mon.	2	M(R0165) D(R0166)	Advanced Physical Chemistry of Condensed Matter	2	HIROSE Yasushi	This course is offered for Physics and Chemistry majors
28	○	○		1st Semester	Tue.	2	M(R0167) D(R0168)	Advanced Theoretical Chemistry	2	NAKATANI Naoki	This course is offered for Physics and Chemistry majors
31	○			1st Semester	*	*	M(R0173) 1st M(R0330) 2nd	Advanced seminar in physics I	2	All instructors	For first-year master's students

Course outline No.	M	D	NA 2026	Semester	Day	Time	Course Number	Course Name	Credit Hours	Instructor(s)	Note (enrollment requirements, subject matter, etc.)
31	○			2nd Semester	*	*	M(R0174) 2nd M(R0331) 1st	Advanced seminar physics II	2	All instructors	For first-year master's students
31	○			1st Semester	*	*	M(R0175) 1st M(R0332) 2nd	Advanced seminar in physics III	2	All instructors	For second-year master's students
31	○			2nd Semester	*	*	M(R0176) 2nd M(R0333) 1st	Advanced seminar in physics IV	2	All instructors	For second-year master's students
32	○			1st Semester	*	*	M(R0177) 1st M(R0334) 2nd	Advanced experiment in physics I	2	All experimental physics instructors	For first-year master's students of experimental physics
32	○			2nd Semester	*	*	M(R0178) 2nd M(R0335) 1st	Advanced experiment in physics II	2	All experimental physics instructors	For first-year master's students of experimental physics
32	○			1st Semester	*	*	M(R0179) 1st M(R0336) 2nd	Advanced experiment in physics III	2	All experimental physics instructors	For second-year master's students of experimental physics
32	○			2nd Semester	*	*	M(R0180) 2nd M(R0337) 1st	Advanced experiment in physics IV	2	All experimental physics instructors	For second-year master's students of experimental physics
33	○			1st Semester	*	*	M(R0181) 1st M(R0338) 2nd	Advanced practice in physics I	2	All instructors of theoretical physics	For first-year master's students of theoretical physics
33	○			2nd Semester	*	*	M(R0182) 2nd M(R0339) 1st	Advanced practice in physics II	2	All instructors of theoretical physics	For first-year master's students of theoretical physics
33	○			1st Semester	*	*	M(R0183) 1st M(R0340) 2nd	Advanced practice in physics III	2	All instructors of theoretical physics	For second-year master's students of theoretical physics
33	○			2nd Semester	*	*	M(R0184) 2nd M(R0341) 1st	Advanced practice in physics IV	2	All instructors of theoretical physics	For second-year master's students of theoretical physics
	○	○			TBA	TBA	M(R0197) D(R0198)	Special lecture in physics I	1	TBA	The credit hours will be added if the course provides a different subject matter.
	○	○			TBA	TBA	M(R0199) D(R0200)	Special lecture in physics II	2	TBA	The credit hours will be added if the course provides a different subject matter.
	○	○			TBA	TBA		Selected topics in physics I	1	TBA	The credit hours will be added if the course provides a different subject matter.
	○	○			TBA	TBA		Selected topics in physics II	2	TBA	The credit hours will be added if the course provides a different subject matter.
	○	○			TBA	TBA		Selected topics in Physics and Chemistry I	1	TBA	The credit hours will be added if the course provides a different subject matter. This course is offered for Physics and Chemistry majors
29	○	○		Intensive course (period TBD)	TBA	TBA	M(R0193) 2 units M(R0195) 1 unit D(R0196) 2 units D(R0194) 1 unit	External experience in physics	1 or 2	All instructors	The credit hours will be added if the course provides a different subject matter.
30	○	○		Intensive course (period TBD)	TBA	TBA	M(R0823) 2 units M(R0821) 1 unit D(R0824) 2 units D(R0822) 1 unit	Internship	1 or 2	All instructors	The credit hours will be added if the course provides a different subject matter.
34		○		1st Semester	*	*	D(R0185) 1st D(R0342) 2nd	Advanced experiment in physics V	4	All experimental physics instructors	For first-year doctoral students of experimental physics
34		○		2nd Semester	*	*	D(R0186) 2nd D(R0343) 1st	Advanced experiment in physics VI	4	All experimental physics instructors	For first-year doctoral students of experimental physics
34		○		1st Semester	*	*	D(R0187) 1st D(R0344) 2nd	Advanced experiment in physics VII	4	All experimental physics instructors	For second-year doctoral students of experimental physics
34		○		2nd Semester	*	*	D(R0188) 2nd D(R0345) 1st	Advanced experiment in physics VIII	4	All experimental physics instructors	For second-year doctoral students of experimental physics
35		○		1st Semester	*	*	D(R0225) 1st D(R0998) 2nd	Advanced experiment in physics IX	2	All experimental physics instructors	For third-year doctoral students of experimental physics
36		○		1st Semester	*	*	D(R0189) 1st D(R0346) 2nd	Advanced practice in physics V	4	All instructors of theoretical physics	For first-year doctoral students of theoretical physics
36		○		2nd Semester	*	*	D(R0190) 2nd D(R0347) 1st	Advanced practice in physics VI	4	All instructors of theoretical physics	For first-year doctoral students of theoretical physics
36		○		1st Semester	*	*	D(R0191) 1st D(R0348) 2nd	Advanced practice in physics VII	4	All instructors of theoretical physics	For second-year doctoral students of theoretical physics
36		○		2nd Semester	*	*	D(R0192) 2nd D(R0349) 1st	Advanced practice in physics VIII	4	All instructors of theoretical physics	For second-year doctoral students of theoretical physics
37		○		1st Semester	*	*	D(R0226) 1st D(R0999) 2nd	Advanced practice in physics IX	2	All instructors of theoretical physics	For third-year doctoral students of theoretical physics

Program	Course Name	Course Number	Semester	Day	Time	Credit Hours
Master's program	General relativity	R0101	1st Semester	Thu.	2	2
Doctoral program						
Instructor(s)			Note			
Hayato Motohashi			This course is also offered in the undergraduate program			
(1) Course policies and topics	<p>This course provides a systematic introduction to General Relativity, which forms the foundation of modern astrophysics, cosmology, and gravitational theory. Special and General Relativity are theories constructed by Einstein on the basis of a small number of fundamental physical principles, and are sometimes referred to as “the most beautiful theory” (Landau and Lifshitz, Classical Theory of Fields). General Relativity is the standard theory for physical phenomena in which gravity plays a central role, and is indispensable for understanding the evolution of the Universe, black holes, and gravitational waves.</p> <p>The aim of this course is to acquire a solid foundation in General Relativity. Students will develop proficiency in covariance and tensor calculus, derive the Einstein field equations governing the time evolution of the gravitational field from the fundamental principles of General Relativity, and understand how black hole spacetimes are explicitly obtained as their solutions.</p>					
(2) Knowledge/skills to be acquired and learning objectives/course goals	<p>This course treats Relativity as one of the cornerstones of modern physics (fundamental understanding of science and technology). Through the course, students will learn the deductive construction of a theoretical framework based on a small number of principles, mathematical methods used in physics, the concept of the gravitational field, and fundamental knowledge and skills required to understand various areas of physics, including astrophysics, cosmology, and gravitational-wave physics (development of logical thinking skills). Students will also cultivate the ability to solve problems by combining concepts and techniques from General Relativity (development of comprehensive problem-solving skills).</p>					
(3) Course schedule, subject matter, and classroom activities	<p>Chapter 1: Special Relativity (Lecture 1) Principle of special relativity, invariance of the speed of light, Lorentz transformations, spacetime diagrams, tensors</p> <p>Chapter 2: Principle of General Relativity (Lectures 2–3) Inertial forces, equivalence principle, principle of general relativity</p> <p>Chapter 3: Riemannian Geometry (Lectures 4–7) Riemannian manifolds, tensor algebra, parallel transport, covariant differentiation, Levi-Civita connection, Christoffel symbols, curvature tensors</p> <p>Chapter 4: Particles in Gravitational Fields (Lectures 8–10) Geodesic equations, propagation of light, weak gravitational fields, stationary gravitational fields</p> <p>Chapter 5: Field Equations of Gravity (Lectures 11–13) Action for the gravitational field, Einstein field equations, energy-momentum tensor, properties of the Einstein equations</p> <p>Chapter 6: Spherically Symmetric Spacetimes (Lectures 14–15) Schwarzschild spacetime, black holes</p>					
(4) Outside-class activities and assignments	<p>Students are expected to prepare for and review each lecture thoroughly, referring to the related courses listed in the special notes and the contents of each class.</p>					
(5) Textbooks and course materials	<p>Lectures will follow the course notes made available on kibaco. The following references are recommended: L. D. Landau and E. M. Lifshitz, The Classical Theory of Fields B. Schutz, A First Course in General Relativity, 3rd ed. P. A. M. Dirac, General Theory of Relativity T. Uchiyama, Theory of Relativity (in Japanese) K. Sato, Theory of Relativity (in Japanese) Y. Suto, Introduction to General Relativity, revised edition (in Japanese)</p>					
(6) Assessment and grading	<p>Grades will be based on problem sets, reports, and examinations. Details will be provided in the first lecture.</p>					
(7) Questions to the instructor (Office hours, etc.)	<p>No fixed office hours are scheduled. Students are encouraged to ask questions during or immediately after lectures. For questions at other times, please contact the instructor by email in advance.</p>					
(8) Special note	<p>A solid understanding of Special Relativity, Analytical Mechanics, and Mathematical Physics I and II is assumed. This course is closely related to Astrophysics.</p>					

Program	Course Name	Course Number	Semester	Day	Time	Credit Hours
Master's program	Statistical physics	R0102	1st Semester	Fri.	4	2
Doctoral program						
Instructor(s)			Note			
HATTORI Kazumasa						
(1) Course policies and topics	The lecture will cover a wide range of topics from the basics to specific examples of phase transitions and critical phenomena. The systems covered include, for example, magnetism, superfluidity, and superconductivity. The lecture will also introduce the minimum knowledge of group theory necessary to understand phase transitions, and discuss the fact that critical phenomena have universal properties regardless of the details of the system and their spontaneous symmetry breaking, without requiring knowledge of field theory.					
(2) Knowledge/skills to be acquired and learning objectives/course goals	The goal is to understand the basic mechanism of spontaneous symmetry breaking and to understand how free energy can be written down from the symmetry of a given order parameter and system symmetry.					
(3) Course schedule, subject matter, and classroom activities	<p>Slides pdf files will be uploaded in kibaco before every class</p> <ol style="list-style-type: none"> 1. Ferromagnetic and antiferromagnetic Ising models: mean-field approximation 2. Bose condensation 3. Symmetry in quantum mechanics 4. Symmetry and group theory: irreducible representations 5. Symmetry and group theory: representation matrices and character 6. Order parameters 7. Correlation functions 8. Scaling hypothesis 9. Landau theory of phase transitions 10. Liquid-gas transition 11. Nematic and tricritical point 12. Superconductivity: Cooper's problem 13. Ginzburg-Landau theory of superconductivity 14. Upper critical field and vortex lattice 15. Report and Explanation 					
(4) Outside-class activities and assignments	Students are expected to review and study the related contents on their own since a quiz will be given in each class. In particular, students who do not fully understand the undergraduate contents [quantum mechanics, statistical mechanics, and physical mathematics] may find it difficult to receive credit for the course. If students feel that they do not have sufficient understanding, they will be required to study outside of class for a considerable amount of additional time. For the first session, a quiz will be given on the basic content of statistical mechanics.					
(5) Textbooks and course materials	<p>References:</p> <p>"The Theory of Critical Phenomena - An Introduction to the Renormalization Group". J. J. Binney, N. J. Dorick, A. J. Fisher, and M. E. J. Newman, Clarendon Press, Oxford.</p> <p>"Statistical Physics of fields" M. Carder, Cambridge University Press, Cambridge.</p> <p>"Fundamentals of Metal Physics 2", Abrikosov, "Group Theory and Its Applications in Physics" (Springer Series in Solid-State Sciences, 78), Tetsuro Inui, Yukito Tanabe, and Yoshitaka Onodera.</p> <p>Other reference books will be given in class as needed.</p>					
(6) Assessment and grading	Evaluation will be based on a total of 100 points: 30 points for the quiz and 70 points for the report.					
(7) Questions to the instructor (Office hours, etc.)	No specific office hours are set, but if you wish to ask questions, please make an appointment in advance by e-mail.					
(8) Special note	An understanding of quantum mechanics, statistical mechanics, and physical mathematics is assumed.					

Program	Course Name	Course Number	Semester	Day	Time	Credit Hours
Master's program	Field theory	R0103	1st Semester	Mon.	3	2
Doctoral program						
Instructor(s)			Note			
Hayato Motohashi						
(1) Course policies and topics	Quantum Field Theory is a theoretical framework that consistently unifies Special Relativity and Quantum Mechanics, and provides the foundation for a unified understanding of the fundamental interactions in nature. Quantum Field Theory is one of the most precisely tested theories in physics, and its range of applications extends across many areas of modern physics, including particle physics, nuclear physics, condensed matter physics, and astrophysics.					
(2) Knowledge/skills to be acquired and learning objectives/course goals	The aim of this course is to acquire a solid foundation in Quantum Field Theory. Students will learn the quantization of fields, Feynman rules, and will develop the ability to explicitly compute scattering amplitudes. This course treats Quantum Field Theory as a foundational pillar of modern physics (fundamental understanding of science and technology). Through the course, students will learn how a theoretical framework is constructed based on relativistic symmetry and the principles of quantum mechanics, acquire mathematical methods used in physics, understand the concept of field quantization, and develop the fundamental knowledge and skills required to understand various areas of physics, including particle physics, nuclear physics, condensed matter physics, and astrophysics (development of logical thinking skills). Students will also cultivate the ability to solve problems by combining concepts and techniques from Quantum Field Theory (development of comprehensive problem-solving skills).					
(3) Course schedule, subject matter, and classroom activities	<p>Chapter 1: Introduction (Lectures 1–2) Lorentz group, analytical mechanics with finite degrees of freedom, analytical mechanics of fields, symmetry and Noether's theorem</p> <p>Chapter 2: Quantization of Scalar Fields (Spin 0) (Lectures 3–5) Quantization of systems with finite degrees of freedom, canonical quantization, creation and annihilation operators, Hamiltonian and momentum, local causality, Feynman propagator</p> <p>Chapter 3: Quantization of Spinor Fields (Spin 1/2) (Lectures 6–8) Dirac equation, representations of the Lorentz group, Lorentz transformation properties of spinor fields, conserved quantities, canonical quantization, creation and annihilation operators, Feynman propagator</p> <p>Chapter 4: Quantization of Vector Fields (Spin 1) (Lectures 9–11) Maxwell equations, gauge symmetry and physical degrees of freedom, gauge fields, Coulomb gauge, canonical quantization in the Coulomb gauge, Lorenz gauge</p> <p>Chapter 5: Interacting Fields (Lectures 12–15) Introduction, S-matrix and invariant scattering amplitudes, scattering cross sections and decay rates, LSZ reduction formula, n-point Green's functions, Wick's theorem, Feynman rules</p>					
(4) Outside-class activities and assignments	Students are expected to prepare for and review each lecture thoroughly, referring to the related courses listed in the special notes and the contents of each class.					
(5) Textbooks and course materials	Lectures will follow the course notes. The following references are recommended: M. Srednicki, Quantum Field Theory M. E. Peskin and D. V. Schroeder, An Introduction to Quantum Field Theory L. H. Ryder, Quantum Field Theory N. Sakai, Quantum Field Theory (in Japanese) M. Sakamoto, Quantum Field Theory I, II (in Japanese) T. Kugo, Quantum Theory of Gauge Fields I (in Japanese)					
(6) Assessment and grading	Grades will be based on problem sets and reports. Details will be provided in the first lecture.					
(7) Questions to the instructor (Office hours, etc.)	No fixed office hours are scheduled. Students are encouraged to ask questions during or immediately after lectures. For questions at other times, please contact the instructor by email in advance.					
(8) Special note	A solid understanding of Quantum Mechanics I, II, III, Special Relativity, Analytical Mechanics, and Mathematical Physics I and II is assumed. This course is closely related to Particle Physics and Nuclear Physics.					

Program	Course Name	Course Number	Semester	Day	Time	Credit Hours
Master's program	Nuclear physics	R0105	1st Semester	Thu.	3	2
Doctoral program						
2Instructor(s)			Note			
YAMAGUCHI Yasuhiro			This course is also offered in the undergraduate program			
(1) Course policies and topics	This course is for studying atomic nuclei and their constituent particles "hadrons" whose properties and dynamics are described by one of the fundamental forces in the nature, Strong force. The theoretical and experimental approaches to investigate the physics of these particles are shown.					
(2) Knowledge/skills to be acquired and learning objectives/course goals	The basic concept of atomic nuclei and hadrons, and theoretical and experimental methods to investigate these particles are studied. Nuclei and hadrons as composite particles of quarks and gluons show various phenomena, which are caused by the strong force. This force exhibits the unique features which are not found in systems dominated by gravitational and electromagnetic forces. In this course, properties of nuclei as multi nucleon systems and hadrons as multi quark systems are studied. The basic concept of Quantum chromodynamics (QCD) as a fundamental theory of quarks and gluons is also shown. (Comprehensive problem thinking ability, logical thinking ability)					
(3) Course schedule, subject matter, and classroom activities	Atomic nuclei are composed of hadrons (protons and nucleons), and the hadrons are composed of quarks and gluons. The study of nuclear and hadron physics covers different levels from quarks to hadron composites. This lecture consists of two parts. First part is for studying basic properties of nuclei and nuclear forces. Second part is for properties of hadrons, symmetries in hadron physics, and QCD. . Part 1: Nuclear physics Lecture 1: Overview of nuclear physics Lecture 2: Basic properties of nuclei, form factor, saturation of density Lecture 3: Basic properties of nuclei, mass formulae Lecture 4: Nuclear force, isospin, deuteron Lecture 5: Structure of nuclei, magic number Lecture 6: Structure of nuclei, shell model, independent particle picture Lecture 7: Decay of nuclei, Gamow theory Part 2: Hadron physics Lecture 8: Overview of hadron physics, classification, internal degrees of freedom Lecture 9: Group theory, representations, SU(2), SU(3) Lecture 10: Symmetries of quarks Lecture 11: Exotic hadrons Lecture 12: Hypernuclei Lecture 13: Asymptotic freedom in QCD Lecture 14: Spontaneous breaking of chiral symmetry Lecture 15: Summary and solutions to exercises					
(4) Outside-class activities and assignments	Some of the exercises assigned during the lectures will be designated as report assignments.					
(5) Textbooks and course materials	No textbook is specified. Relevant references will be introduced during the lectures as needed.					
(6) Assessment and grading	Based on class participation and reports.					
(7) Questions to the instructor (Office hours, etc.)	No regular office hours are scheduled. Students are welcome to ask questions at any time by making an appointment via email in advance. Questions by email are also accepted.					
(8) Special note	A basic understanding of quantum mechanics is assumed. Prior knowledge of nuclear and particle physics is desirable. This course is closely related to the course "Particle physics".					

Program	Course Name	Course Number	Semester	Day	Time	Credit Hours
Master's program	Particle physics	I0022	1st Semester	Wed.	2	2
Doctoral program						
Instructor(s)			Note			
YIN Wen			This course is also offered in the undergraduate program			
(1) Course policies and topics	Almost all phenomena observed in elementary particle physics to date have been described consistently by a theory known as the Standard Model. This model has been verified across a wide range of fields, including cosmology and astronomy, and is regarded as being close to the ultimate law that describes all phenomena in the universe. In this lecture, the Standard Model of elementary particles and its theoretical background will be explained logically. Moreover, evidence indicating that the Standard Model is not perfect will be presented, and the potential of the underlying theories will be discussed.					
(2) Knowledge/skills to be acquired and learning objectives/course goals	By taking this course, students will gain a solid foundation in the above concepts.					
(3) Course schedule, subject matter, and classroom activities	<p>Lecture 1: Chapter 1 – Introduction: An Overview of Elementary Particle Physics</p> <p>Lecture 2: Chapter 2 – Quantum Field Theory (Quantum Mechanics, Path Integral, Symmetry)</p> <p>Lecture 3: Chapter 2 – Quantum Field Theory (Locality + Special Relativity + Quantum Mechanics = Quantum Field Theory, Continuous Global Symmetries and Conservation Laws)</p> <p>Lecture 4: Chapter 3 – Abelian Gauge Theories (Gauge Symmetry, Coupling of Gauge Fields and Matter)</p> <p>Lecture 5: Chapter 3 – Abelian Gauge Theories (Quantum Electrodynamics (QED) and Specific Calculation Examples)</p> <p>Lecture 6: Chapter 3 – Abelian Gauge Theories (Digression: Renormalizability and Effective Field Theories)</p> <p>Lecture 7: Chapter 4 – Non-Abelian Gauge Theories (SU(2) Gauge Symmetry, Strong Force, Quantum Chromodynamics (QCD), Asymptotic Freedom)</p> <p>Lecture 8: Chapter 4 – Non-Abelian Gauge Theories (Spontaneous Breaking of Global Symmetries, Nucleons and Mesons)</p> <p>Lecture 9: Chapter 5 – What is Mass? (Weak Interactions, Massive Vector Bosons and Spontaneous Breaking of Gauge Symmetry)</p> <p>Lecture 10: Chapter 5 – What is Mass? (The Origin of Elementary Particle Mass, Electroweak Unification and the Higgs Field)</p> <p>Lecture 11: Chapter 6 – The Standard Model of Elementary Particles (Standard Model Lagrangian, Generations, and CP Symmetry)</p> <p>Lecture 12: Chapter 6 – The Standard Model of Elementary Particles (Digression 1: Why is the Proton Stable?; Digression 2: Higgs Field Dependence of Hadron Mass; Digression 3: Will All Forces Be Unified?)</p> <p>Lecture 13: Chapter 7 – Beyond the Standard Model (Mysteries of the Beginning of the Universe – Inflation; The Existence of Unknown Matter – Dark Matter; Disappeared Antimatter – Matter-Antimatter Asymmetry; Evolving Neutrinos – Neutrino Mass; or Other (Latest Topics))</p> <p>Lecture 14: Chapter 7 – Beyond the Standard Model (Mysteries of the Beginning of the Universe – Inflation; The Existence of Unknown Matter – Dark Matter; Disappeared Antimatter – Matter-Antimatter Asymmetry; Evolving Neutrinos – Neutrino Mass; or Other (Latest Topics))</p> <p>Lecture 15 – Discussion of Exercises</p>					
(4) Outside-class activities and assignments	Self-study using reference books. Solve exercise problems and quizzes presented during class. Review the material.					
(5) Textbooks and course materials	<p>The lectures will primarily be based on original lecture notes (posted regularly on kibaco). The following can be mentioned as reference books for extracurricular learning:</p> <ol style="list-style-type: none"> "An Introduction to the Standard Model of Particle Physics" by W. Cottingham and D. Greenwood Difficult but important for those aspiring to be particle theory researchers: "The Quantum Theory of Fields, Volume I" by S. Weinberg, "The Quantum Theory of Fields, Volume II" by S. Weinberg 					
(6) Assessment and grading	The final grade will be based on a written assignment. Participation in class, such as asking non-trivial questions and presenting on exercise problems, will be rewarded with additional points, up to a maximum of 10%.					
(7) Questions to the instructor (Office hours, etc.)	Office hours are not specified, so students should contact the instructor by email (the email address will be provided through the KIBACO system) if they have any questions.					
(8) Special note	Announcements will be sent to students' TMU email addresses ending with '@ed.tmu.ac.jp', and students should configure their TMU mail accounts to forward all emails addressed to '@ed.tmu.ac.jp' to their private email addresses.					

Program	Course Name	Course Number	Semester	Day	Time	Credit Hours
Master's program	Astrophysics	R0107	2nd Semester	Fri.	2	2
Doctoral program						
Instructor(s)			Note			
ISHISAKI Yoshitaka			This course is also offered in the undergraduate program			
(1) Course policies and topics	This course gives explanation of modern view of the Universe based on the Big Bang theory and describes evolution of stars and galaxies as well as large scale structures in the Universe. Compact objects having strong magnetic fields or strong gravity such as neutron stars and black holes will be also introduced.					
(2) Knowledge/skills to be acquired and learning objectives/course goals	The student will understand basic phenomena observed in the Universe based on physical processes and will learn how basic physics (e.g., particle physics, atomic physics, quantum mechanics, etc) can be applied to astronomical phenomena.					
(3) Course schedule, subject matter, and classroom activities	01. Introduction 02-04. Expanding Universe 05-07. Stellar evolution 08-10. Compact stars (white dwarfs, neutron stars) and black holes 11 Supernova and supernova remnant 12 Galaxy and interstellar materials 13-14 Clusters of galaxies, super clusters 15. Reports and comments					
(4) Outside-class activities and assignments	Students are expected to study the contents of the course with materials given in the class and also references.					
(5) Textbooks and course materials	Not in particular.					
(6) Assessment and grading	The final grade will be based on reports.					
(7) Questions to the instructor (Office hours, etc.)	Office hour is 1st period on Friday. Questions via e-mail is welcome.					
(8) Special note	The student should learn special relativity and general relativity to understand the standard model of the Universe and Einstein equation. High energy emission from compact objects and supernova remanants will be touched in another lecture "high energy astrophysics" so the student is recommended to take that lecture in addition to this one.					

Program	Course Name	Course Number	Semester	Day	Time	Credit Hours
Master's program	Selected topics in Physics and chemistry II (Atomic Physics)	R0108	1st Semester	Tue.	2	2
Doctoral program						
Instructor(s)			Note			
TANUMA Hajime			This course is offered for Physics and Chemistry majors and also in the undergraduate program			
(1) Course policies and topics	Fundamental theory on atoms and molecules, which are quantal few-body systems, will be explained based on elementary quantum mechanics.					
(2) Knowledge/skills to be acquired and learning objectives/course goals	The most practical and fundamental application of quantum mechanics to one- and many-electron atoms and small molecules.					
(3) Course schedule, subject matter, and classroom activities	<ol style="list-style-type: none"> 1. What is the atomic physics? 2. Hydrogenic atoms: non-relativistic theory 3. Hydrogenic atoms: relativistic theory 4. Hydrogenic atoms in electromagnetic fields 5. Semi-classical theory for optical transitions of atoms 6. Many-electron atoms 7. Spin-orbital interaction in atoms 8. Electron correlation and configuration interaction 9. Dynamics of excited atoms I 10. Dynamics of excited atoms II 11. Diatomic molecules I: Born-Oppenheimer approximation 12. Diatomic molecules II: LCAO-MO method 13. Diatomic molecules III: vibration and rotation 14. Diatomic molecules IV: electronic transitions 15. Recent topics on atomic physics 					
(4) Outside-class activities and assignments	Before the class, check and confirm the understanding of previous lectures.					
(5) Textbooks and course materials	Presentation slides will be provided through the "kibako" system. Reference books will be introduced in the lectures.					
(6) Assessment and grading	Questions and reports after whole lectures					
(7) Questions to the instructor (Office hours, etc.)	Contact via e-mail to tanuma-hajime@tmu.ac.jp					
(8) Special note						

Program	Course Name	Course Number	Semester	Day	Time	Credit Hours
Master's program	Selected topics in Physics and chemistry II (Solid state Physics I)	R0109	1st Semester	Mon.	2	2
Doctoral program						
Instructor(s)			Note			
ARAHATA Emiko			This course is offered for Physics and Chemistry majors and also in the undergraduate program			
(1) Course policies and topics	In this lecture, we will learn about the motion and energy state of electrons in a solid, which is the periodic potential of crystals, that is, the band theory.					
(2) Knowledge/skills to be acquired and learning objectives/course goals	This lecture will give you a deep knowledge of band theory. You can also learn how to calculate specific values in a simple model					
(3) Course schedule, subject matter, and classroom activities	1: Review of quantum mechanics 2: Drude theory of metals 3: Sommerfeld's theory of metals 4: Crystal structures 5: Electron states in a periodic potential 6: Electrons in a weak periodic potential 7: The nearly-free-electron approximation 8: Electrons in a periodic potential where the potential is very strong 9: The tight-banding approximation 10: Transport phenomena 11: Boltzmann equation and relaxation time 12: Phonon spectroscopy 13: Thermoelectric effect 14: Semiconductors 15: Summary					
(4) Outside-class activities and assignments	Giving some assignments in every class					
(5) Textbooks and course materials	Posting materials on kibaco					
(6) Assessment and grading	Reports(70%) and assignments(30%)					
(7) Questions to the instructor (Office hours, etc.)	Questions will be accepted at any time. Make an appointment or directly send questions by email.					
(8) Special note						

Program	Course Name	Course Number	Semester	Day	Time	Credit Hours
Master's program	Solid state physics II	R0111	2nd Semester	Mon.	2	2
Doctoral program						
Instructor(s)			Note			
MATSUDA Tatsuma			This course is also offered in the undergraduate program			
(1) Course policies and topics	The aim of this lecture is understanding the magnetism, transport properties, and quantum phenomena in crystal based on the theories for condensed electrons system.					
(2) Knowledge/skills to be acquired and learning objectives/course goals	microscopic theory of solids, group theory, phase transition and spontaneous symmetry breaking, macroscopic response of crystal and its applications					
(3) Course schedule, subject matter, and classroom activities	<p>The lectures will cover topics which are necessary for those who will be engaging to the fundamental or development research on solid materials.</p> <p>1st, 2nd : the origin of magnetic dipole (electron configuration of an atom) 3rd : symmetry of crystal structure (point group, space group) 4th, 5th : magnetism of crystal, crystalline electric field 6th, 7th : magnetic order, mean field theory 8th, 9th : magnetic materials, semiconductors, dielectric materials 10th : dielectric response of crystal 11th, 12th : low temperature, superconductivity, superfluid 13th, 14th : theoretical development 15th : practices</p> <p>Basically, these lectures will be given by the face to face classes.</p>					
(4) Outside-class activities and assignments	Outside-class activities will be uploaded to kibaco system appropriately.					
(5) Textbooks and course materials	Textbooks and references will be introduced in the lectures. The contents of this lecture will be uploaded to kibaco system.					
(6) Assessment and grading	practice problems in the lectures and 5 reports assignments					
(7) Questions to the instructor (Office hours, etc.)	Send an appointment e-mail to instructor.					
(8) Special note						

Program	Course Name	Course Number	Semester	Day	Time	Credit Hours
Master's program	Computational physics	R0114	2nd Semester	Wed.	5	2
Doctoral program						
Instructor(s)			Note			
SHUDO Akira			This course is also offered in the undergraduate program			
(1) Course policies and topics	In this lecture, the fundamentals of computer-aided research methods in physics and practical numerical methods will be presented, and students will deepen their understanding of these methods using workstations.					
(2) Knowledge/skills to be acquired and learning objectives/course goals	<ul style="list-style-type: none"> • To learn basic computational algorithms for analyzing physical phenomena, and to be able to code them using an appropriate programming language. • To learn a series of steps to run a program created on a workstation using Linux. • To be able to create programs using deterministic methods (ordinary differential equations, partial differential equations) and stochastic methods (Monte Carlo methods, etc.) using the C language. • To be able to use graphic routines to display calculation results and create simple movies. 					
(3) Course schedule, subject matter, and classroom activities	<p>The class will be conducted in the form of practical lessons at the workstation classroom on the first floor of the Information Processing Facility. Specifically, the class will proceed in the following order.</p> <p>Part 1: Fundamentals for learning computational physics (1) Operating systems Part 2: Fundamentals for learning computational physics (2) Programming languages, etc. Part 3: A brief explanation of using Linux Part 4: How to use graphic libraries Part 5: Numerical solution of ordinary differential equations (1) Euler method Part 6: Numerical methods for solving ordinary differential equations (2) Runge-Kutta method Part 7: Applications of numerical methods for solving ordinary differential equations Part 8: Report practice Part 9: Probabilistic numerical methods (1) Generation of random numbers Part 10: Probabilistic numerical methods (2) Monte Carlo method Part 11: Applications of stochastic numerical methods Part 12: Report practice Part 13: Numerical solution of partial differential equations (1)</p>					
(4) Outside-class activities and assignments	Each assignment not completed during class time will be worked on during the available time in the workstation classroom.					
(5) Textbooks and course materials	Handouts will be distributed as needed during class time. Reference books and materials will be introduced at the beginning of the class.					
(6) Assessment and grading	Students will be required to submit reports three times, and their grades will be based on the reports.					
(7) Questions to the instructor (Office hours, etc.)	If you have any questions, please feel free to ask me. However, please make an appointment in advance by e-mail. Contact information: shudo@tmu.ac.jp					
(8) Special note	In this course, students are expected to have computer knowledge equivalent to that of "Physical Information Processing" (knowledge of how to use a workstation classroom and blogging language).					

Program	Course Name	Course Number	Semester	Day	Time	Credit Hours
Master's program	Advanced experimental technique in physics A	R0171	2nd Semester II	Tue.	3	1
Doctoral program	Advanced experimental technique in physics A	R0172				
Instructor(s)			Note			
AOKI Yuji						
(1) Course policies and topics	"Low temperature" is one of the important fundamental concepts required for various types of experiments in physics. In this course, we will discuss the basics of low temperature experiments and will introduce recent experimental researches on the subject.					
(2) Knowledge/skills to be acquired and learning objectives/course goals	To understand the basic techniques (temperature measurements and constructions of experimental systems) and physical phenomena required for low temperature generation and experiments at low temperatures.					
(3) Course schedule, subject matter, and classroom activities	<p>Based on the knowledge of thermodynamics, statistical mechanics, quantum mechanics and condensed matter physics, the following major topics will be reviewed. In order to deepen the students' understanding, reports on basic topics will be assigned several times. In addition, latest researches on related topics will be introduced.</p> <ol style="list-style-type: none"> 1. Introduction to Low Temperature 2. Properties of cryogens (liquid helium, liquid nitrogen) and their handling techniques 3. Temperature measurement techniques 4. Various types of thermometers 5. Properties of materials at low temperatures (specific heat, thermal conductivity, electrical conductivity, etc.) 6. Cryostat: Techniques required for low temperature experiments 7. Superconducting magnets, adiabatic demagnetization, high-vacuum techniques related to low temperature experiments 8. Reports and explanations 					
(4) Outside-class activities and assignments	The class will be conducted mainly by lectures. The scope of preparations and reviews will be indicated in the lecture. Students are expected to prepare for the class by reviewing the course materials in advance, sorting out questions, and understanding the meaning of technical terms before attending the class.					
(5) Textbooks and course materials	Lecture materials will be posted on kibaco. Reference book: Shunichi Kobayashi and Yoichi Otsuka, "Low Temperature Techniques" (University of Tokyo Press: in Japanese)					
(6) Assessment and grading	Evaluation will be made on the basis of assignment reports (70%) and class activities (30%).					
(7) Questions to the instructor (Office hours, etc.)	How to ask questions (office hours, etc.) The office hours will be held during the second period on Fridays. Questions will also be accepted on other days. Please contact me in advance by e-mail, etc. and visit my room 8-531. For e-mail addresses and other information, please refer to "Faculty Profiles" on the university website.					
(8) Special note						

Program	Course Name	Course Number	Semester	Day	Time	Credit Hours
Master's program	Advanced experimental technique in physics B	R0937	Winter intensive			1
Doctoral program	Advanced experimental technique in physics B	R0938				
Instructor(s)			Note			
YANAGI Kazuhiro, TSUTSUI Satoshi			Register during the 2nd semester registration period			
(1) Course policies and topics	Experimental observation and measurement utilizing the properties of light and particle radiation are employed not only in solid-state physics but also in Earth sciences, astrophysics, and other fields. Various techniques are used to observe the microstructure of materials, electronic states, and to investigate the structures of buildings, the Earth's interior, and the universe. Along with fundamental concepts about these experimental methods, students learn about cutting-edge equipment, experimental sites, and practical examples. This course aims to provide introductory content to enable students to apply these techniques in actual research activities. It is envisioned to be held during the third period on Tuesday mornings.					
(2) Knowledge/skills to be acquired and learning objectives/course goals	Based on fundamental knowledge about the basic properties and generation principles of light and particle radiation, as well as observation techniques, students will understand practical examples of experiments, particularly in the field of solid-state physics, and applications. This will enable them to acquire the ability to conduct measurement experiments using both on-campus and off-campus experimental equipment.					
(3) Course schedule, subject matter, and classroom activities	<p>This course will be divided into two parts: the first four sessions will be taught by Prof. Yanagi, while the remaining four sessions will be led by Prof. Tsutsui. In the first half, fundamental principles and applications of optical experiments and laser spectroscopy, focusing particularly on selection rules for optical transitions and Raman spectroscopy, will be covered. The second half will introduce the basics and applications of solid-state experiments using X-rays, gamma rays, electron beams, neutron beams, and muons, in addition to discussing beam characteristics such as synchrotron radiation and heavy ion beams. Although it is planned as a concentrated lecture format, it is expected to be held on Tuesday mornings after the third period.</p> <p>Lecturer: Prof. Kazuhiro Yanagi Session 1: Overview of spectroscopic measurement techniques used for material structure and properties elucidation Session 2: Material symmetry, group theory, and optical transitions I Session 3: Material symmetry, group theory, and optical transitions II Session 4: Fundamentals and applications of Raman spectroscopy</p> <p>Lecturer: Prof. Satoshi Tsutsui (Part-time lecturer: High Luminosity Science Research Center) Session 5: Introduction of beam types and their characteristics: synchrotron radiation, neutrons, muons, (heavy ion beams, etc.) Session 6: Static structural analysis reflecting crystal structures and electronic states: neutron scattering, synchrotron radiation diffraction (resonant and non-resonant) Session 7: Measurement of electron and atomic dynamics: neutron inelastic scattering, X-ray inelastic scattering (resonant and non-resonant), nuclear resonance inelastic scattering Session 8: Utilization of electron and nuclear interactions (hyperfine interactions) for solid-state measurements: nuclear resonance scattering, μSR, (PAC, β-NMR, etc.) Note: In the lectures conducted by Prof. Tsutsui in the latter half, there may be a possibility of combining two sessions into one day for Sessions 5 and 6, as well as Sessions 7 and 8, depending on discussions with the enrolled students. Further details will be provided through the first half lecturer and communication channels like KIBACO.</p>					
(4) Outside-class activities and assignments	Students are expected to prepare and review the materials specified in each lecture for their pre-class and post-class studies. It is advisable to go through the provided course materials in advance, organize any uncertainties or questions, and ensure comprehension of specialized terminology before attending the lecture.					
(5) Textbooks and course materials	The slides and materials used in the lectures will be uploaded to KIBACO. Additionally, reference books and literature will be introduced as needed during the lectures.					
(6) Assessment and grading	Students will be evaluated based on two reports corresponding to each of the first four sessions and the last four sessions of the course.					
(7) Questions to the instructor (Office hours, etc.)	Office hours will not be specifically set, but students can schedule appointments via email if they have any questions. Kazuhiro Yanagi (kyanagi@tmu.ac.jp) Satoshi Tsutsui(satoshi@spring8.or.jp)					
(8) Special note						

Program	Course Name	Course Number	Semester	Day	Time	Credit Hours
Master's program	Selected topics in Physics and chemistry I (Advanced experimental technique in physics C)	R0161	2nd Semester I	Wed.	3	1
Doctoral program	Selected topics in Physics and chemistry I (Advanced experimental technique in physics C)	R0162				
Instructor(s)			Note			
TANUMA Hajime			This course is offered for Physics and Chemistry majors			
(1) Course policies and topics	Particle detection techniques, which are used in various physical measurements, will be explained for not only high energy radiation, but also low energy photons, electrons, ions, and neutral particles.					
(2) Knowledge/skills to be acquired and learning objectives/course goals	Fundamental understanding of physical phenomena used for particle detection, and practical technical methods for measurements of various particles in physics.					
(3) Course schedule, subject matter, and classroom activities	<ol style="list-style-type: none"> 1. Fundamental collision processes of electrons and ions in gases 2. Gase-based particle detectors 3. Particle detectors using processes on solid surfaces 4. Position sensitive detectors 5. Particle detectors using processes in solids 6. Mass and kinetic energy analyzers for slow charged particles in vacuum 7. Energy loss of fast particles in solid 8. Question and answers 					
(4) Outside-class activities and assignments	Before the class, check and confirm the understanding of previous lectures.					
(5) Textbooks and course materials	Presentation slides will be provided through the "kibako" system.					
(6) Assessment and grading	Questions and reports after whole lectures					
(7) Questions to the instructor (Office hours, etc.)	Contact via e-mail to tanuma-hajime@tmu.ac.jp					
(8) Special note						

Program	Graduate School of Science		Semester	Day	Time	Credit Hours
	Course Name	Course Number				
Master's program	Selected Topics in Physics and Chemistry I (Advanced Experimental Technique in Physics D)	R0159	2 nd B	Mon.	3	1
Doctoral program	Selected Topics in Physics and Chemistry I (Advanced Experimental Technique in Physics D)	R0160				
Instructor(s)			Note			
TANUMA Hajime						
(1) Course policies and topics	This course deals with the fundamentals of vacuum, which is a common feature in various physics experiments. Vacuum technology is indispensable not only for particle beam experiments but also for physical properties, sample fabrication and low-temperature experiments. How to prepare and measure vacuum in the laboratory? The fundamentals of vacuum will be explained also with the viewpoints of atomic physics and surface physics.					
(2) Knowledge/skills to be acquired and learning objectives/course goals	We gain a level of knowledge that will enable to understand the characteristics of vacuum equipment and to design their own equipment.					
(3) Course schedule, subject matter, and classroom activities	Drawing on knowledge of thermodynamic and statistical mechanics, fluid mechanics, quantum mechanics, and condensed matter physics, the following major topics will be reviewed. Students will be required to write reports on fundamental topics in order to deepen their understanding of the subject matter. Course schedule Lecture 1: What is the vacuum? Lecture 2: Kinetic theory of gases Lecture 3: Physics of dilute gases Lecture 4: Pumps for low vacuum Lecture 5: Pumps for high vacuum Lecture 6: Pressure measurements for low vacuum Lecture 7: Pressure measurements for high vacuum Lecture 8: Thermal transpiration effects					
(4) Outside-class activities and assignments	After each class, an assignment related to the content of the class will be given, which will be reviewed in the next class.					
(5) Textbooks and course materials	Slides to be used in class will be printed and distributed. Others will be given in class					
(6) Assessment and grading	Based on reports.					
(7) Questions to the instructor (Office hours, etc.)	E-mail questions at any time.					
(8) Special note						

Program	Course Name	Course Number	Semester	Day	Time	Credit Hours
Master's program	Advanced particle physics	R0097	Summer intensive			1
Doctoral program	Advanced particle physics	R0098				
Instructor(s)			Note			
YIN Wen			Register during the 1st semester registration period			
(1) Course policies and topics	A basic explanation is provided in order to enable research in particle cosmology. In particular, the lecture emphasizes order-of-magnitude evaluations for gaining insights into complex systems rather than precise calculations.					
(2) Knowledge/skills to be acquired and learning objectives/course goals	The Standard Model of elementary particles (and General Relativity) is an extremely fundamental theory for understanding most physical phenomena. However, through the study of the history of the universe, several mysteries have become apparent that hint at the existence of new physical laws: for instance, the description of the beginning of the universe by inflation; dark matter, an unknown substance present in the current universe; dark energy, an unknown form of energy; and the matter-antimatter asymmetry, whose origin remains unexplained despite being essential for the existence of stars and ourselves. In this course, by combining discussions on particle model building with cosmology, students will learn the basics for considering "how fundamental physical laws have been understood" and "how they should be understood."					
(3) Course schedule, subject matter, and classroom activities	Lecture 1: Introduction to the Standard Model of elementary particles Lecture 2: The perspective of cosmology Lecture 3: The beginning of the universe: Inflation Lecture 4: Inflation models Lecture 5: Unknown substances: Dark Matter Lecture 6: Experimental search methods for Dark Matter Lecture 7: Recipes for generating matter-antimatter asymmetry Lecture 8: Summary					
(4) Outside-class activities and assignments	The slides used in the course will be published in advance on kibaco;					
(5) Textbooks and course materials	If one must choose, Modern Cosmology by Takahiko Matsubara. Cosmology by S.Weinberg					
(6) Assessment and grading	Evaluation will be based solely (100%) on reports.					
(7) Questions to the instructor (Office hours, etc.)	If there are any questions, students are encouraged to ask during the lecture or via email (please refer to the announcements on kibaco for the email address).					
(8) Special note	Announcements will be sent to students' TMU email addresses ending with '@ed.tmu.ac.jp', and students should configure their TMU mail accounts to forward all emails addressed to '@ed.tmu.ac.jp' to their private email addresses.					

Program	Course Name	Course Number	Semester	Day	Time	Credit Hours
Master's program	Advanced high energy astrophysics I	R0131	2nd Semester I	Fri.	3	1
Doctoral program	Advanced high energy astrophysics I	R0132				
Instructor(s)			Note			
FUJITA Yutaka						
(1) Course policies and topics	This course introduces theories of high energy astrophysics. The aim of this course is to help students understand physical processes relevant to the structure and evolution of high-energy objects.					
(2) Knowledge/skills to be acquired and learning objectives/course goals	At the end of the course, participants are expected to explain radiation processes based on physics such as electromagnetism and special relativity.					
(3) Course schedule, subject matter, and classroom activities	<ol style="list-style-type: none"> 1. Overview of high-energy astrophysics 2. Radiation from moving particles 3. Dipole emission 4. Special relativity 5. Synchrotron emission I 6. Synchrotron emission II 7. Inverse Compton scattering 8. Summary 					
(4) Outside-class activities and assignments	Participants are highly recommended to prepare each lecture by reading the textbook and review the things that they have learned in the lecture.					
(5) Textbooks and course materials	Textbook is provided in the lecture. Reference book: Radiative Processes in Astrophysics (George B. Rybicki, Saul A. Teukolsky; Wiley)					
(6) Assessment and grading	Your final grade will be calculated according to the following process: Usual performance score, Reports.					
(7) Questions to the instructor (Office hours, etc.)	Make an appointment in advance.					
(8) Special note	This course is complementary to "Advanced High Energy Astrophysics II", in which specific phenomena such as accretion disks and cosmic-ray acceleration are dealt with.					

Program	Course Name	Course Number	Semester	Day	Time	Credit Hours
Master's program	Advanced statistical mechanics	R0117	1st Semester II	Tue.	3	1
Doctoral program	Advanced statistical mechanics	R0118				
Instructor(s)			Note			
ARAHATA Emiko						
(1) Course policies and topics	Explains from the beginning of classical statistical mechanics to the basics of quantum statistical mechanics. Learn about perturbation expansion and linear response theory of interaction systems at finite temperatures.					
(2) Knowledge/skills to be acquired and learning objectives/course goals	This lecture will give you a deep knowledge of perturbation expansion of interaction systems and linear response theory at finite temperatures					
(3) Course schedule, subject matter, and classroom activities	1: Review of classical statistical mechanics 2: Canonical ensemble of quantum statistical mechanics 3: Green's function 4: Perturbation theory of interacting systems 5: Feynman diagram 6: Path integral 7: Dyson's equation 8: Application of linear response theory					
(4) Outside-class activities and assignments	Giving some assignments in every class					
(5) Textbooks and course materials	Posting materials on kibaco					
(6) Assessment and grading	Reports(100%)					
(7) Questions to the instructor (Office hours, etc.)	Questions will be accepted at any time. Make an appointment or directly send questions by email.					
(8) Special note	Statistical mechanics and quantum mechanics have been learned. It is desirable to take Advanced Quantum Many Body System					

Program	Course Name	Course Number	Semester	Day	Time	Credit Hours
Master's program	Advanced quantum many body system	R0115	1st Semester I	Wed.	3	1
Doctoral program	Advanced quantum many body system	R0116				
Instructor(s)			Note			
NOMOTO Takuya						
(1) Course policies and topics	Field theory is one of the most suitable theories for describing the quantum mechanics of many-body systems and plays a central role in modern condensed matter physics. In this lecture, as the foundation, we will study many-body perturbation theory using Green's functions at zero temperature.					
(2) Knowledge/skills to be acquired and learning objectives/course goals	Understanding second quantization and many-body perturbation theory. For example, one of the purposes is to understand mean-field approximations in terms of Feynman diagram techniques.					
(3) Course schedule, subject matter, and classroom activities	<ol style="list-style-type: none"> 1. Second quantization 2. Exact diagonalization 3. Free particles and mean-field approximations 4. Green's functions 5. Perturbation theory and Feynman diagram techniques 6. Dyson's equation 7. Mean-field theory in terms of Green function methods 8. Random-phase approximation 					
(4) Outside-class activities and assignments	The detail about the schedule will be announced by the middle of April. Students are expected to study at least one of the books in (5) or similar textbooks by yourself.					
(5) Textbooks and course materials	References: A. Fetter and J. Walecka "Quantum Theory of Many-Particle Systems" (Dover Books on Physics). J. Schrieffer "Theory of Superconductivity" (Advanced Books Classics). E. M. Lifshitz and L. P. Pitaevskii "Statistical Physics" (Butterworth-Heinemann)					
(6) Assessment and grading	A report (100%)					
(7) Questions to the instructor (Office hours, etc.)	No specific office hours are set, but if you wish to ask questions, please make an appointment in advance by e-mail.					
(8) Special note	Knowledge of quantum mechanics, statistical mechanics, and physical mathematics is a prerequisite.					

Program	Course Name	Course Number	Semester	Day	Time	Credit Hours
Master's program	Advanced physics of magnetism	R0123	2nd Semester I	Mon.	3	1
Doctoral program	Advanced physics of magnetism	R0124				
Instructor(s)			Note			
HOTTA Takashi						
(1) Course policies and topics	We learn from the basics about the magnetic properties of matter. After reviewing the basics of solid-state electron theory, we show that the Heisenberg model can be understood as an effective Hamiltonian in the Mott insulator of the Hubbard model, and we learn about spin-wave approximation. Next, we seek a magnetic phase diagram by molecular field approximation of itinerant magnetic materials, and we further discuss the importance of spin fluctuations. Finally, as an introduction to the latest topics, we explain the basics of topological materials.					
(2) Knowledge/skills to be acquired and learning objectives/course goals	It is possible to acquire basic theoretical methods and basic concepts such as molecular field approximation and correlation function. We also understand that they are indispensable for understanding actual magnetic materials.					
(3) Course schedule, subject matter, and classroom activities	Lecture 1. Magnetic ions Lecture 2. Free electron gas model, Magnetism in electron gas Lecture 3. Bloch's theorem, Band structure, Hubbard model Lecture 4. Theory of magnetic insulators I Lecture 5. Theory of magnetic insulators II Lecture 6. Theory of itinerant magnetic materials I Lecture 7. Theory of itinerant magnetic materials II Lecture 8. Basics of topological materials Classroom activities: Classes centered on lectures will be conducted.					
(4) Outside-class activities and assignments	It is necessary to prepare for the next class and understand the meaning of technical terms.					
(5) Textbooks and course materials	They will be introduced in the lecture as appropriate.					
(6) Assessment and grading	Grade evaluation is based on the report assignment.					
(7) Questions to the instructor (Office hours, etc.)	Office hours are not specified, but questions are welcome. Students should make an appointment by email in advance. Email: hotta@tmu.ac.jp					
(8) Special note	Knowledge of quantum mechanics and statistical mechanics is assumed.					

Program	Course Name	Course Number	Semester	Day	Time	Credit Hours
Master's program	Advanced high energy physics I	R0119	1st Semester II	Fri.	3	1
Doctoral program	Advanced high energy physics I	R0120				
Instructor(s)			Note			
KAKUNO Hidekazu						
(1) Course policies and topics	This course will focus on collider experiments at the high energy frontier. We will review how we establish the Standard Model using collider experiments, and will discuss current and future collider experiments that will explore new physics beyond the Standard Model. Accelerators and detectors that are used at collider experiments, will also be introduced in this course.					
(2) Knowledge/skills to be acquired and learning objectives/course goals	The aim of this lecture is to provide the knowledge of experimental approach to establish the Standard Model and to search for new physics beyond the Standard Model. Students will also learn principles and performance of particle detectors and accelerators that are used in energy frontier experiments.					
(3) Course schedule, subject matter, and classroom activities	<ol style="list-style-type: none"> 1. Validation of the Quark Model (experiments before TRISTAN) 2. The Search for New Generation Quarks (TRISTAN experiment) 3. Observation of the W and Z Bosons (SppS experiment) 4. The Study of the W and Z Bosons (LEP experiment, SLD experiment) 5. Observation of the Top Quark (TEVATRON experiment) 6. Observation of the Higgs Boson (LHC experiment) 7. The Study of the Higgs Boson and the Search for New Physics (LHC upgrade, ILC project) 8. Summary 					
(4) Outside-class activities and assignments	Reference journal articles will be shown in the lecture. Students are asked to summarize contents of articles as necessary.					
(5) Textbooks and course materials	Reference books and journal articles will be shown in the lecture.					
(6) Assessment and grading	Assessment will be based on the combination of the final report and in-class short reports.					
(7) Questions to the instructor (Office hours, etc.)	Office hours are not set. Please contact H.Kakuno by email.					
(8) Special note						

Program	Course Name	Course Number	Semester	Day	Time	Credit Hours
Master's program	Advanced atomic physics I	R0153	2nd Semester II	Mon.	4	1
Doctoral program	Advanced atomic physics I	R0154				
Instructor(s)			Note			
TANUMA Hajimeji						
(1) Course policies and topics	Although referred to as atomic collision experiments, they vary widely depending on the incident and target particles, collision energy, and observation methods. This lecture will present specific research examples from atomic collision experiments, focusing primarily on those conducted by the instructor.					
(2) Knowledge/skills to be acquired and learning objectives/course goals	Based on quantum mechanics, understand the collision dynamics of atoms and molecules—typical examples of few-body systems—and develop a perspective on nature that views natural phenomena as the result of various elementary processes.					
(3) Course schedule, subject matter, and classroom activities	<p>This lecture introduces examples of experimental research on atomic and molecular collision phenomena.</p> <p>Lecture 1: Fundamental concepts of atomic collision experiments Lecture 2: Post-collision interactions and quasi-molecular autoionization Lecture 3: Rotational rainbow effect in ion-molecule collisions Lecture 4: Quantum effects in ion mobility Lecture 5: Feshbach resonance and transient rotational excitation of molecular ions Lecture 6: Solar wind charge exchange reactions Lecture 7: Semiconductor photo lithography and unresolved transition arrays of highly charged ions Lecture 8: Reports and Explanations</p>					
(4) Outside-class activities and assignments	After each class, homework related to the content of the class will be given, which will be reviewed in the next class.					
(5) Textbooks and course materials	Slides to be used in class will be printed and distributed. Others will be given in class					
(6) Assessment and grading	Based on reports.					
(7) Questions to the instructor (Office hours, etc.)	E-mail questions at any time.					
(8) Special note						

Program	Course Name	Course Number	Semester	Day	Time	Credit Hours
Master's program	Advanced astrophysics I	R0127	1st Semester I	Wed.	3	1
Doctoral program	Advanced astrophysics I	R0128				
Instructor(s)			Note			
EZOE Yuichiro						
(1) Course policies and topics	We introduce radiation detector technology used for X-ray astronomy. The radiation detector technology has made significant progress in recent years, because of advances in semiconductor technology and microfabrication techniques. We highlight representative detectors as well as optical systems, and explain their structures and principles.					
(2) Knowledge/skills to be acquired and learning objectives/course goals	We understand basic principles and examples of representative radiation measurement technologies. The achievement goals are to acquire basic knowledge and skills on this field, leading to a fundamental understanding of the science and technology. At the same time, comprehensive problem-solving abilities and logical thinking skills will be fostered through reports.					
(3) Course schedule, subject matter, and classroom activities	<p>Course schedule is as follows.</p> <p>Lecture 1: Principles of radiation detection Lecture 2: Gas-based detectors Lecture 3: Solid-state and semiconductor detectors Lecture 4: Imaging detectors Lecture 5: Cryogenic detectors Lecture 6: Related technologies for radiation detection Lecture 7: X-ray optics Lecture 8: Summary and discussion</p>					
(4) Outside-class activities and assignments	Textbooks will be introduced. Understanding will be assessed through classes and reports.					
(5) Textbooks and course materials	Textbooks will be distributed in class.					
(6) Assessment and grading	Based on reports and attendance.					
(7) Questions to the instructor (Office hours, etc.)	E-mail questions at any time. If necessary, on-line meeting tools such as zoom will be utilized.					
(8) Special note						

Program	Course Name	Course Number	Semester	Day	Time	Credit Hours
Master's program	Selected Topics in Physics and Chemistry I (Advanced Soft Matter Physics II)	R0143	1st Semester II	Thu.	3	1
Doctoral program	Selected Topics in Physics and Chemistry I (Advanced Soft Matter Physics II)	R0144				
Instructor(s)			Note			
KURITA Rei			This course is offered for Physics and Chemistry majors			
(1) Course policies and topics	Soft matter is a subfield of condensed matter comprising a variety of physical systems that can be deformed. They include liquids, colloids, polymers, foams, gels, granular materials, liquid crystals, pillows, flesh, and a number of biological materials. This program aims to understand the basis of the soft matter.					
(2) Knowledge/skills to be acquired and learning objectives/course goals	The goals are to learn phase transitions, coarsenings, self similarities, and then the basis of the non-equilibrium dynamics.					
(3) Course schedule, subject matter, and classroom activities	<ol style="list-style-type: none"> 1. What is soft matters? 2. Thermal equilibrium and phase separations. 3. Colloidal dispersion and Brownian motions. 4. Ideal chain model for polymers. 5. Elastic modulus of polymers. 6. Phase transitions in liquid crystals. 7. Surfactants. 8. Reports and comments. 					
(4) Outside-class activities and assignments	As next content is announced, prepare for next lesson after the class					
(5) Textbooks and course materials	Not in particular.					
(6) Assessment and grading	Evaluate marks in a question-and-answer session and in reports					
(7) Questions to the instructor (Office hours, etc.)	Need to take an appointment by email (kurita@tmu.ac.jp)					
(8) Special note						

Program	Course Name	Course Number	Semester	Day	Time	Credit Hours
Master's program	Advanced English for science	R0139	2nd Semester I	Thu.	2	1
Doctoral program	Advanced English for science	R0140				
Instructor(s)			Note			
MORI Hiroyuki						
(1) Course policies and topics	Scientific English is a very important skill for writing scientific papers. In this class, we will focus on writing scientific English and aim to improve skills in this area. Rather than a passive class with lectures, students will practice writing scientific English by composing sentences in English for each assignment.					
(2) Knowledge/skills to be acquired and learning objectives/course goals	In addition to learning what to pay attention to when writing scientific English and what to keep in mind on a regular basis, students can write their own English sentences and receive corrections to understand the specific mistakes they are likely to make.					
(3) Course schedule, subject matter, and classroom activities	<p>[Course schedule, subject matter]</p> <ol style="list-style-type: none"> 1. General explanation of scientific English 2. Expressions used in papers in Physics (part 1): Explanation of graphs 3. Expressions used in papers in Physics (part 2): Expressions on increase/decrease 4. Expressions used in papers in Physics (part 3): Explanation of differences 5. Expressions used in papers in Physics (part 4): Explanation of equations 6. Expressions used in papers in Physics (part 5): Expressions on "larger than" or "smaller than" 7. Expressions used in papers in Physics (part 6): Expressions on research summary 1 8. Expressions used in papers in Physics (part 7): Expressions on research summary 2 <p>[Classroom activities]</p> <p>The class will be conducted in the form of exercises, and each student will be given an assignment to complete. In class, we will take up some of the submitted answers and correct them during the class time. Those that cannot be corrected during the class time will be corrected and returned by e-mail.</p>					
(4) Outside-class activities and assignments	Students should write responses in English to the assignments given in each class. It is acceptable to use a dictionary, etc., but it is necessary to develop your English carefully so that there are no grammatical or spelling errors.					
(5) Textbooks and course materials	<p>Convenient dictionary sites:</p> <p>Weblio (http://ejje.weblio.jp/)</p> <p>ALC (http://www.alc.co.jp/)</p>					
(6) Assessment and grading	Grades will be based on the submission of assignments.					
(7) Questions to the instructor (Office hours, etc.)	There are no office hours designated, but if you would like to ask a question in person, I am always available. Please make an appointment by sending an email to mori@phys.se.tmu.ac.jp .					
(8) Special note	<p>Since the class will be more like an exercise than a lecture, it is desirable to actively ask questions during the class.</p> <p>Note that this class will be provided in Japanese to non-English native students.</p>					

Program	Course Name	Course Number	Semester	Day	Time	Credit Hours
Master's program	Advanced Molecular Spectroscopy	R0163	2nd	Wed.	1	2
Doctoral program	Advanced Molecular Spectroscopy	R0164				
Instructor(s)			Note			
KANYA Reika			This course is offered for Physics and Chemistry majors			
(1) Course policies and topics	Determination of geometrical structures of isolated gas molecules is lectured from the basics to the advanced topics.					
(2) Knowledge/skills to be acquired and learning objectives/course goals	Basic theory of electron scattering processes by atoms and molecules as well as the principle of structural determination of molecules. Recent progress of experimental techniques for probing structural dynamics of molecules.					
(3) Course schedule, subject matter, and classroom activities	01. Interference of waves and basics of electron diffraction method 02. Electron scattering by atoms 03. Green function 04. Lippmann-Schwinger equation 05. Differential cross section 06. Partial wave analysis 07. Partial wave analysis by numerical calculations 08. Intermediate summary 09. Born approximation 10. Electron scattering by molecules and the independent atom model 11. Effect of molecular vibration 12. Molecular scattering curve and radial distribution function 13. Analyses of electron diffraction images 1 14. Analyses of electron diffraction images 2 15. Time-resolved electron diffraction method					
(4) Outside-class activities and assignments	Lecture slides are uploaded in advance for preparation of the lecture.					
(5) Textbooks and course materials	"Quantum Mechanics of Molecular Structures" Kaoru Yamanouchi (Springer, 2012)					
(6) Assessment and grading	Attendance (20%), Intermediate exam. (40%), Final exam. (40%)					
(7) Questions to the instructor (Office hours, etc.)	E-mail (kanya@tmu.ac.jp)					
(8) Special note	If you want to take classes in English, please contact the instructor by email (kanya@tmu.ac.jp) at least one week before the first lecture. The classes in English will be held at the first period on Friday in the second semester.					

Program	Course Name	Course Number	Semester	Day	Time	Credit Hours
Master's program	Advanced Physical Chemistry of Condensed Matter	R0165	1st	Mon.	2	2
Doctoral program	Advanced Physical Chemistry of Condensed Matter	R0166				
Instructor(s)		Note				
HIROSE Yasushi		This course is offered for Physics and Chemistry majors				
(1) Course policies and topics	Semiconductors are widely applied for information technology, communication technology, and materials for energy conversion. In this lecture, fundamental properties and their applications of semiconductors are overviewed.					
(2) Knowledge/skills to be acquired and learning objectives/course goals	To understand the followings: - Fundamental properties of semiconductors and how to control them in Chemistry - Working mechanism of basic semiconductor devices					
(3) Course schedule, subject matter, and classroom activities	Followings are contents of this course. Detailed schedule will be announced at the first day. - 01 Introduction, Band structure of semiconductor - 02 Intrinsic semiconductor - 03 Carrier doping - 04 Transport of electrons in a semiconductor - 05 Optical properties of a semiconductor - 06 Diffusion of carriers - 07 Short summary - 08-09 p-n junction - 10-11 Optoelectronics devices and heterojunction - 12 Bipolar transistor - 13 Metal-semiconductor junction and field effect transistor - 14 MOS transistor - 15 Summary					
(4) Outside-class activities and assignments	Students are assigned for some homework related to the lecture.					
(5) Textbooks and course materials	Course materials are distributed if necessary. Some textbooks are recommended in the lecture for further learning.					
(6) Assessment and grading	Grading by class participation and homework (or semester exam).					
(7) Questions to the instructor (Office hours, etc.)	Questions and concerns are accepted by e-mail.					
(8) Special note	Scientific calculator is used for exercise during the lecture.					

Program	Course Name	Course Number	Semester	Day	Time	Credit Hours
Master's program	Advanced Theoretical Chemistry	R0167	1st	Tue.	2	2
Doctoral program	Advanced Theoretical Chemistry	R0168				
Instructor(s)		Note				
NAKATANI Naoki		This course is offered for Physics and Chemistry majors				
(1) Course policies and topics	In this course, an advanced lecture series about "molecular electronic structure theory", one of the topics in "quantum chemistry", is provided. Particularly, it is focused on the practical methods to compute electronic structures (such that energy, geometry, and properties of molecules). It is able to predict the physical properties with the extremely high accuracy in recent quantum chemistry. On the other hand, it is also applied for large molecular systems such as proteins and nano-materials, with an appropriate approximation. In this lecture series, such these state-of-the-art methods and their applications are overviewed, too.					
(2) Knowledge/skills to be acquired and learning objectives/course goals	To learn advanced and practical knowledge about quantum chemistry and computational chemistry which can be applied for own research topics. To learn the recent research results in the lecture to cultivate own skills which help to understand computational results and discussions in academic articles and to apply them for research.					
(3) Course schedule, subject matter, and classroom activities	The lecture series consists of 15 sessions including some exercises. [01] Introduction, Review of quantum chemistry [02] Hartree-Fock energy [03] Hamiltonian matrix elements [04] Spin eigenfunctions [05] Configuration interaction (CI) [06] Lagrange multiplier [06] Exercise 1 [07] Rayleigh-Schrödinger perturbation theory (RSPT) [08] Møller-Plesset perturbation theory (MP) [09] Exercise 2 [10] Linux commands for beginner's [11] Z-matrix and cartesian coordinates [12] Exercise 3 [13] Density functional theory (DFT) [14] Practical guide for quantum chemistry [15] Exercise 4 NOTE: Course schedule can be changed due to number of registered students, major field of students, and instructor's circumstances.					
(4) Outside-class activities and assignments	Students are assigned for a report to summarize the lectures.					
(5) Textbooks and course materials	Course materials are distributed if necessary. Also, students should have copies of article and web page which are specified preliminary.					
(6) Assessment and grading	Grading by the report (80%) and mini-quiz in the lecture (20%).					
(7) Questions to the instructor (Office hours, etc.)	Office-hour is not arranged, but questions are welcome through e-mail (naokin@tmu.ac.jp). In the e-mail, please specify your name in the subject and use an e-mail address which can be replied through internet (an e-mail including special characters which only available for mobile phone is not acceptable).					
(8) Special note	In the exercise, please bring your laptop PC in which MS office is installed.					

Program	Course Name	Course Number	Semester	Day	Time	Credit Hours
Master's program	External experience in physics		Intensive course	TBA	TBA	1 or 2
Doctoral program	External experience in physics					
Instructor(s)			Note			
All instructors			The credit hours will be added if the course provides a different subject matter.			
(1) Course policies and topics	Engage in extracurricular activities such as work experience, research outside of the university, and volunteer work related to specialized topics in physics.					
(2) Knowledge/skills to be acquired and learning objectives/course goals	Through work experience, research outside of the university, volunteer work, and other extracurricular activities, students acquire knowledge and experience that cannot be gained through activities within the university.					
(3) Course schedule, subject matter, and classroom activities	Dependent on the content of the practical training.					
(4) Outside-class activities and assignments	Dependent on the content of the practical training.					
(5) Textbooks and course materials	Dependent on the content of the practical training.					
(6) Assessment and grading	Students who participate in experiential learning are required to submit a report on their learning experiences to their supervising instructor upon completion. The supervising instructor will then determine the eligibility for unit accreditation based on the alignment with the objectives of the experiential learning. The maximum limit for units in one semester is set at 2. Those wishing to obtain units must notify the supervising instructor at least 2 months before the scheduled start date of the experiential learning.					
(7) Questions to the instructor (Office hours, etc.)	Inquire with the supervising instructor or the Academic Affairs Committee.					
(8) Special note	<p>This class is taught by instructors or faculty members with practical experience.</p> <p>Units will be recognized for extracurricular activities such as work experience, research outside of the university, and volunteer work related to specialized topics in physics, provided they meet certain criteria. These criteria include:</p> <ol style="list-style-type: none"> (1) The activity must be conducted for a minimum of 30 hours. If it exceeds 30 hours but is less than 60 hours, it counts as 1 unit; if it is 60 hours or more, it counts as 2 units. (2) The activity should not impede the learning of other subjects. (3) Participants should not receive compensation. (4) A completion certificate must be obtained from the organizer upon completion of the experiential learning. (5) The content of the experiential learning must be deemed equivalent to the curriculum level of the university by the supervising instructor. <p>Furthermore, students are responsible for finding their own placement. As these activities are offered as newly established courses upon student request, they cannot be included in the initial course registration at the beginning of the semester.</p>					

Program	Course Name	Course Number	Semester	Day	Time	Credit Hours
Master's program	Internship		Intensive course	TBA	TBA	1 or 2
Doctoral program	Internship					
Instructor(s)			Note			
All instructors			The credit hours will be added if the course provides a different subject matter.			
(1) Course policies and topics	The aim is for students to acquire a wide range of practical skills by certifying units of study based on completion of at least 5 days (or 40 hours) of work experience related to specialized education in physics, meeting specific criteria.					
(2) Knowledge/skills to be acquired and learning objectives/course goals	Through extracurricular learning, students gain knowledge and experience that cannot be acquired through activities within the university.					
(3) Course schedule, subject matter, and classroom activities	<p>【Course Plan and Content】 Dependent on the location of the internship.</p> <p>【Teaching Method】 Undertake work experience at the internship site for a period of 5 days (or 40 hours) or more. Work experience should be conducted for more than half of the scheduled dates.</p>					
(4) Outside-class activities and assignments	Dependent on the location of the internship.					
(5) Textbooks and course materials	Dependent on the location of the internship.					
(6) Assessment and grading	Refer to the special notes for further details.					
(7) Questions to the instructor (Office hours, etc.)	Inquire with the Academic Affairs Committee.					
(8) Special note	<p>This class is taught by instructors or faculty members with practical experience.</p> <p>(Unit Requirement)</p> <p>The specified subject allows for overlapping enrollment. It can be added to the units required for graduation.</p> <p>(Enrollment Requirements)</p> <p>(1) The activity must be conducted for at least 5 days (or 40 hours). However, if it is between more than 5 days (or 40 hours) and less than 8 days (or 60 hours), it counts as 1 unit; if it is 8 days (or 60 hours) or more, it counts as 2 units.</p> <p>(2) It should ideally take place over several days during vacation periods. Students should not receive compensation (although allowances for food, transportation, and accommodation provided by the host are acceptable).</p> <p>(3) The content should be equivalent to the curriculum level of the department and related to specialized education in physics. The components covered in this practical experience should not serve as requirements for other units or qualifications.</p> <p>(4) If the university or research institution publicly invites (voluntary) participation, a copy of the announcement should be available. For companies, training schools, etc., the recruitment guidelines should be available, along with the name, affiliation, and contact information of the supervising authority at the host institution, along with a signed acceptance letter. Participation in "Student Education Research Accident and Injury Insurance" and "Internship, Care Experience Activity, Teaching Practice, etc., Liability Insurance" (or equivalent or greater accident and liability insurance).</p> <p>(5) Students should be able to obtain a completion certificate issued by the organizer (instructor) or agree to have the completion certificate on a separate sheet verified by the organizer (instructor) through signature and stamp.</p> <p>(6) Students wishing to have units accredited must submit a preliminary application to the Academic Affairs Committee before the implementation, including contact information for the internship host, contact information for the student during the internship, and documents detailing the content and objectives of the internship. Permission must be obtained in advance.</p> <p>(7) After completing the internship, students must summarize their experiences and impressions in a few pages and submit a report to the Academic Affairs Committee, along with the documents mentioned in (5). Unit accreditation will be determined by the Academic Affairs Committee based on the alignment with the above objectives, the evaluation by the organizer, and the assessment of the report.</p>					

Program	Course Name	Course Number	Semester	Day	Time	Credit Hours
Master's program	Advanced seminar in physics I, II, III, IV		1st/2nd Semester			2
Doctoral program						
Instructor(s)			Note			
All instructors						
(1) Course policies and topics	This is for students in the master course program. They will belong to individual research labs and conduct literature reviews and oral presentations at seminars and other events.					
(2) Knowledge/skills to be acquired and learning objectives/course goals	Through literature reading and oral presentations at seminars, students will acquire the basic knowledge necessary to advance their research in physics, develop logical thinking skills, and gain the ability to engage in discussions with other researchers.					
(3) Course schedule, subject matter, and classroom activities	Please consult the supervisor regarding the course schedule, content, and methodology. The topics covered in each session are as follows. The course will be conducted flexibly in consultation with the supervisor according to the progress of the research. 1 : Introduction to the research conducted in the laboratory and the presentation of future seminar plans. 2-7 : Reading and explanation of literature related to the research topic. 8-13 : Reading and explanation of related papers. 14: Organizing acquired specialized knowledge. 15: General discussion.					
(4) Outside-class activities and assignments	Please consult your supervisor.					
(5) Textbooks and course materials	The necessary reference materials for the seminar will be provided by the supervisor as appropriate.					
(6) Assessment and grading	Overall assessment will be based on factors such as literature review, oral presentations, and participation in seminars.					
(7) Questions to the instructor (Office hours, etc.)	Please consult your supervisor.					
(8) Special note	Students must take I-IV in order, and cannot take multiple courses simultaneously.					

Program	Course Name	Course Number	Semester	Day	Time	Credit Hours
Master's program	Advanced experiment in physics I, II, III, IV		1st/2nd Semester			2
Doctoral program						
Instructor(s)			Note			
All experimental physics instructors						
(1) Course policies and topics	This is for students in the master course program. They will belong to a laboratory and learn how to conduct experimental research in physics by setting and achieving research goals under the guidance of a faculty member in the laboratory.					
(2) Knowledge/skills to be acquired and learning objectives/course goals	Through the study of experimental techniques and knowledge of physics, students will acquire the ability to solve problems, write papers, and present research results.					
(3) Course schedule, subject matter, and classroom activities	The topics covered in each session are as follows. The course will be conducted flexibly in consultation with the supervisor according to the progress of the research. 1 : Introduction to the research conducted in the laboratory and the presentation of future seminar plans. 2-4 : Task setting and planning. 5-7 : Acquisition of experimental and calculation methods necessary for research. 8: Interim report and discussion on experimental and computational methods. 9-12: Implementation of task experiments. 13-14: Arrangement of obtained experimental data. 15: Summary report and discussion.					
(4) Outside-class activities and assignments	Please consult your supervisor about what you will study outside of class.					
(5) Textbooks and course materials	The necessary reference materials for the seminar will be provided by the supervisor as appropriate.					
(6) Assessment and grading	Overall assessment will be based on factors such as literature review, oral presentations, and participation in seminars.					
(7) Questions to the instructor (Office hours, etc.)	Please consult your supervisor.					
(8) Special note	Students must take I-IV in order, and cannot take multiple courses simultaneously.					

Program	Course Name	Course Number	Semester	Day	Time	Credit Hours
Master's program	Advanced practice in physics I, II, III, IV		1st/2nd Semester			2
Doctoral program						
Instructor(s)			Note			
All instructors of theoretical physics						
(1) Course policies and topics	This is for students in the master course program. They will belong to a laboratory and learn how to conduct theoretical research in physics by setting and achieving research goals under the guidance of a faculty member in the laboratory.					
(2) Knowledge/skills to be acquired and learning objectives/course goals	Through the study of theoretical physics, students will acquire the ability to solve problems, write papers, and present research results.					
(3) Course schedule, subject matter, and classroom activities	The topics covered in each session are as follows. The course will be conducted flexibly in consultation with the supervisor according to the progress of the research. 1 : Introduction to the research conducted in the laboratory and the presentation of future seminar plans. 2-4 : Task setting and planning. 5-7 : Acquisition of theoretical and calculation methods necessary for research. 8: Interim report and discussion on theoretical and computational methods. 9-12: Implementation of task practice. 13-14: Arrangement of obtained practice results. 15: Summary report and discussion.					
(4) Outside-class activities and assignments	Please consult your supervisor about what you will study outside of class.					
(5) Textbooks and course materials	The necessary reference materials for the seminar will be provided by the supervisor as appropriate.					
(6) Assessment and grading	Overall assessment will be based on factors such as literature review, oral presentations, and participation in seminars.					
(7) Questions to the instructor (Office hours, etc.)	Please consult your supervisor.					
(8) Special note	Students must take I-IV in order, and cannot take multiple courses simultaneously.					

Program	Course Name	Course Number	Semester	Day	Time	Credit Hours
Master's program			1st/2nd Semester			4
Doctoral program	Advanced experiment in physics V, VI, VII, VIII					
Instructor(s)			Note			
All experimental physics instructors						
(1) Course policies and topics	This is for students in the doctor course program. Belonging to each experimental laboratory, and learning how to proceed with research as an autonomous researcher by setting and carrying out original tasks under the guidance or advice of laboratory faculty members.					
(2) Knowledge/skills to be acquired and learning objectives/course goals	Acquire knowledge of advanced experimental techniques in physics. Acquire the ability to compile original papers, communicate research results and their significance, and acquire the ability to position them in relation to society.					
(3) Course schedule, subject matter, and classroom activities	The topics covered in each session are as follows. The course will be conducted flexibly in consultation with the supervisor according to the progress of the research. 1 : Introduction to the research conducted in the laboratory and the presentation of future seminar plans. 2-4 : Task setting and planning. 5-7 : Acquisition of experimental and calculation methods necessary for research. 8: Interim report and discussion on experimental and computational methods. 9-12: Implementation of task experiments. 13-14: Arrangement of obtained experimental data. 15: Summary report and discussion.					
(4) Outside-class activities and assignments	Please consult your supervisor about what you will study outside of class.					
(5) Textbooks and course materials	The necessary reference materials for the seminar will be provided by the supervisor as appropriate.					
(6) Assessment and grading	Overall assessment will be based on factors such as literature review, oral presentations, and participation in seminars.					
(7) Questions to the instructor (Office hours, etc.)	Please consult your supervisor.					
(8) Special note	Students must take V-VIII in order, and cannot take multiple courses simultaneously. IX can be taken after completing VIII.					

Program	Course Name	Course Number	Semester	Day	Time	Credit Hours
Master's program			1st/2nd Semester			2
Doctoral program	Advanced experiment in physics IX					
Instructor(s)			Note			
All experimental physics instructors						
(1) Course policies and topics	This is for students in the doctor course program. Belonging to each experimental laboratory, and learning how to proceed with research as an autonomous researcher by setting and carrying out original tasks under the guidance or advice of laboratory faculty members.					
(2) Knowledge/skills to be acquired and learning objectives/course goals	Acquire knowledge of advanced experimental techniques in physics. Acquire the ability to compile original papers, communicate research results and their significance, and acquire the ability to position them in relation to society.					
(3) Course schedule, subject matter, and classroom activities	The topics covered in each session are as follows. The course will be conducted flexibly in consultation with the supervisor according to the progress of the research. 1 : Introduction to the research conducted in the laboratory and the presentation of future seminar plans. 2-4 : Task setting and planning. 5-7 : Acquisition of experimental and calculation methods necessary for research. 8: Interim report and discussion on experimental and computational methods. 9-12: Implementation of task experiments. 13-14: Arrangement of obtained experimental data. 15: Summary report and discussion.					
(4) Outside-class activities and assignments	Please consult your supervisor about what you will study outside of class.					
(5) Textbooks and course materials	The necessary reference materials for the seminar will be provided by the supervisor as appropriate.					
(6) Assessment and grading	Overall assessment will be based on factors such as literature review, oral presentations, and participation in seminars.					
(7) Questions to the instructor (Office hours, etc.)	Please consult your supervisor.					
(8) Special note	Students must take V-VIII in order, and cannot take multiple courses simultaneously. IX can be taken after completing VIII.					

Program	Course Name	Course Number	Semester	Day	Time	Credit Hours
Master's program			1st/2nd Semester			4
Doctoral program	Advanced practice in physics V, VI, VII, VIII					
Instructor(s)			Note			
All instructors of theoretical physics						
(1) Course policies and topics	This is for students in the doctor course program. Belonging to each theoretical laboratory, and learning how to proceed with research as an autonomous researcher by setting and carrying out original tasks under the guidance or advice of laboratory faculty members.					
(2) Knowledge/skills to be acquired and learning objectives/course goals	Acquire knowledge of advanced theoretical techniques in physics. Acquire the ability to compile original papers, communicate research results and their significance, and acquire the ability to position them in relation to society.					
(3) Course schedule, subject matter, and classroom activities	The topics covered in each session are as follows. The course will be conducted flexibly in consultation with the supervisor according to the progress of the research. 1 : Introduction to the research conducted in the laboratory and the presentation of future seminar plans. 2-4 : Task setting and planning. 5-7 : Acquisition of theoretical and calculation methods necessary for research. 8: Interim report and discussion on theoretical and computational methods. 9-12: Implementation of task practice. 13-14: Arrangement of obtained practice results. 15: Summary report and discussion.					
(4) Outside-class activities and assignments	Please consult your supervisor about what you will study outside of class.					
(5) Textbooks and course materials	The necessary reference materials for the seminar will be provided by the supervisor as appropriate.					
(6) Assessment and grading	Overall assessment will be based on factors such as literature review, oral presentations, and participation in seminars.					
(7) Questions to the instructor (Office hours, etc.)	Please consult your supervisor.					
(8) Special note	Students must take V-VIII in order, and cannot take multiple courses simultaneously. IX can be taken after completing VIII.					

Program	Course Name	Course Number	Semester	Day	Time	Credit Hours
Master's program			1st/2nd Semester			2
Doctoral program	Advanced practice in physics IX					
Instructor(s)			Note			
All instructors of theoretical physics						
(1) Course policies and topics	This is for students in the doctor course program. Belonging to each theoretical laboratory, and learning how to proceed with research as an autonomous researcher by setting and carrying out original tasks under the guidance or advice of laboratory faculty members.					
(2) Knowledge/skills to be acquired and learning objectives/course goals	Acquire knowledge of advanced theoretical techniques in physics. Acquire the ability to compile original papers, communicate research results and their significance, and acquire the ability to position them in relation to society.					
(3) Course schedule, subject matter, and classroom activities	The topics covered in each session are as follows. The course will be conducted flexibly in consultation with the supervisor according to the progress of the research. 1 : Introduction to the research conducted in the laboratory and the presentation of future seminar plans. 2-4 : Task setting and planning. 5-7 : Acquisition of theoretical and calculation methods necessary for research. 8: Interim report and discussion on theoretical and computational methods. 9-12: Implementation of task practice. 13-14: Arrangement of obtained practice results. 15: Summary report and discussion.					
(4) Outside-class activities and assignments	Please consult your supervisor about what you will study outside of class.					
(5) Textbooks and course materials	The necessary reference materials for the seminar will be provided by the supervisor as appropriate.					
(6) Assessment and grading	Overall assessment will be based on factors such as literature review, oral presentations, and participation in seminars.					
(7) Questions to the instructor (Office hours, etc.)	Please consult your supervisor.					
(8) Special note	Students must take V-VIII in order, and cannot take multiple courses simultaneously. IX can be taken after completing VIII.					

2026 Graduate School Course Catalog
Graduate School of Science (Chemistry)

* M = master's courses, D = doctoral courses
* NA 2026 = Courses not offered in the academic year 2026

Course outline No.	M	D	NA 2026	Semester	Day	Time	Course Number	Course Name	Credit Hours	Instructor(s)	Note (enrollment requirements, subject matter, etc.)
1	○			1st Semester	Fri.	1	M(R0221)	Advanced Inorganic Chemistry	2	SUGIURA Ken-ichi KUBUKI Siro YAMAZOE Seizi	
2	○			2nd Semester	Tue.	2	M(R0222)	Advanced Geo-and Cosmochemistry	2	TAKEGAWA Nobuyuki MOTEGI Nobuhiro OURA Yasuji	
3	○			1st Semester	Wed.	2	M(R0223)	Advanced Organic Chemistry	2	NOMURA Kotohiro KUSUMOTO Shuhei DOI Ryohei	
4	○			2nd Semester	Wed.	2	M(R0224)	Advanced Biological Chemistry	2	HIROTA Kouji ITO Yutaka TAOKA Masato	
5	○	○		2nd Semester	Wed.	1	M(R0163) D(R0164)	Advanced Molecular Spectroscopy	2	KANYA Reika	This course is offered for Physics and Chemistry majors
6	○	○		1st Semester	Mon.	2	M(R0165) D(R0166)	Advanced Physical Chemistry of Condensed Matter	2	HIROSE Yasushi	This course is offered for Physics and Chemistry majors
7	○	○		1st Semester	Tue.	2	M(R0167) D(R0168)	Advanced Theoretical Chemistry	2	NAKATANI Naoki	This course is offered for Physics and Chemistry majors
8	○	○		1st Semester	Tue.	2	M(R0108) D(R0205)	Selected topics in Physics and chemistry II (Atomic Physics)	2	TANUMA Hajime	This course is offered for Physics and Chemistry majors and also in the undergraduate program
9	○	○		1st Semester	Mon.	2	M(R0109) D(R0206)	Selected topics in Physics and chemistry II (Solid state Physics I)	2	ARAHATA Emiko	This course is offered for Physics and Chemistry majors and also in the undergraduate program
10	○	○		1st Semester	Thu.	1	M(R0231) D(R0232)	Advanced Lecture in Chemistry II (Organic Reaction Mechanisms)	2	NOMURA Kotohiro	
11	○	○		1st Semester	Wed.	1	M(R0233) D(R0234)	Advanced Lecture in Chemistry II (Advanced Material Science)	2	OKA Daichi	
12	○	○		1st Semester	Tue.	1	M(R0300) D(R0302)	Advanced Lecture in Chemistry II (Functional materials chemistry)	2	ISHIDA Masatoshi KAWASOKO Hideyuki	
	○	○	△	2nd Semester	Fri.	2	M(R0299) D(R0301)	Advanced Lecture in Chemistry II (Advanced Materials Chemistry)	2	NOMURA Kotohiro	
	○		△	2nd Semester	Wed.	5	M(R0237)	Advanced English in Chemistry	2	*Julian Koe	
13	○	○		Intensive course			M(R0295) 1 unit M(R0297) 2 units D(R0296) 1 unit D(R0298) 2 units	External experience in Chemistry	1·2	Multiple instructors	
14	○	○		Intensive course			M(R0825) 1 unit M(R0827) 2 units D(R0826) 1 unit D(R0828) 2 units	Internship	1·2	Multiple instructors	
	○	○		Intensive course				Lecture of Advanced Chemistry I	1	*TBA	This course is also offered in the undergraduate program
	○	○		Intensive course				Selected topics in Physics and Chemistry I	1	*TBA	This course is offered for Physics and Chemistry majors and also in the undergraduate program
	○	○	△	1st Semester II	Fri.	2	M(R0147) D(R0148)	Selected topics in Physics and chemistry I (Advanced nanoscience, surface, and interface physics I)	1	TBA	This course is offered for Physics and Chemistry majors
	○	○	△	1st Semester II	Tue.	1	M(R0137) D(R0138)	Selected topics in physics and chemistry I (Advanced nanoscience, surface, and interface physics II)	1	YANAGI Kazuhiro	This course is offered for Physics and Chemistry majors
15	○	○		1st Semester II	Thu.	3	M(R0151) D(R0152)	Selected topics in physics and chemistry I (Advanced soft matter physics I)	1	KURITA Rei	This course is offered for Physics and Chemistry majors
	○	○	△	1st Semester II	Thu.	3	M(R0143) D(R0144)	Selected topics in physics and chemistry I (Advanced soft matter physics II)	1	KURITA Rei	This course is offered for Physics and Chemistry majors
16	○	○		2nd Semester I	Wed.	3	M(R0161) D(R0162)	Selected topics in Physics and chemistry I (Advanced experimental technique in physics C)	1	TANUMA Hajime	This course is offered for Physics and Chemistry majors
17	○	○		2nd Semester II	Mon.	3	M(R0159) D(R0160)	Selected topics in Physics and chemistry I (Advanced experimental technique in physics D)	1	TANUMA Hajime	This course is offered for Physics and Chemistry majors
For students enrolling in April											
18	○			1st Semester	Fri.	3·4	I : M(R0235)	Seminar on Advanced Chemistry I	2	HIROSE Yasushi OKA Daichi	
19	○			2nd Semester	Fri.	3·4	II : M(R0236)	Seminar on Advanced Chemistry II	2	HIROSE Yasushi OKA Daichi	
18	○			1st Semester	Mon.	1·2	I : M(R0239)	Seminar on Advanced Chemistry I	2	TAKEGAWA Nobuyuki MOTEGI Nobuhiro	

Course outline No.	M	D	NA 2026	Semester	Day	Time	Course Number	Course Name	Credit Hours	Instructor(s)	Note (enrollment requirements, subject matter, etc.)
19	○			2nd Semester	Mon.	1・2	II : M(R0240)	Seminar on Advanced Chemistry II	2	TAKEGAWA Nobuyuki MOTEGI Nobuhiro	
18	○			1st Semester	Mon.	1・2	I : M(R0241)	Seminar on Advanced Chemistry I	2	HIROTA Kouji TAOKA Masato	
19	○			2nd Semester	Mon.	1・2	II : M(R0242)	Seminar on Advanced Chemistry II	2	HIROTA Kouji TAOKA Masato	
18	○			1st Semester	Mon.	3・4	I : M(R0243)	Seminar on Advanced Chemistry I	2	KANYA Reika OKUMURA Takuma	
19	○			2nd Semester	Mon.	5・6	II : M(R0244)	Seminar on Advanced Chemistry II	2	KANYA Reika OKUMURA Takuma	
18	○			1st Semester	Tue.	4・5	I : M(R0245)	Seminar on Advanced Chemistry I	2	NAKATANI Naoki	
19	○			2nd Semester	Mon.	4・5	II : M(R0246)	Seminar on Advanced Chemistry II	2	NAKATANI Naoki	
18	○			1st Semester	Mon.	3・4	I : M(R0247)	Seminar on Advanced Chemistry I	2	KUSUMOTO Shuhei DOI Ryohei	
19	○			2nd Semester	Mon.	3・4	II : M(R0248)	Seminar on Advanced Chemistry II	2	KUSUMOTO Shuhei DOI Ryohei	
18	○			1st Semester	Fri.	3・4	I : M(R0249)	Seminar on Advanced Chemistry I	2	KUBUKI Siro	
19	○			2nd Semester	Fri.	1・2	II : M(R0250)	Seminar on Advanced Chemistry II	2	KUBUKI Siro	
18	○			1st Semester	Mon.	1・2	I : M(R0251)	Seminar on Advanced Chemistry I	2	SUGIURA Ken-ichi ISHIDA Masatoshi	
19	○			2nd Semester	Mon.	1・2	II : M(R0252)	Seminar on Advanced Chemistry II	2	SUGIURA Ken-ichi ISHIDA Masatoshi	
18	○			1st Semester	Mon.	5・6	I : M(R0253)	Seminar on Advanced Chemistry I	2	NOMURA Kotohiro	
19	○			2nd Semester	Mon.	5・6	II : M(R0254)	Seminar on Advanced Chemistry II	2	NOMURA Kotohiro	
18	○			1st Semester	Fri.	4・5	I : M(R0255)	Seminar on Advanced Chemistry I	2	YAMAZOE Seizi KAWASOKO Hideyuki OURA Yasuji	
19	○			2nd Semester	Fri.	4・5	II : M(R0256)	Seminar on Advanced Chemistry II	2	YAMAZOE Seizi KAWASOKO Hideyuki OURA Yasuji	
18	○			1st Semester	Fri.	3・4	I : M(R0257)	Seminar on Advanced Chemistry I	2	ITO Yutaka	
19	○			2nd Semester	Fri.	3・4	II : M(R0258)	Seminar on Advanced Chemistry II	2	ITO Yutaka	
20		○		1st Semester	Fri.	3・4	III : D(R0259)	Seminar on Advanced Chemistry III	2	HIROSE Yasushi OKA Daichi	
21		○		2nd Semester	Fri.	3・4	IV : D(R0260)	Seminar on Advanced Chemistry IV	2	HIROSE Yasushi OKA Daichi	
20		○		1st Semester	Mon.	1・2	III : D(R0263)	Seminar on Advanced Chemistry III	2	TAKEGAWA Nobuyuki MOTEGI Nobuhiro	
21		○		2nd Semester	Mon.	1・2	IV : D(R0264)	Seminar on Advanced Chemistry IV	2	TAKEGAWA Nobuyuki MOTEGI Nobuhiro	
20		○		1st Semester	Mon.	1・2	III : D(R0265)	Seminar on Advanced Chemistry III	2	HIROTA Kouji TAOKA Masato	
21		○		2nd Semester	Mon.	1・2	IV : D(R0266)	Seminar on Advanced Chemistry IV	2	HIROTA Kouji TAOKA Masato	
20		○		1st Semester	Mon.	3・4	III : D(R0267)	Seminar on Advanced Chemistry III	2	KANYA Reika OKUMURA Takuma	
21		○		2nd Semester	Mon.	5・6	IV : D(R0268)	Seminar on Advanced Chemistry IV	2	KANYA Reika OKUMURA Takuma	
20		○		1st Semester	Tue.	4・5	III : D(R0269)	Seminar on Advanced Chemistry III	2	NAKATANI Naoki	
21		○		2nd Semester	Mon.	4・5	IV : D(R0270)	Seminar on Advanced Chemistry IV	2	NAKATANI Naoki	
20		○		1st Semester	Mon.	3・4	III : D(R0271)	Seminar on Advanced Chemistry III	2	KUSUMOTO Shuhei DOI Ryohei	
21		○		2nd Semester	Mon.	3・4	IV : D(R0272)	Seminar on Advanced Chemistry IV	2	KUSUMOTO Shuhei DOI Ryohei	
20		○		1st Semester	Fri.	3・4	III : D(R0273)	Seminar on Advanced Chemistry III	2	KUBUKI Siro	
21		○		2nd Semester	Fri.	1・2	IV : D(R0274)	Seminar on Advanced Chemistry IV	2	KUBUKI Siro	
20		○		1st Semester	Mon.	1・2	III : D(R0275)	Seminar on Advanced Chemistry III	2	SUGIURA Ken-ichi ISHIDA Masatoshi	
21		○		2nd Semester	Mon.	1・2	IV : D(R0276)	Seminar on Advanced Chemistry IV	2	SUGIURA Ken-ichi ISHIDA Masatoshi	
20		○		1st Semester	Mon.	5・6	III : D(R0277)	Seminar on Advanced Chemistry III	2	NOMURA Kotohiro	
21		○		2nd Semester	Mon.	5・6	IV : D(R0278)	Seminar on Advanced Chemistry IV	2	NOMURA Kotohiro	
20		○		1st Semester	Fri.	4・5	III : D(R0279)	Seminar on Advanced Chemistry III	2	YAMAZOE Seizi KAWASOKO Hideyuki OURA Yasuji	

Course outline No.	M	D	NA 2026	Semester	Day	Time	Course Number	Course Name	Credit Hours	Instructor(s)	Note (enrollment requirements, subject matter, etc.)
21		○		2nd Semester	Fri.	4・5	IV : D(R0280)	Seminar on Advanced Chemistry IV	2	YAMAZOE Seizi KAWASOKO Hideyuki OURA Yasuji	
20		○		1st Semester	Fri.	3・4	III : D(R0281)	Seminar on Advanced Chemistry III	2	ITO Yutaka	
21		○		2nd Semester	Fri.	3・4	IV : D(R0282)	Seminar on Advanced Chemistry IV	2	ITO Yutaka	
22	○			1st Semester			I A : M(R0284)	Advanced Research of Chemistry IA	2	Multiple instructors	
23	○			2nd Semester			I B : M(R0285)	Advanced Research of Chemistry IB	2	Multiple instructors	
24	○			1st Semester			II A : M(R0287)	Advanced Research of Chemistry IIA	2	Multiple instructors	
25	○			2nd Semester			II B : M(R0288)	Advanced Research of Chemistry IIB	2	Multiple instructors	
26		○		1st Semester			III A : D(R0290)	Advanced Research of Chemistry IIIA	2	Multiple instructors	
27		○		2nd Semester			III B : D(R0291)	Advanced Research of Chemistry IIIB	2	Multiple instructors	
28		○		1st Semester			IV A : D(R0293)	Advanced Research of Chemistry IVA	2	Multiple instructors	
29		○		2nd Semester			IV B : D(R0294)	Advanced Research of Chemistry IVB	2	Multiple instructors	
For students enrolling in October											
18	○			2nd Semester	Fri.	3・4	I : M(R0951)	Seminar on Advanced Chemistry I	2	HIROSE Yasushi OKA Daichi	
19	○			1st Semester	Fri.	3・4	II : M(R0950)	Seminar on Advanced Chemistry II	2	HIROSE Yasushi OKA Daichi	
18	○			2nd Semester	Mon.	1・2	I : M(R0955)	Seminar on Advanced Chemistry I	2	TAKEGAWA Nobuyuki MOTEGI Nobuhiro	
19	○			1st Semester	Mon.	1・2	II : M(R0954)	Seminar on Advanced Chemistry II	2	TAKEGAWA Nobuyuki MOTEGI Nobuhiro	
18	○			2nd Semester	Mon.	1・2	I : M(R0957)	Seminar on Advanced Chemistry I	2	HIROTA Kouji TAOKA Masato	
19	○			1st Semester	Mon.	1・2	II : M(R0956)	Seminar on Advanced Chemistry II	2	HIROTA Kouji TAOKA Masato	
18	○			2nd Semester	Mon.	5・6	I : M(R0959)	Seminar on Advanced Chemistry I	2	KANYA Reika OKUMURA Takuma	
19	○			1st Semester	Mon.	3・4	II : M(R0958)	Seminar on Advanced Chemistry II	2	KANYA Reika OKUMURA Takuma	
18	○			2nd Semester	Mon.	4・5	I : M(R0961)	Seminar on Advanced Chemistry I	2	NAKATANI Naoki	
19	○			1st Semester	Tue.	4・5	II : M(R0960)	Seminar on Advanced Chemistry II	2	NAKATANI Naoki	
18	○			2nd Semester	Mon.	3・4	I : M(R0963)	Seminar on Advanced Chemistry I	2	KUSUMOTO Shuhei DOI Ryohei	
19	○			1st Semester	Mon.	3・4	II : M(R0962)	Seminar on Advanced Chemistry II	2	KUSUMOTO Shuhei DOI Ryohei	
18	○			2nd Semester	Fri.	1・2	I : M(R0965)	Seminar on Advanced Chemistry I	2	KUBUKI Siro	
19	○			1st Semester	Fri.	3・4	II : M(R0964)	Seminar on Advanced Chemistry II	2	KUBUKI Siro	
18	○			2nd Semester	Mon.	1・2	I : M(R0967)	Seminar on Advanced Chemistry I	2	SUGIURA Ken-ichi ISHIDA Masatoshi	
19	○			1st Semester	Mon.	1・2	II : M(R0966)	Seminar on Advanced Chemistry II	2	SUGIURA Ken-ichi ISHIDA Masatoshi	
18	○			2nd Semester	Mon.	5・6	I : M(R0969)	Seminar on Advanced Chemistry I	2	NOMURA Kotohiro	
19	○			1st Semester	Mon.	5・6	II : M(R0968)	Seminar on Advanced Chemistry II	2	NOMURA Kotohiro	
18	○			2nd Semester	Fri.	4・5	I : M(R0971)	Seminar on Advanced Chemistry I	2	YAMAZOE Seizi KAWASOKO Hideyuki OURA Yasuji	
19	○			1st Semester	Fri.	4・5	II : M(R0970)	Seminar on Advanced Chemistry II	2	YAMAZOE Seizi KAWASOKO Hideyuki OURA Yasuji	
18	○			2nd Semester	Fri.	3・4	I : M(R0973)	Seminar on Advanced Chemistry I	2	ITO Yutaka	
19	○			1st Semester	Fri.	3・4	II : M(R0972)	Seminar on Advanced Chemistry II	2	ITO Yutaka	
20		○		2nd Semester	Fri.	3・4	III : D(R0975)	Seminar on Advanced Chemistry III	2	HIROSE Yasushi OKA Daichi	
21		○		1st Semester	Fri.	3・4	IV : D(R0974)	Seminar on Advanced Chemistry IV	2	HIROSE Yasushi OKA Daichi	
20		○		2nd Semester	Mon.	1・2	III : D(R0979)	Seminar on Advanced Chemistry III	2	TAKEGAWA Nobuyuki MOTEGI Nobuhiro	
21		○		1st Semester	Mon.	1・2	IV : D(R0978)	Seminar on Advanced Chemistry IV	2	TAKEGAWA Nobuyuki MOTEGI Nobuhiro	
20		○		2nd Semester	Mon.	1・2	III : D(R0981)	Seminar on Advanced Chemistry III	2	HIROTA Kouji TAOKA Masato	

Course outline No.	M	D	NA 2026	Semester	Day	Time	Course Number	Course Name	Credit Hours	Instructor(s)	Note (enrollment requirements, subject matter, etc.)
21		○		1st Semester	Mon.	1•2	IV : D(R0980)	Seminar on Advanced Chemistry IV	2	HIROTA Kouji TAOKA Masato	
20		○		2nd Semester	Mon.	5•6	III : D(R0983)	Seminar on Advanced Chemistry III	2	KANYA Reika OKUMURA Takuma	
21		○		1st Semester	Mon.	3•4	IV : D(R0982)	Seminar on Advanced Chemistry IV	2	KANYA Reika OKUMURA Takuma	
20		○		2nd Semester	Mon.	4•5	III : D(R0985)	Seminar on Advanced Chemistry III	2	NAKATANI Naoki	
21		○		1st Semester	Tue.	4•5	IV : D(R0984)	Seminar on Advanced Chemistry IV	2	NAKATANI Naoki	
20		○		2nd Semester	Mon.	3•4	III : D(R0987)	Seminar on Advanced Chemistry III	2	KUSUMOTO Shuhei DOI Ryohei	
21		○		1st Semester	Mon.	3•4	IV : D(R0986)	Seminar on Advanced Chemistry IV	2	KUSUMOTO Shuhei DOI Ryohei	
20		○		2nd Semester	Fri.	1•2	III : D(R0989)	Seminar on Advanced Chemistry III	2	KUBUKI Siro	
21		○		1st Semester	Fri.	3•4	IV : D(R0988)	Seminar on Advanced Chemistry IV	2	KUBUKI Siro	
20		○		2nd Semester	Mon.	1•2	III : D(R0991)	Seminar on Advanced Chemistry III	2	SUGIURA Ken-ichi ISHIDA Masatoshi	
21		○		1st Semester	Mon.	1•2	IV : D(R0990)	Seminar on Advanced Chemistry IV	2	SUGIURA Ken-ichi ISHIDA Masatoshi	
20		○		2nd Semester	Mon.	5•6	III : D(R0993)	Seminar on Advanced Chemistry III	2	NOMURA Kotohiro	
21		○		1st Semester	Mon.	5•6	IV : D(R0992)	Seminar on Advanced Chemistry IV	2	NOMURA Kotohiro	
20		○		2nd Semester	Fri.	4•5	III : D(R0995)	Seminar on Advanced Chemistry III	2	YAMAZOE Seizi KAWASOKO Hideyuki OURA Yasuji	
21		○		1st Semester	Fri.	4•5	IV : D(R0994)	Seminar on Advanced Chemistry IV	2	YAMAZOE Seizi KAWASOKO Hideyuki OURA Yasuji	
20		○		2nd Semester	Fri.	3•4	III : D(R0997)	Seminar on Advanced Chemistry III	2	ITO Yutaka	
21		○		1st Semester	Fri.	3•4	IV : D(R0996)	Seminar on Advanced Chemistry IV	2	ITO Yutaka	
22	○			2nd Semester			I A : M(R0941)	Advanced Research of Chemistry IA	2	Multiple instructors	
23	○			1st Semester			I B : M(R0940)	Advanced Research of Chemistry IB	2	Multiple instructors	
24	○			2nd Semester			II A : M(R0943)	Advanced Research of Chemistry IIA	2	Multiple instructors	
25	○			1st Semester			II B : M(R0942)	Advanced Research of Chemistry IIB	2	Multiple instructors	
26		○		2nd Semester			III A : D(R0945)	Advanced Research of Chemistry IIIA	2	Multiple instructors	
27		○		1st Semester			III B : D(R0944)	Advanced Research of Chemistry IIIB	2	Multiple instructors	
28		○		2nd Semester			IV A : D(R0947)	Advanced Research of Chemistry IVA	2	Multiple instructors	
29		○		1st Semester			IV B : D(R0946)	Advanced Research of Chemistry IVB	2	Multiple instructors	

Program	Course Name	Course Number	Semester	Day	Time	Credit Hours
Master's program	Advanced Inorganic Chemistry	R0221	1st	Fri.	1	2
Doctoral program	-	-				
Instructor(s)			Note			
SUGIURA Ken-ichi, KUBUKI Shiro, YAMAZOE Seiji						
(1) Course policies and topics	In this academic year, Kubuki provides the first seven lectures, and Yamazoe provides the latter seven lectures.					
(2) Knowledge/skills to be acquired and learning objectives/course goals	<p><Lectures by Kubuki> 1) To explain the relationship between structures and physical properties of inorganic solid materials such as metal, ionic solids, and glass-ceramics. 2) To explain electrical, magnetic, and optical properties of inorganic solid materials.</p> <p><Lectures by Yamazoe> To learn fundamental knowledge of X-ray absorption spectroscopy (X-ray absorption fine structure: XAFS) and its applications. To learn how to understand mechanistic aspects of functional materials based on the local geometry and its electronic structure obtained from XAFS, as providing some practical examples.</p>					
(3) Course schedule, subject matter, and classroom activities	<p><1st half (Kubuki)> 1. Crystal structure (1): Notification of crystal structures (ccp, hcp, and bcc) 2. Crystal structure (2): Lattice, unit cell, and lattice energy 3. Electrical property: Band model, conductivity of metal and semiconductor 4. Optical property: Interaction between light and electron, absorption and emission of light 5. Magnetic property: Magnetic susceptibility, ferromagnetism, anti-ferromagnetism, and ferrimagnetism 6. Superconductivity: Discovery and theory of superconductivity 7. Summary</p> <p><2nd half (Yamazoe)> 8. Historical backgrounds of XAS, and synchrotron radiation facility 9. Fundamentals of XAS: XANES 10. Fundamentals of XAS: EXAFS 11. XAFS measurement 12. XAFS analysis 13. XAFS application I 14. XAFS application II</p>					
(4) Outside-class activities and assignments	<p>15. Either Kubuki or Yamazoe provides a more advanced lecture. <Kubuki> Assigned reports are given to attending students at each end of the lecture. They should be submitted by the beginning of the next lecture.</p> <p><Yamazoe> Review every lecture and prepare for the next lecture in advance.</p>					
(5) Textbooks and course materials	<p><Kubuki> L. Smart and E. Moore "Solid State Chemistry -an introduction" (Chapman and Hall)</p> <p><Yamazoe> None.</p>					
(6) Assessment and grading	<p>Total score is of the average of each instructor's evaluation. If one of the rating is less than 60%, the credit may not be provided. <Kubuki> Rating by the assigned reports (100%) <Yamazoe> Rating by the assigned reports (100%)</p>					
(7) Questions to the instructor (Office hours, etc.)	Each instructor will answer students' questions personally after adjusting the available time by e-mail. Therefore, the answer will not be given by sending an e-mail.					
(8) Special note						

Program	Course Name	Course Number	Semester	Day	Time	Credit Hours
Master's program	Advanced Geo- and Cosmochemistry	R0222	2nd	Tue.	2	2
Doctoral program	-	-				
Instructor(s)			Note			
TAKEGAWA Nobuyuki, MOTEKI Nobuhiro, OURA Yasuji						
(1) Course policies and topics	This lecture covers physical and chemical processes that govern the formation and circulation of matters in the universe and on the Earth. The first half of the lecture focuses on the Earth's atmosphere and hydrosphere. The second half of the lecture focuses on the formation of matters in the universe and the solar system.					
(2) Knowledge/skills to be acquired and learning objectives/course goals	The goal is to understand important chemical processes in the solar system and on the Earth, based on basic knowledge of inorganic chemistry, analytical chemistry, radiochemistry, and physical chemistry.					
(3) Course schedule, subject matter, and classroom activities	<ol style="list-style-type: none"> 1. Atmospheric photochemistry 2. Aerosol Thermodynamics 3. Geochemical cycles in the atmosphere and the oceans 4. Overview of atmospheric radiation 5. Longwave radiation and its observation 6. Shortwave radiation and scattering theory -1 7. Shortwave radiation and scattering theory -2 8. Atmospheric thermodynamics and temperature profiles 9. Radiative convective energy transfer and climate change 10. Radiochemistry-1 (Nuclear stability, radioactive decay) 11. Radiochemistry-2 (Nuclear reactions) 12. Natural and environmental radionuclides 13. Natural nuclear reactions 14. Cosmochemical and geochemical applications of natural radionuclides -1 15. Cosmochemical and geochemical applications of natural radionuclides- 2 <p>The above schedule may be changed depending on the progress of the course.</p>					
(4) Outside-class activities and assignments	Work presented in the class is assigned.					
(5) Textbooks and course materials	Handouts are distributed in the class. Reference books are indicated in the class as needed.					
(6) Assessment and grading	Regular score in the class (20%), Final report (80%)					
(7) Questions to the instructor (Office hours, etc.)	No office hours are arranged. If you have any questions, please make an appointment in advance by e-mail. Contact via Kibaco is also acceptable.					
(8) Special note						

Program	Course Name	Course Number	Semester	Day	Time	Credit Hours
Master's program	Advanced Organic Chemistry	R0223	1st	Wed.	2	2
Doctoral program						
Instructor(s)			Note			
NOMURA Kotohiro, KUSUMOTO Shuhei, DOI Ryohei						
(1) Course policies and topics	The lecture concerns "Basics for modern organic synthesis and application to bottom up chemistry" for graduate study including introduction of recent topics by each instructor.					
(2) Knowledge/skills to be acquired and learning objectives/course goals	Through this lecture series, the students will acquire knowledges concerning historical flow and basics in modern organic chemistry and materials chemistry. For example, supramolecular chemistry through bottom up chemistry, effect of periodic law toward property in materials, basics in precision synthesis and the methodology including integration of functionality, catalysis mechanism including basic reactions.					
(3) Course schedule, subject matter, and classroom activities	The course consists of 15 lectures including the following topics by each instructor. Introduction of basic and bottom up chemistry for functional molecules through supramolecular interactions. Basics for precision synthesis and/or methodologies directed toward advanced organic and polymeric materials including integration of functionality. Heavier main group elements from the viewpoint of fundamental chemistry and material sciences Basic catalysis mechanism for green sustainable synthesis.					
(4) Outside-class activities and assignments	The students should read and understand textbook, handout before/after the lecture.					
(5) Textbooks and course materials	Will be introduced.					
(6) Assessment and grading	Lecture attendance, report or examination					
(7) Questions to the instructor (Office hours, etc.)	No specified office hours but contact by e-mail to each instructor. Nomura: ktnomura@tmu.ac.jp Abdellatif: Mohamed-soliman@tmu.ac.jp					
(8) Special note						

Program	Course Name	Course Number	Semester	Day	Time	Credit Hours
Master's program	Advanced Biological Chemistry	R0224	2nd	Wed.	2	2
Doctoral program						
Instructor(s)			Note			
HIROTA Kouji, ITO Yutaka, TAOKA Masato						
(1) Course policies and topics	The life sciences have made remarkable progress, and new interdisciplinary fields that differ from the conventional framework of academic disciplines are emerging. In such advanced fields, it is necessary to objectively perceive and reconstruct chemical concepts and methods having been built up over the years. This lecture will explain recent biochemistry, molecular biology, and structural biology trends in the background of living organisms' genomic information.					
(2) Knowledge/skills to be acquired and learning objectives/course goals	The goal is to deepen students' understanding of the relationship between new "chemistry" and "life" based on the network of biological macromolecules.					
(3) Course schedule, subject matter, and classroom activities	<p>Recent trends in biochemistry, molecular biology, and structural biology in the context of genomic information of organisms will be explained.</p> <ol style="list-style-type: none"> 1. Aerobic respiration, fermentation pathway 2. Energy metabolism and diabetes mellitus 3. Physicochemical properties and biological effects of radiation 4. Understanding DNA repair pathways and cancer therapy 5. Introduction to omics research 6. Genomics 7. Proteomics 8. Ribonucleomics 9. Fundamentals of heterogeneous nuclear multidimensional NMR for structural biology analysis 10. Rapid multidimensional NMR measurement methods 11. Protein conformational analysis using solution NMR 12. Dynamic analysis of intracellular proteins using solution NMR 13. Understanding replication, transcription, and translation by molecular structure 14. Intracellular signal transduction understood by molecular structure 15. Receptor activation mechanism understood by molecular structure 					
(4) Outside-class activities and assignments	Students are required to write reports on the assignments given at the end of the class.					
(5) Textbooks and course materials	The textbooks will be introduced during the lecture. Handouts will be distributed as necessary.					
(6) Assessment and grading	A comprehensive evaluation will be made based on reports and quizzes.					
(7) Questions to the instructor (Office hours, etc.)	No specific office hours will be set, but if you want to ask questions directly, please make an appointment in advance by e-mail.					
(8) Special note						

Program	Course Name	Course Number	Semester	Day	Time	Credit Hours
Master's program	Advanced Molecular Spectroscopy	R0163	2nd	Wed.	1	2
Doctoral program	Advanced Molecular Spectroscopy	R0164				
Instructor(s)			Note			
KANYA Reika			This course is offered for Physics and Chemistry majors			
(1) Course policies and topics	Determination of geometrical structures of isolated gas molecules is lectured from the basics to the advanced topics.					
(2) Knowledge/skills to be acquired and learning objectives/course goals	Basic theory of electron scattering processes by atoms and molecules as well as the principle of structural determination of molecules. Recent progress of experimental techniques for probing structural dynamics of molecules.					
(3) Course schedule, subject matter, and classroom activities	01. Interference of waves and basics of electron diffraction method 02. Electron scattering by atoms 03. Green function 04. Lippmann-Schwinger equation 05. Differential cross section 06. Partial wave analysis 07. Partial wave analysis by numerical calculations 08. Intermediate summary 09. Born approximation 10. Electron scattering by molecules and the independent atom model 11. Effect of molecular vibration 12. Molecular scattering curve and radial distribution function 13. Analyses of electron diffraction images 1 14. Analyses of electron diffraction images 2 15. Time-resolved electron diffraction method					
(4) Outside-class activities and assignments	Lecture slides are uploaded in advance for preparation of the lecture.					
(5) Textbooks and course materials	"Quantum Mechanics of Molecular Structures" Kaoru Yamanouchi (Springer, 2012)					
(6) Assessment and grading	Attendance (20%), Intermediate exam. (40%), Final exam. (40%)					
(7) Questions to the instructor (Office hours, etc.)	E-mail (kanya@tmu.ac.jp)					
(8) Special note	If you want to take classes in English, please contact the instructor by email (kanya@tmu.ac.jp) at least one week before the first lecture. The classes in English will be held at the first period on Friday in the second semester.					

Program	Course Name	Course Number	Semester	Day	Time	Credit Hours
Master's program	Advanced Physical Chemistry of Condensed Matter	R0165	1st	Mon.	2	2
Doctoral program	Advanced Physical Chemistry of Condensed Matter	R0166				
Instructor(s)			Note			
HIROSE Yasushi			This course is offered for Physics and Chemistry majors			
(1) Course policies and topics	Semiconductors are widely applied for information technology, communication technology, and materials for energy conversion. In this lecture, fundamental properties and their applications of semiconductors are overviewed.					
(2) Knowledge/skills to be acquired and learning objectives/course goals	To understand the followings: - Fundamental properties of semiconductors and how to control them in Chemistry - Working mechanism of basic semiconductor devices					
(3) Course schedule, subject matter, and classroom activities	Followings are contents of this course. Detailed schedule will be announced at the first day. - 01 Introduction, Band structure of semiconductor - 02 Intrinsic semiconductor - 03 Carrier doping - 04 Transport of electrons in a semiconductor - 05 Optical properties of a semiconductor - 06 Diffusion of carriers - 07 Short summary - 08-09 p-n junction - 10-11 Optoelectronics devices and heterojunction - 12 Bipolar transistor - 13 Metal-semiconductor junction and field effect transistor - 14 MOS transistor - 15 Summary					
(4) Outside-class activities and assignments	Students are assigned for some homework related to the lecture.					
(5) Textbooks and course materials	Course materials are distributed if necessary. Some textbooks are recommended in the lecture for further learning.					
(6) Assessment and grading	Grading by class participation and homework (or semester exam).					
(7) Questions to the instructor (Office hours, etc.)	Questions and concerns are accepted by e-mail.					
(8) Special note	Scientific calculator is used for exercise during the lecture.					

Program	Course Name	Course Number	Semester	Day	Time	Credit Hours
Master's program	Advanced Theoretical Chemistry	R0167	1st	Tue.	2	2
Doctoral program	Advanced Theoretical Chemistry	R0168				
Instructor(s)		Note				
NAKATANI Naoki		This course is offered for Physics and Chemistry majors				
(1) Course policies and topics	In this course, an advanced lecture series about "molecular electronic structure theory", one of the topics in "quantum chemistry", is provided. Particularly, it is focused on the practical methods to compute electronic structures (such that energy, geometry, and properties of molecules). It is able to predict the physical properties with the extremely high accuracy in recent quantum chemistry. On the other hand, it is also applied for large molecular systems such as proteins and nano-materials, with an appropriate approximation. In this lecture series, such these state-of-the-art methods and their applications are overviewed, too.					
(2) Knowledge/skills to be acquired and learning objectives/course goals	To learn advanced and practical knowledge about quantum chemistry and computational chemistry which can be applied for own research topics. To learn the recent research results in the lecture to cultivate own skills which help to understand computational results and discussions in academic articles and to apply them for research.					
(3) Course schedule, subject matter, and classroom activities	The lecture series consists of 15 sessions including some exercises. [01] Introduction, Review of quantum chemistry [02] Hartree-Fock energy [03] Hamiltonian matrix elements [04] Spin eigenfunctions [05] Configuration interaction (CI) [06] Lagrange multiplier [06] Exercise 1 [07] Rayleigh-Schrödinger perturbation theory (RSPT) [08] Møller-Plesset perturbation theory (MP) [09] Exercise 2 [10] Linux commands for beginner's [11] Z-matrix and cartesian coordinates [12] Exercise 3 [13] Density functional theory (DFT) [14] Practical guide for quantum chemistry [15] Exercise 4 NOTE: Course schedule can be changed due to number of registered students, major field of students, and instructor's circumstances.					
(4) Outside-class activities and assignments	Students are assigned for a report to summarize the lectures.					
(5) Textbooks and course materials	Course materials are distributed if necessary. Also, students should have copies of article and web page which are specified preliminary.					
(6) Assessment and grading	Grading by the report (80%) and mini-quiz in the lecture (20%).					
(7) Questions to the instructor (Office hours, etc.)	Office-hour is not arranged, but questions are welcome through e-mail (naokin@tmu.ac.jp). In the e-mail, please specify your name in the subject and use an e-mail address which can be replied through internet (an e-mail including special characters which only available for mobile phone is not acceptable).					
(8) Special note	In the exercise, please bring your laptop PC in which MS office is installed.					

Program	Course Name	Course Number	Semester	Day	Time	Credit Hours
Master's program	Selected topics in Physics and chemistry II (Atomic Physics)	R0108	1st Semester	Tue.	2	2
Doctoral program						
Instructor(s)			Note			
TANUMA Hajime			This course is offered for Physics and Chemistry majors and also in the undergraduate program			
(1) Course policies and topics	Fundamental theory on atoms and molecules, which are quantal few-body systems, will be explained based on elementary quantum mechanics.					
(2) Knowledge/skills to be acquired and learning objectives/course goals	The most practical and fundamental application of quantum mechanics to one- and many-electron atoms and small molecules.					
(3) Course schedule, subject matter, and classroom activities	<ol style="list-style-type: none"> 1. What is the atomic physics? 2. Hydrogenic atoms: non-relativistic theory 3. Hydrogenic atoms: relativistic theory 4. Hydrogenic atoms in electromagnetic fields 5. Semi-classical theory for optical transitions of atoms 6. Many-electron atoms 7. Spin-orbital interaction in atoms 8. Electron correlation and configuration interaction 9. Dynamics of excited atoms I 10. Dynamics of excited atoms II 11. Diatomic molecules I: Born-Oppenheimer approximation 12. Diatomic molecules II: LCAO-MO method 13. Diatomic molecules III: vibration and rotation 14. Diatomic molecules IV: electronic transitions 15. Recent topics on atomic physics 					
(4) Outside-class activities and assignments	Before the class, check and confirm the understanding of previous lectures.					
(5) Textbooks and course materials	Presentation slides will be provided through the "kibako" system. Reference books will be introduced in the lectures.					
(6) Assessment and grading	Questions and reports after whole lectures					
(7) Questions to the instructor (Office hours, etc.)	Contact via e-mail to tanuma-hajime@tmu.ac.jp					
(8) Special note						

Program	Course Name	Course Number	Semester	Day	Time	Credit Hours
Master's program	Selected topics in Physics and chemistry II (Solid state Physics I)	R0109	1st Semester	Mon.	2	2
Doctoral program						
Instructor(s)			Note			
ARAHATA Emiko			This course is offered for Physics and Chemistry majors and also in the undergraduate program			
(1) Course policies and topics	In this lecture, we will learn about the motion and energy state of electrons in a solid, which is the periodic potential of crystals, that is, the band theory.					
(2) Knowledge/skills to be acquired and learning objectives/course goals	This lecture will give you a deep knowledge of band theory. You can also learn how to calculate specific values in a simple model					
(3) Course schedule, subject matter, and classroom activities	1: Review of quantum mechanics 2: Drude theory of metals 3: Sommerfeld's theory of metals 4: Crystal structures 5: Electron states in a periodic potential 6: Electrons in a weak periodic potential 7: The nearly-free-electron approximation 8: Electrons in a periodic potential where the potential is very strong 9: The tight-banding approximation 10: Transport phenomena 11: Boltzmann equation and relaxation time 12: Phonon spectroscopy 13: Thermoelectric effect 14: Semiconductors 15: Summary					
(4) Outside-class activities and assignments	Giving some assignments in every class					
(5) Textbooks and course materials	Posting materials on kibaco					
(6) Assessment and grading	Reports(70%) and assignments(30%)					
(7) Questions to the instructor (Office hours, etc.)	Questions will be accepted at any time. Make an appointment or directly send questions by email.					
(8) Special note						

Program	Course Name	Course Number	Semester	Day	Time	Credit Hours
Master's program	Advanced Lecture in Chemistry II (Organic Reaction Mechanisms)	R0231	1st	Thu.	1	2
Doctoral program	Advanced Lecture in Chemistry II (Organic Reaction Mechanisms)	R0232				
Instructor(s)			Note			
NOMURA Kotohiro						
(1) Course policies and topics	For students who learned organic chemistry, coordination chemistry, the lecture provides contents of "organometallic chemistry for precision organic synthesis" required for the graduate study as well as for modern research in organic chemistry, materials science.					
(2) Knowledge/skills to be acquired and learning objectives/course goals	The lecture also introduces recent topics with explanation of basic mechanism, methodology, historical flow. Through this lecture, the student will acquire basics in organometallic chemistry that should be required for graduate study, including basic reaction steps in metal catalyzed organic reactions (often employed as conventional synthesis), methodologies for the green sustainable synthesis and advanced materials.					
(3) Course schedule, subject matter, and classroom activities	The contents are as follows 1) Introductory in organometallic chemistry 2-3) Basics in coordination chemistry: 18 electron rules, structure and properties, bonding etc. 4-8) Basics in organometallic chemistry: Coordination and dissociation, oxidative addition and reductive elimination, insertion and elimination, reaction with coordinative ligands, typical reactions (coupling, carbonylation etc.) 9) Practice for reaction mechanism 10-12) Topics (olefin polymerization and oligomerization, olefin metathesis, asymmetric synthesis etc.) 13-14) Precision polymer synthesis (living polymerization) 15) Final examination					
(4) Outside-class activities and assignments	The students should read and study the handouts (distributed during the lecture course) and notes explained on the white board for better understanding. Lecture will be in both Japanese and English					
(5) Textbooks and course materials	Handouts will be distributed. Reference: R. H. Crabtree, The Organometallic Chemistry of the Transition Metals, Wiley					
(6) Assessment and grading	Written Exam (final) 90 % and mini test 10%					
(7) Questions to the instructor (Office hours, etc.)	No specified office hours but contact by e-mail (ktnomura@tmu.ac.jp)					
(8) Special note	The students should have basic knowledge in organic chemistry and inorganic chemistry					

Program	Course Name	Course Number	Semester	Day	Time	Credit Hours
Master's program	Advanced Lecture in Chemistry II (Advanced Material Science)	R0233	1st	Wed.	1	2
Doctoral program	Advanced Lecture in Chemistry II (Advanced Material Science)	R0237				
Instructor(s)			Note			
OKA Daichi						
(1) Course policies and topics	This lecture introduces synthesis and analysis methods and electronic properties of oxides, including recent topics.					
(2) Knowledge/skills to be acquired and learning objectives/course goals	The students will learn experimental methods in solid-state chemistry and the relationship between structure/composition and physical properties in solids focusing on oxide materials. The goal is to achieve basic knowledge to understand the latest research topics.					
(3) Course schedule, subject matter, and classroom activities	<ol style="list-style-type: none"> 1. Crystal structure of oxides 2. Synthesis and analysis methods for bulk oxides 3. Synthesis and analysis methods for oxide thin films 4. Band structure and electronic state 5. Optical properties and transparent conducting oxides 6. Mixed anion oxides 7. Electron correlation 8. Metal-to-insulator transition 9. Phenomenology of superconductivity 10. Superconductivity in cuprates 11. Oxide superconductors discovered after cuprates 12. Magnetism in oxides 13. Dielectric properties of oxides 14. Multiferroic oxides 15. Summary and exercise 					
(4) Outside-class activities and assignments	Please study the course materials and references before and after the classes.					
(5) Textbooks and course materials	The presentation slides will be shared.					
(6) Assessment and grading	Participation (20%) and reports (80%)					
(7) Questions to the instructor (Office hours, etc.)	No specified office hours are arranged. Please contact by e-mail (daichi.oka@tmu.ac.jp).					
(8) Special note						

Program	Course Name	Course Number	Semester	Day	Time	Credit Hours
Master's program	Advanced Lecture in Chemistry II (Functional Materials Chemistry)	R0300	1st	Tue.	1	2
Doctoral program	Advanced Lecture in Chemistry II (Functional Materials Chemistry)	R0302				
Instructor(s)			Note			
ISHIDA Masatoshi, KAWASOKO Hideyuki						
(1) Course policies and topics	<p>In this course, advanced lectures are provided on the fundamental principles governing the functions of structures and properties of various materials, from the perspectives of both organic and inorganic chemistry. This includes recent advancements in material applications.</p> <p>During the first half of the lecture series, we will discuss fundamental physical and chemical properties of organic materials focusing on aspects e.g., electronic conductivity, photoelectric conversion, emission, and photochemical reactions. This is relevant due to the growing importance of organic materials exhibiting exceptional functionality across diverse fields, including quantum information, environmental energy, and medical applications.</p> <p>During the second half of the lecture series, we will discuss that crystalline inorganic solids exhibit a variety of electrical, magnetic, dielectric, thermal, and optical properties, and behind those features, there is a diversity of crystal structures that correspond to the three-dimensional arrangement of atoms. Focusing on the diversity of such crystal structures.</p>					
(2) Knowledge/skills to be acquired and learning objectives/course goals	<p>1) Learn the design principles of advanced organic molecular materials with various functions, and develop the ability to elucidate photophysical processes and structural relationships.</p> <p>2) Be able to explain the parameters that characterize the crystal structure of inorganic solids.</p> <p>3) Be able to explain the atomic arrangement in typical crystal structures of inorganic solids.</p>					
(3) Course schedule, subject matter, and classroom activities	<p>The lecture consists of 15 sessions. Each topic will be covered in both the first and second halves of the course, offering a comprehensive overview.</p> <p>1: Introduction of photochemistry 2: Basics of optical functional materials 3: Spectroscopy of organic materials 4: Bio-Imaging 5: Light emitting devices 6: Solar cells 7: Photocatalysts 8: Summary (first half) 9: Basics of Crystallography 10: Structure of elemental solids 11: CsCl type/NaCl type structures and their derived structures 12: ZnS type structure and its derived structures 13: NiAs type structure and its derived structures 14: Perovskite structure and its derived structures 15: Spinel-type structure, corundum-type structure, and their derived structures</p>					
(4) Outside-class activities and assignments	<p>First half of the lecture: Report assignments given during class must be submitted by the deadline after the lecture.</p> <p>Second half of the lecture: After each lecture, students will be required to submit a summary of the lecture content (approximately 800 characters) as a report assignment. Furthermore, students will be required to submit an exercise assignment to review the content of the seven lectures as a final report assignment.</p>					
(5) Textbooks and course materials	<p>First half of the lecture: Lecture handouts will be distributed during the lecture.</p> <p>Second half of the lecture: Text "Crystal Chemistry of Fine Ceramics" by F. S. Galasso, translated by Seiki Kato and Keizo Uematsu, Agne Technology Center.</p>					
(6) Assessment and grading	<p>First half of the lecture: In principle, a comprehensive evaluation will be made based on the degree of participation in the class, assignment reports, presentations, etc.</p> <p>Second half of the lecture: In principle, grades will be evaluated based on each report assignment and final report assignment.</p>					
(7) Questions to the instructor (Office hours, etc.)	<p>First half of the lecture: If you contact us in advance by email, we will accept your request at any time.</p> <p>Second half of the lecture: Office hours will not be scheduled. Questions regarding the lecture content will be accepted via email. If you would like to ask questions directly outside of class hours, please contact us via email in advance so we can adjust the schedule.</p>					
(8) Special note	<p>First half of the lecture: If it is difficult to hold a face-to-face lecture in a lecture room, the lecture may be conducted online using Zoom, etc. If you have a computer or tablet, please bring it with you.</p> <p>Second half of the lecture: During the lecture, we plan to distribute materials as appropriate and use both slides and blackboard materials. If it is not possible to conduct a lecture face-to-face in a lecture room due to the influence of the new coronavirus, lecture materials and reports may be distributed via Kibaco, etc., and the lecture may be conducted via video distribution such as Zoom.</p>					

Program	Course Name	Course Number	Semester	Day	Time	Credit Hours
Master's program	External Experience in Chemistry	R0295 / 1 cre. R0297 / 2 cre.	Intensive course	-	-	1 or 2
Doctoral program	External Experience in Chemistry	R0296 / 1 cre. R0298 / 2 cre.				
Instructor(s)			Note			
Multiple instructors						
(1) Course policies and topics	To have an external experience or a voluntary work related to advanced chemistry.					
(2) Knowledge/skills to be acquired and learning objectives/course goals	To acquire a wide range of academic abilities throughout the external experiences or voluntary work related to advanced education in chemistry.					
(3) Course schedule, subject matter, and classroom activities	Content equivalent to the curriculum level of the graduate school including practical training or research activity program of 30 hours or more provided by other department or external organization (limited to that with clear accreditation criteria).					
(4) Outside-class activities and assignments	Depending on the host organization.					
(5) Textbooks and course materials	Depending on the host organization.					
(6) Assessment and grading	5-point rating incorporating by training diary, report, and evaluation from the host organization.					
(7) Questions to the instructor (Office hours, etc.)	Contact to N. Nakatani (academic affairs committee in chemistry), accepted at any time through e-mail (naokin@tmu.ac.jp).					
(8) Special note	(Credit hours) - 1 or 2 depending on the training hours and the accreditation criteria of the host organization. - Duplicate enrollment is allowed if the content is different. - The credits can be included in those required for graduation. (Notes) - Course registration cannot be made at the beginning of the semester, as the course enrollment is approved upon request from the student. - Make a preliminary application to your supervisor at least 6 weeks before the start date of the training, and receive permission from your supervisor for the content of the training. - In principle, the training must be arranged during the break season.					

Program	Course Name	Course Number	Semester	Day	Time	Credit Hours
Master's program	Internship	R0825 / 1 cre. R0827 / 2 cre.	Intensive course	-	-	1 or 2
Doctoral program	Internship	R0826 / 1 cre. R0828 / 2 cre.				
Instructor(s)			Note			
Multiple instructors						
(1) Course policies and topics	To have a work experience for 5 days (or 40 hours) or more at a company, government agency, NPO, etc.					
(2) Knowledge/skills to be acquired and learning objectives/course goals	To improve practical abilities (knowledge/techniques) from the work experience including advanced knowledge and techniques in chemistry.					
(3) Course schedule, subject matter, and classroom activities	<p>This subject is intended for graduate students.</p> <p>Participants will undergo work experience for a period of 5 days (or 40 hours) or more according to the program provided by the implementing agency. However, work experience must be conducted for at least half of the participating dates for credit recognition.</p> <p>During the training, please follow the instructions of the implementing agency's employees and staff. Gather information about the implementing agency using literature, the Internet, etc.</p>					
(4) Outside-class activities and assignments						
(5) Textbooks and course materials	Depending on the host organization.					
(6) Assessment and grading	5-point rating incorporating by training diary, report, and evaluation from the host organization.					
(7) Questions to the instructor (Office hours, etc.)	Contact to N. Nakatani (academic affairs committee in chemistry), accepted at any time through e-mail (naokin@tmu.ac.jp).					
(8) Special note	<p>(Credit hours)</p> <ul style="list-style-type: none"> - Depending on the length of the internship. 1 credit: 5 days (or 40 hours) or more, up to 8 days (or 60 hours) 2 credit: 8 days (or 60 hours) or more: 2 credit - Duplicate enrollment is allowed if the content is different. - The credits can be included in those required for graduation. <p>(Notes)</p> <ol style="list-style-type: none"> 1. In principle, the internship must be arranged during the break season. 2. Content must be equivalent to the curriculum level of the graduate school and related to advanced education in chemistry. A part of the internship should not be a requirement for accreditation of other course credit or qualification. 3. If a university or research institute freely invites participates from outside, a copy of the information flyer must be available. In the case of company, training school, etc., the agreement of acceptance indicating the name, affiliation, and contact information of instructor with his/her seal and signature. Must be enrolled in "Personal Accident Insurance for Students Pursuing Education and Research" and "Liability Insurance for Internship, Nursing training, and Teaching training, etc." (or accident and liability insurances with equivalent or higher quality). 4. A certificate of completion issued by the instructor must be obtained, or the instructor agrees to provide his/her signature and seal for confirmation to a university's certificate format. 5. Make a preliminary application to the academic affairs committee (N. Nakatani) with the documents in paragraph 3 containing the contact information of the host organization and the student, contents and purpose of the internship, to obtain permission. 6. After the internship, the student must compile a summary of the content, impressions, and training log into a several pages of report, and submit it to the academic affairs committee with the documents in paragraph 4. Accreditation will be made by the academic affairs committee, based on the compatibility with the purpose, the evaluation by the instructor, and the score of the report. 					

Program	Course Name	Course Number	Semester	Day	Time	Credit Hours
Master's program	Selected Topics in Physics and Chemistry I (Advanced Soft Matter Physics II)	R0143	1st Semester II	Thu.	3	1
Doctoral program	Selected Topics in Physics and Chemistry I (Advanced Soft Matter Physics II)	R0144				
Instructor(s)			Note			
KURITA Rei			This course is offered for Physics and Chemistry majors			
(1) Course policies and topics	Soft matter is a subfield of condensed matter comprising a variety of physical systems that can be deformed. They include liquids, colloids, polymers, foams, gels, granular materials, liquid crystals, pillows, flesh, and a number of biological materials. This program aims to understand the basis of the soft matter.					
(2) Knowledge/skills to be acquired and learning objectives/course goals	The goals are to learn phase transitions, coarsenings, self similarities, and then the basis of the non-equilibrium dynamics.					
(3) Course schedule, subject matter, and classroom activities	<ol style="list-style-type: none"> 1. What is soft matters? 2. Thermal equilibrium and phase separations. 3. Colloidal dispersion and Brownian motions. 4. Ideal chain model for polymers. 5. Elastic modulus of polymers. 6. Phase transitions in liquid crystals. 7. Surfactants. 8. Reports and comments. 					
(4) Outside-class activities and assignments	As next content is announced, prepare for next lesson after the class					
(5) Textbooks and course materials	Not in particular.					
(6) Assessment and grading	Evaluate marks in a question-and-answer session and in reports					
(7) Questions to the instructor (Office hours, etc.)	Need to take an appointment by email (kurita@tmu.ac.jp)					
(8) Special note						

Program	Course Name	Course Number	Semester	Day	Time	Credit Hours
Master's program	Selected topics in Physics and chemistry I (Advanced experimental technique in physics C)	R0161	2nd Semester I	Wed.	3	1
Doctoral program	Selected topics in Physics and chemistry I (Advanced experimental technique in physics C)	R0162				
Instructor(s)			Note			
TANUMA Hajime			This course is offered for Physics and Chemistry majors			
(1) Course policies and topics	Particle detection techniques, which are used in various physical measurements, will be explained for not only high energy radiation, but also low energy photons, electrons, ions, and neutral particles.					
(2) Knowledge/skills to be acquired and learning objectives/course goals	Fundamental understanding of physical phenomena used for particle detection, and practical technical methods for measurements of various particles in physics.					
(3) Course schedule, subject matter, and classroom activities	<ol style="list-style-type: none"> 1. Fundamental collision processes of electrons and ions in gases 2. Gase-based particle detectors 3. Particle detectors using processes on solid surfaces 4. Position sensitive detectors 5. Particle detectors using processes in solids 6. Mass and kinetic energy analyzers for slow charged particles in vacuum 7. Energy loss of fast particles in solid 8. Question and answers 					
(4) Outside-class activities and assignments	Before the class, check and confirm the understanding of previous lectures.					
(5) Textbooks and course materials	Presentation slides will be provided through the "kibako" system.					
(6) Assessment and grading	Questions and reports after whole lectures					
(7) Questions to the instructor (Office hours, etc.)	Contact via e-mail to tanuma-hajime@tmu.ac.jp					
(8) Special note						

Program	Graduate School of Science		Semester	Day	Time	Credit Hours
	Course Name	Course Number				
Master's program	Selected Topics in Physics and Chemistry I (Advanced Experimental Technique in Physics D)	R0159	2 nd B	Mon.	3	1
Doctoral program	Selected Topics in Physics and Chemistry I (Advanced Experimental Technique in Physics D)	R0160				
Instructor(s)			Note			
TANUMA Hajime						
(1) Course policies and topics	This course deals with the fundamentals of vacuum, which is a common feature in various physics experiments. Vacuum technology is indispensable not only for particle beam experiments but also for physical properties, sample fabrication and low-temperature experiments. How to prepare and measure vacuum in the laboratory? The fundamentals of vacuum will be explained also with the viewpoints of atomic physics and surface physics.					
(2) Knowledge/skills to be acquired and learning objectives/course goals	We gain a level of knowledge that will enable to understand the characteristics of vacuum equipment and to design their own equipment.					
(3) Course schedule, subject matter, and classroom activities	Drawing on knowledge of thermodynamic and statistical mechanics, fluid mechanics, quantum mechanics, and condensed matter physics, the following major topics will be reviewed. Students will be required to write reports on fundamental topics in order to deepen their understanding of the subject matter. Course schedule Lecture 1: What is the vacuum? Lecture 2: Kinetic theory of gases Lecture 3: Physics of dilute gases Lecture 4: Pumps for low vacuum Lecture 5: Pumps for high vacuum Lecture 6: Pressure measurements for low vacuum Lecture 7: Pressure measurements for high vacuum Lecture 8: Thermal transpiration effects					
(4) Outside-class activities and assignments	After each class, an assignment related to the content of the class will be given, which will be reviewed in the next class.					
(5) Textbooks and course materials	Slides to be used in class will be printed and distributed. Others will be given in class					
(6) Assessment and grading	Based on reports.					
(7) Questions to the instructor (Office hours, etc.)	E-mail questions at any time.					
(8) Special note						

Program	Course Name	Course Number	Semester	Day	Time	Credit Hours
Master's program	Seminar on Advanced Chemistry I		1st	-	-	2
Doctoral program						
Instructor(s)		Note				
		The course is provided in 2nd semester for students of fall enrollment				
(1) Course policies and topics	This course is for master's degree students. Students will subscribe to foreign language literature and give presentations on cutting-edge topics in chemistry. In particular, Seminar on Advanced Chemistry I provides students with basic academic skills and specialized knowledge that will serve as an introduction to specialized topics.					
(2) Knowledge/skills to be acquired and learning objectives/course goals	In the Department of Chemistry, experimental and theoretical research is conducted on a wide range of subjects extending from organic, inorganic, and biological materials to substances related to the ocean, atmospheric environment, and space. In this class, master's students will read foreign literature and give presentations on cutting-edge topics in chemistry. By being exposed to the latest chemistry, students will acquire a wide range of basic and specialized knowledge in chemistry.					
(3) Course schedule, subject matter, and classroom activities	<p>The specific content of each of the following classes will vary depending on the specialized theme of each laboratory. In addition, introductory foreign language literature 1-3 and related papers 1-3 will be specifically defined by each laboratory that you belong to.</p> <ol style="list-style-type: none"> 1. Review of each laboratory's specialized topics and explanation of future seminar plans 2. Detailed reading of introductory foreign-language literature 1 related to the theme of the course 3. Introductory foreign-language literature 1 on the theme of your specialty 4. Detailed reading of introductory foreign-language literature 2 in accordance with the theme of your specialty 5. Explanation of introductory foreign-language literature 2 in accordance with the theme of your specialty 6. Detailed reading of introductory foreign-language literature 3 in accordance with the theme of your specialty 7. Explanation of introductory foreign-language literature 3 in accordance with the theme of the specialty 8. Detailed reading of related paper 1 9. Explanation of related paper 1 10. Detailed reading of related paper 2 11. Commentary on related paper 2 12. Detailed reading of related paper 3 13. Explanation of related paper 3 14. Summary of basic knowledge acquired 15. General Discussion 					
(4) Outside-class activities and assignments	Follow the instructions of your instructor.					
(5) Textbooks and course materials	Introductions will be made as appropriate to the research topic and progress.					
(6) Assessment and grading	Judgments will be made comprehensively based on the level of understanding and presentation in the seminar.					
(7) Questions to the instructor (Office hours, etc.)	Introductions will be made as appropriate to the research topic and progress.					
(8) Special note						

Program	Course Name	Course Number	Semester	Day	Time	Credit Hours
Master's program	Seminar on Advanced Chemistry II		2nd	-	-	2
Doctoral program						
Instructor(s)			Note			
			The course is provided in 1st semester for students of fall enrollment			
(1) Course policies and topics	This course is for master's degree students. Students will subscribe to foreign language literature and give presentations on cutting-edge topics in chemistry. In particular, in Seminar on Advanced Chemistry II, students will continue to subscribe to and present foreign language literature as in Seminar on Advanced Chemistry I, thereby further deepening the basic academic skills and specialized knowledge acquired in Seminar on Advanced Chemistry I.					
(2) Knowledge/skills to be acquired and learning objectives/course goals	In the Department of Chemistry, experimental and theoretical research is conducted on a wide range of subjects extending from organic, inorganic, and biological materials to substances related to the ocean, atmospheric environment, and space. In this class, master's students will read foreign literature and give presentations on cutting-edge topics in chemistry. By being exposed to the latest chemistry, students will acquire a wide range of basic and specialized knowledge in chemistry.					
(3) Course schedule, subject matter, and classroom activities	<p>The specific content of each of the following classes will vary depending on the specialized theme of each laboratory. In addition, introductory foreign language literature 1-3 and related papers 1-3 will be specifically defined by each laboratory that you belong to.</p> <ol style="list-style-type: none"> 1. Review of each laboratory's specialized topics and explanation of future seminar plans 2. Detailed reading of introductory foreign-language literature 1 related to the theme of the course 3. Introductory foreign-language literature 1 on the theme of your specialty 4. Detailed reading of introductory foreign-language literature 2 in accordance with the theme of your specialty 5. Explanation of introductory foreign-language literature 2 in accordance with the theme of your specialty 6. Detailed reading of introductory foreign-language literature 3 in accordance with the theme of your specialty 7. Explanation of introductory foreign-language literature 3 in accordance with the theme of the specialty 8. Detailed reading of related paper 1 9. Explanation of related paper 1 10. Detailed reading of related paper 2 11. Commentary on related paper 2 12. Detailed reading of related paper 3 13. Explanation of related paper 3 14. Summary of basic knowledge acquired 15. General Discussion 					
(4) Outside-class activities and assignments	Follow the instructions of your instructor.					
(5) Textbooks and course materials	Introductions will be made as appropriate to the research topic and progress.					
(6) Assessment and grading	Judgments will be made comprehensively based on the level of understanding and presentation in the seminar.					
(7) Questions to the instructor (Office hours, etc.)	Introductions will be made as appropriate to the research topic and progress.					
(8) Special note						

Program	Course Name	Course Number	Semester	Day	Time	Credit Hours
Master's program			1st	-	-	2
Doctoral program	Seminar on Advanced Chemistry III					
Instructor(s)			Note			
			The course is provided in 2nd semester for students of fall enrollment			
(1) Course policies and topics	The program is for the doctoral course. Students will be assigned to each laboratory and introduced to foreign language literature. The purpose of this course is to cultivate the ability to read, understand, summarize, and orally present the content of original literature written in a foreign language. Students will summarize and orally present their own research topics and related topics, and ask questions and engage in discussions about the contents of the original literature.					
(2) Knowledge/skills to be acquired and learning objectives/course goals	In this class, doctoral students will read foreign language literature and give presentations on cutting-edge topics in chemistry. By being exposed to the latest chemistry, students will acquire a wide range of basic and specialized knowledge about chemistry.					
(3) Course schedule, subject matter, and classroom activities	The contents of the program include 15 sessions which will vary depending on the specialized theme of each laboratory that the student belongs to.					
(4) Outside-class activities and assignments	Follow the instructions of your instructor.					
(5) Textbooks and course materials	Introductions will be made as appropriate to the research topic and progress.					
(6) Assessment and grading	Judgments will be made comprehensively based on the level of understanding and presentation in the seminar.					
(7) Questions to the instructor (Office hours, etc.)	Follow the instructions of your instructor.					
(8) Special note						

Program	Course Name	Course Number	Semester	Day	Time	Credit Hours
Master's program			2nd	-	-	2
Doctoral program	Seminar on Advanced Chemistry IV					
Instructor(s)			Note			
			The course is provided in 1st semester for students of fall enrollment			
(1) Course policies and topics	The program is for the doctoral course. Students will be assigned to each laboratory and introduced to foreign language literature. The purpose of this course is to cultivate the ability to read, understand, summarize, and orally present the content of original literature written in a foreign language. Students will summarize and orally present their own research topics and related topics, and ask questions and engage in discussions about the contents of the original literature.					
(2) Knowledge/skills to be acquired and learning objectives/course goals	In this class, doctoral students will read foreign language literature and give presentations on cutting-edge topics in chemistry. By being exposed to the latest chemistry, students will acquire a wide range of basic and specialized knowledge about chemistry.					
(3) Course schedule, subject matter, and classroom activities	The contents of the program include 15 sessions which will vary depending on the specialized theme of each laboratory that the student belongs to.					
(4) Outside-class activities and assignments	Follow the instructions of your instructor.					
(5) Textbooks and course materials	Introductions will be made as appropriate to the research topic and progress.					
(6) Assessment and grading	Judgments will be made comprehensively based on the level of understanding and presentation in the seminar.					
(7) Questions to the instructor (Office hours, etc.)	Follow the instructions of your instructor.					
(8) Special note						

Program	Course Name	Course Number	Semester	Day	Time	Credit Hours
Master's program	Advanced Research of Chemistry I A	R0284 R0941	1st	-	-	2
Doctoral program						
Instructor(s)			Note			
Multiple instructors			The course is provided in 2nd semester for students of fall enrollment			
(1) Course policies and topics	In this course, students will acquire systematic and state-of-the-art specialized knowledge on one theme in a specific field by continuing with the four Advanced Research of Chemistry IA, IB, IIA, and IIB. The main contents of Advanced Research of Chemistry IA are to set a research theme, formulate a research plan, learn experimental and computational methods necessary for the research, and conduct preliminary experiments. When appropriate, progress, results, and problems are summarized and presented in a debriefing session.					
(2) Knowledge/skills to be acquired and learning objectives/course goals	In the Department of Chemistry, experimental and theoretical research is being conducted on a wide range of subjects, from organic, inorganic, and bio-related substances to substances related to the ocean, atmospheric environment, and space. In this course, students will deepen their expertise on specific topics at the cutting edge of chemistry. Students will continue to take the four Advanced Research of Chemistry IA, IB, IIA, and IIB to master experimental and computational methods for their individual appropriate topics, analyze and organize the resulting data, deepen their specific knowledge of chemistry, and comprehensively acquire the ability to present the results of their research.					
(3) Course schedule, subject matter, and classroom activities	<p>The specific content of each of the following classes will vary depending on the specialized theme of each laboratory that the student belongs to.</p> <ol style="list-style-type: none"> 1. Overview of research conducted in each laboratory 2. Establishment of a research theme and research plan (Part 1): Literature review and problem search 3. Establishment of a research theme and research plan (Part 2): Setting subject 4. Establishment of a research theme and research plan (Part 3): Research planning 5. Mastering experimental and computational methods necessary for research (Part 1): Investigation of experimental and computational methods 6. Mastering experimental and computational methods necessary for research (Part 2): Conducting experiments and calculations 7. Mastering experimental and computational methods necessary for research (Part 3): Reconfirming problems 8. Interim debriefing on research plan and experimental and computational methods 9. Preliminary experiments (Part 1): Investigations for conducting preliminary experiments 10. Preliminary experiments (Part 2): Conducting experiments 11. Preliminary experiments (Part 3): Discussion of problems 12. Preliminary experiments (Part 4): Re-experimentation based on the results of the study 13. Data analysis and organization of preliminary experiments (Part 1) 14. Data analysis and organization of preliminary experiments (Part 2) 15. Summary report of Advanced Research of Chemistry IA 					
(4) Outside-class activities and assignments	Follow the instructions of your instructor.					
(5) Textbooks and course materials	Textbooks and reference books will be introduced in each laboratory as appropriate to the content of the experiments.					
(6) Assessment and grading	Evaluation will be based on the midterm and summary report of Advanced Research of Chemistry IA and the experiment report					
(7) Questions to the instructor (Office hours, etc.)	Follow the instructions of your instructor.					
(8) Special note						

Program	Course Name	Course Number	Semester	Day	Time	Credit Hours
Master's program	Advanced Research of Chemistry I B	R0285 R0940	2nd	-	-	2
Doctoral program						
Instructor(s)			Note			
Multiple instructors			The course is provided in 1st semester for students of fall enrollment			
(1) Course policies and topics	In this course, students will acquire systematic and state-of-the-art specialized knowledge on a single theme in a specific field by continuing with the four Advanced Research of Chemistry IA, IB, IIA, and IIB. The main content of Advanced Research of Chemistry IB is to conduct basic experiments based on the results of preliminary experiments in Advanced Research of Chemistry IA, and to analyze and evaluate the results of the experiments. The progress, results, and problems will be summarized and presented in debriefing sessions as appropriate.					
(2) Knowledge/skills to be acquired and learning objectives/course goals	In the Department of Chemistry, experimental and theoretical research is being conducted on a wide range of subjects from organic, inorganic, and biological substances to substances related to the ocean, atmospheric environment, and space. In this course, each student will conduct research on a specific topic at the cutting edge of chemistry. Students continue to take the four Advanced Research of Chemistry IA, IB, IIA, and IIB to master experimental and computational methods on individually set appropriate themes, as well as to analyze and organize the resulting data, deepen their specific knowledge, and comprehensively acquire the ability to present their research results.					
(3) Course schedule, subject matter, and classroom activities	<p>The specific content of each of the following classes will vary depending on the specialized theme of each laboratory that the student belongs to.</p> <ol style="list-style-type: none"> 1. Overview of research conducted in each laboratory 2. Research planning for basic experiments (Part 1): Literature review and problem search 3. Research planning for basic experiments (Part 2): Setting subject 4. Research planning for basic experiments (Part 3): Research planning 5. Conducting Basic Experiments (Part 1): Investigations for conducting basic experiments 6. Conducting Basic Experiments (Part 2): Conducting Experiments 7. Conducting Basic Experiments (Part 3): Examining Problems 8. Conducting basic experiments (Part 4): Re-experimentation based on the results of the study 9. Conducting basic experiments (Part 5): Summary of basic experiments 10. Interim debriefing of basic experiments 11. Data analysis and organization of basic experiments (Part 1) 12. Data analysis and organization of basic experiments (Part 2): Organizing Analysis Results 13. Discussion of basic experiment results (Part 1): Comparison with literature, etc. 14. Discussion of basic experiment results (Part 2): Discussion of results 15. Summary report session of Advanced Research of Chemistry IB 					
(4) Outside-class activities and assignments	Follow the instructions of your instructor.					
(5) Textbooks and course materials	Textbooks and reference books will be introduced in each laboratory as appropriate to the content of the experiments.					
(6) Assessment and grading	Evaluation will be based on the midterm and summary report of Advanced Research of Chemistry IB and the experiment report					
(7) Questions to the instructor (Office hours, etc.)	Follow the instructions of your instructor.					
(8) Special note						

Program	Course Name	Course Number	Semester	Day	Time	Credit Hours
Master's program	Advanced Research of Chemistry II A	R0287 R0943	1st	-	-	2
Doctoral program						
Instructor(s)			Note			
Multiple instructors			The course is provided in 2nd semester for students of fall enrollment			
(1) Course policies and topics	In this course, students will acquire systematic and state-of-the-art specialized knowledge on a single theme in a specific field by continuing with the four Advanced Research of Chemistry IA, IB, IIA, and IIB. The main content of Advanced Research of Chemistry IIA is to conduct applied experiments based on the results of the basic experiments conducted so far, and to analyze and evaluate the results of the experiments. When appropriate, progress, results, and problems will be summarized and presented in a debriefing session.					
(2) Knowledge/skills to be acquired and learning objectives/course goals	In the Department of Chemistry, experimental and theoretical research is being conducted on a wide range of subjects from organic, inorganic, and biological substances to substances related to the ocean, atmospheric environment, and space. In this course, each student will conduct research on a specific topic at the cutting edge of chemistry. Students will continue to take the four Advanced Research of Chemistry IA, IB, IIA, and IIB to master experimental and computational methods for their individually set specific topics, analyze and organize the resulting data, deepen their specialized knowledge of chemistry, and comprehensively acquire the ability to present the results of their research.					
(3) Course schedule, subject matter, and classroom activities	<p>The specific content of each of the following classes will vary depending on the specialized theme of each laboratory that the student belongs to.</p> <ol style="list-style-type: none"> Confirmation of outline of applied experiments to be conducted in Advanced Research of Chemistry IIA. Research planning for applied experiments (Part 1): Literature Review and problem search Research planning for applied experiments (Part 2): Setting subject Research planning for applied experiments (Part 3): Research planning Conducting applied experiments (Part 1): Investigations for conducting applied experiments Conducting applied experiments (Part 2): Conducting Experiment Conducting applied experiments (Part 3): Examining problems Conducting applied experiments (Part 4): Re-experimentation based on the results of the study Conducting applied experiments (Part 5): Summary of applied experiments Interim debriefing of applied experiments Data analysis and organization of applied experiments (Part 1) Data Analysis and organization of applied experiments (Part 2): organizing analysis results Discussion of applied experimental results (Part 1): Comparison with literature, etc. Discussion of applied experimental results (Part 2): Discussion of results Summary report session of Advanced Research of Chemistry IIA 					
(4) Outside-class activities and assignments	Follow the instructions of your instructor.					
(5) Textbooks and course materials	Textbooks and reference books will be introduced in each laboratory as appropriate to the content of the experiments.					
(6) Assessment and grading	Evaluation will be based on the midterm and summary report of Advanced Research of Chemistry IIA and the experiment report					
(7) Questions to the instructor (Office hours, etc.)	Follow the instructions of your instructor.					
(8) Special note						

Program	Course Name	Course Number	Semester	Day	Time	Credit Hours
Master's program	Advanced Research of Chemistry II B	R0288 R0942	2nd	-	-	2
Doctoral program						
Instructor(s)			Note			
Multiple instructors			The course is provided in 1st semester for students of fall enrollment			
(1) Course policies and topics	In this course, students will acquire systematic and state-of-the-art specialized knowledge on a single theme in a specific field by continuing with the four Advanced Research of Chemistry IA, IB, IIA, and IIB. The main content of Advanced Research of Chemistry IIA is to conduct applied experiments based on the results of the basic experiments conducted so far, and to analyze and evaluate the results of the experiments. When appropriate, progress, results, and problems will be summarized and presented in a debriefing session.					
(2) Knowledge/skills to be acquired and learning objectives/course goals	In the Department of Chemistry, experimental and theoretical research is being conducted on a wide range of subjects from organic, inorganic, and biological substances to substances related to the ocean, atmospheric environment, and space. In this course, each student will conduct research on a specific topic at the cutting edge of chemistry. Students will continue to take the four Advanced Research of Chemistry IA, IB, IIA, and IIB to master experimental and computational methods for their individually set specific topics, analyze and organize the resulting data, deepen their specialized knowledge of chemistry, and comprehensively acquire the ability to present the results of their research.					
(3) Course schedule, subject matter, and classroom activities	<p>The specific content of each of the following classes will vary depending on the specialized theme of each laboratory that the student belongs to.</p> <ol style="list-style-type: none"> Confirmation of outline of applied experiments to be conducted in Advanced Research of Chemistry IIB. Research planning for advanced experiments (Part 1): Literature Review and problem search Research planning for advanced experiments (Part 2): Setting subject Research planning for advanced experiments (Part 3): Research planning Conducting advanced experiments (Part 1): Investigations for conducting advanced experiments Conducting advanced experiments (Part 2): Conducting Experiment Conducting advanced experiments (Part 3): Examining problems Conducting advanced experiments (Part 4): Re-experimentation based on the results of the study Conducting advanced experiments (Part 5): Summary of advanced experiments Interim debriefing of advanced experiments Data analysis and organization of advanced experiments (Part 1) Data Analysis and organization of advanced experiments (Part 2): organizing analysis results Discussion of advanced experimental results (Part 1): Comparison with literature, etc. Discussion of advanced experimental results (Part 2): Discussion of results Summary report session of Advanced Research of Chemistry IIB 					
(4) Outside-class activities and assignments	Follow the instructions of your instructor.					
(5) Textbooks and course materials	Textbooks and reference books will be introduced in each laboratory as appropriate to the content of the experiments.					
(6) Assessment and grading	Evaluation will be based on the midterm and summary report of Advanced Research of Chemistry IIB and the experiment report					
(7) Questions to the instructor (Office hours, etc.)	Follow the instructions of your instructor.					
(8) Special note						

Program	Course Name	Course Number	Semester	Day	Time	Credit Hours
Master's program			1st	-	-	2
Doctoral program	Advanced Research of Chemistry III A	R0290 R0945				
Instructor(s)			Note			
Multiple instructors			The course is provided in 2nd semester for students of fall enrollment			
(1) Course policies and topics	This course is for doctoral students. Each student will belong to a laboratory and conduct research on a specific research topic under the guidance of the laboratory's faculty members. The research results will be summarized as a doctoral thesis.					
(2) Knowledge/skills to be acquired and learning objectives/course goals	Upon completion of this course, students will acquire the knowledge and skills necessary to perform research in cutting-edge chemistry.					
(3) Course schedule, subject matter, and classroom activities	Depends on the research project. Contact the instructor for details.					
(4) Outside-class activities and assignments	Follow the instructions of your instructor.					
(5) Textbooks and course materials	Depends on the research project. Contact the instructor for details.					
(6) Assessment and grading	Depends on the research project. Contact the instructor for details.					
(7) Questions to the instructor (Office hours, etc.)	Follow the instructions of your instructor.					
(8) Special note						

Program	Course Name	Course Number	Semester	Day	Time	Credit Hours
Master's program			2nd	-	-	2
Doctoral program	Advanced Research of Chemistry III B	R0291 R0944				
Instructor(s)			Note			
Multiple instructors			The course is provided in 1st semester for students of fall enrollment			
(1) Course policies and topics	This course is for doctoral students. Each student will belong to a laboratory and conduct research on a specific research topic under the guidance of the laboratory's faculty members. The research results will be summarized as a doctoral thesis.					
(2) Knowledge/skills to be acquired and learning objectives/course goals	Upon completion of this course, students will acquire the knowledge and skills necessary to perform research in cutting-edge chemistry.					
(3) Course schedule, subject matter, and classroom activities	Depends on the research project. Contact the instructor for details.					
(4) Outside-class activities and assignments	Follow the instructions of your instructor.					
(5) Textbooks and course materials	Depends on the research project. Contact the instructor for details.					
(6) Assessment and grading	Depends on the research project. Contact the instructor for details.					
(7) Questions to the instructor (Office hours, etc.)	Follow the instructions of your instructor.					
(8) Special note						

Program	Course Name	Course Number	Semester	Day	Time	Credit Hours
Master's program			1st	-	-	2
Doctoral program	Advanced Research of Chemistry IV A	R0293 R0947				
Instructor(s)			Note			
Multiple instructors			The course is provided in 2nd semester for students of fall enrollment			
(1) Course policies and topics	This course is for doctoral students. Each student will belong to a laboratory and conduct research on a specific research topic under the guidance of the laboratory's faculty members. The research results will be summarized as a doctoral thesis.					
(2) Knowledge/skills to be acquired and learning objectives/course goals	Upon completion of this course, students will acquire the knowledge and skills necessary to perform research in cutting-edge chemistry.					
(3) Course schedule, subject matter, and classroom activities	Depends on the research project. Contact the instructor for details.					
(4) Outside-class activities and assignments	Follow the instructions of your instructor.					
(5) Textbooks and course materials	Depends on the research project. Contact the instructor for details.					
(6) Assessment and grading	Depends on the research project. Contact the instructor for details.					
(7) Questions to the instructor (Office hours, etc.)	Follow the instructions of your instructor.					
(8) Special note						

Program	Course Name	Course Number	Semester	Day	Time	Credit Hours
Master's program			2nd	-	-	2
Doctoral program	Advanced Research of Chemistry IV B	R0294 R0946				
Instructor(s)			Note			
Multiple instructors			The course is provided in 1st semester for students of fall enrollment			
(1) Course policies and topics	This course is for doctoral students. Each student will belong to a laboratory and conduct research on a specific research topic under the guidance of the laboratory's faculty members. The research results will be summarized as a doctoral thesis.					
(2) Knowledge/skills to be acquired and learning objectives/course goals	Upon completion of this course, students will acquire the knowledge and skills necessary to perform research in cutting-edge chemistry.					
(3) Course schedule, subject matter, and classroom activities	Depends on the research project. Contact the instructor for details.					
(4) Outside-class activities and assignments	Follow the instructions of your instructor.					
(5) Textbooks and course materials	Depends on the research project. Contact the instructor for details.					
(6) Assessment and grading	Depends on the research project. Contact the instructor for details.					
(7) Questions to the instructor (Office hours, etc.)	Follow the instructions of your instructor.					
(8) Special note						

2026 Graduate School Course Catalog
Graduate School of Science (Biological Sciences)

* M = master's courses, D = doctoral courses
* NA 2026 = Courses not offered in the academic year 2026

Course outline No.	M	D	NA 2026	Semester	Day	Time	Course Number	Course Name	Credit Hours	Instructor(s)	Note (enrollment requirements, subject matter, etc.)
1	○	○		2nd Semester	Thu.	1	M(R0359) D(R0360)	Advanced Lecture on Biological Information	2	SAKAI Takaomi ANDO Kanae	Physiological biochemistry of the brain and nervous system, molecular biology
2	○	○		1st Semester	Fri.	1	M(R0363) D(R0364)	Advanced Lecture on Biochemistry	2	KAWAHARA Hiroyuki OTANI Tetsuhisa OKAMOTO Takashi	Biochemistry of protein metabolism
3	○	○		1st Semester	Thu.	1	M(R0369) D(R0370)	Advanced Lecture on Developmental Biology	2	FUKUDA Kimiko TAKATORI Naohito	Modern developmental biology
4	○	○		2nd Semester	Fri.	1	M(R0371) D(R0372)	Advanced Lecture on Molecular Biology	2	EHIRA Shigeki OHYAYASHI Ryudo	Basics and practice of genomic science
5	○	○		Summer intensive			M(R0377) D(R0378)	Advanced Lecture on Biological Sciences	2	*YOKOMIZO Hiroyuki	Basic statistical analysis using RStudio for biological systems
6	○	○		Summer intensive			M(R0365) D(R0366)	Advanced Lecture on Biological Sciences	2	*FUKASAWA Keita	An introduction to R programming language for biological systems
7	○	○		2nd Semester II	Fri.	2	M(R0391) D(R0392)	Special Lecture on Genetic Information	1	TAMURA Koichiro TAKAHASHI Aya NOZAWA Masafumi	Population genetics and molecular evolution
8	○	○		1st Semester II	Fri.	2	M(R0393) D(R0394)	Special Lecture on Ecological Science	1	SUZUKI Jun-ichiro OKAMURA Yu	Animal behavior and society, renewal of plant communities
9	○	○		1st Semester I	Fri.	1	M(R0397) D(R0398)	Special Lecture on Responses to Environment	1	KANEGAE Takeshi NARIKAWA Rei	Environmental response and speciation of plants
10	○	○		2nd Semester I	Tue.	1	M(R0373) D(R0374)	Special Lecture on Systematics and Evolution	1	EGUCHI Katsuyuki TAKAYAMA Koji	Phylogenetic evolution of plants and animals
11	○	○		Summer intensive			M(R0401) D(R0402)	Special Lecture on Biological Sciences	1	Multiple instructors	The continuous education of modern biology
12	○	○		Winter intensive			M(R0759) D(R0760)	Special Lecture on Developmental Biology	1	*Guojun Sheng	
13	○	○		Winter intensive			M(R0701) D(R0702)	Special Lecture on Ecological Science	1	*SHIGA Sakiko	
14	○	○		Winter intensive			M(R0395) D(R0396)	Special Lecture on Systematics and Evolution	1	*DOHZONO Ikumi	
15	○	○		Winter intensive			M(R0351) D(R0352)	Special Lecture on Cell Biology	1	*MORIMOTO Takako	
16	○	○		Winter intensive			M(R0355) D(R0356)	Special Lecture on Biomolecules	1	*FURUSE Mikio	
17	○	○		Summer intensive			M(R0415) D(R0416)	Special Lecture on Biological Sciences	1	*YODA Sunao *MURA Yuri *MARIYAMA Chiaki *INOUE Azusa	Latest topics in biomedical research 2
18	○	○		Summer intensive			M(R0421) D(R0422)	English for Biology	2	*IJIMA Yuka	English for science: listening and speaking
19	○	○		Winter intensive			M(R0423) D(R0424)	English for Biology	2	*MASAWANA Sayako	How to write English papers
20	○	○		1st Semester	Mon.	4	M(R0425) D(R0426)	Special Course in Biology II	2	*Elisabeth Zielinska	Nature talk, Science and Culture
21	○	○		2nd Semester	Mon.	3	M(R0427) D(R0428)	Special Course in Biology II	2	*Elisabeth Zielinska	How to create a Persuasive Presentation
22	○	○		2nd Semester	Mon.	4	M(R0429) D(R0430)	Special Course in Biology II	2	*Elisabeth Zielinska	Nature talk II
23	○	○		2nd Semester I	Fri.	2	M(R0433) D(R0434)	Special Course in Biology I	1	ANDO Kanae CRONIN Adam	Technique for Research Communication Course in English
24	○	○		Summer intensive			M(R0439) D(R0440)	Special Course in Biology I	1	NOZAWA Masafumi	Computer Practice: Basics
25	○	○		1st Semester	Tue.	2	M(R0443) D(R0444)	Biology course in planning and management 1	1	HARUTA Shin Multiple instructors	Biology Course in Planning and Management
26	○	○		2nd Semester	Tue.	2	M(R0445) D(R0446)	Biology course in planning and management 2	1	HARUTA Shin Multiple instructors	Biology Course in Planning and Management
27	○	○		1st Semester	Tue.	3	M(R0447) D(R0448)	Biology course in international research experiences 1	1	FUKUDA Kimiko TAKAHASHI Aya Multiple instructors	raining for developing global leadership skills
28	○	○		2nd Semester	Tue.	3	M(R0449) D(R0450)	Biology course in international research experiences 2	1	FUKUDA Kimiko TAKAHASHI Aya Multiple instructors	raining for developing global leadership skills
29	○	○		1st Semester	Wed.	1	M(R0451) D(R0452)	Biology course in research evaluation 1	1	SUZUKI Jun-ichiro Multiple instructors	Evaluation of research proposals and applications
30	○	○		2nd Semester	Wed.	1	M(R0453) D(R0454)	Biology course in research evaluation 2	1	SUZUKI Jun-ichiro Multiple instructors	Evaluation of research presentation
31	○	○		At all times			M(R0693) D(R0694)	External Experience in Biological Sciences 1	1	Multiple instructors	
32	○	○		At all times			M(R0695)2単位 D(R0696)2単位 M(R0411)1単位 D(R0412)1単位	External Experience in Biological Sciences 2	1又{2	Multiple instructors	
33	○	○		At all times			M(R0931)2単位 D(R0932)2単位 M(R0929)1単位 D(R0930)1単位	Internship	1又{2	Multiple instructors	
34	○	○		1st Semester	Fri.	5	M(R0457) D(R0458)	Special Seminar in Biological Sciences 1	1	Multiple instructors	The latest issues in Biological Sciences (department seminar)
35	○	○		2nd Semester	Fri.	5	M(R0459) D(R0460)	Special Seminar in Biological Sciences 2	1	Multiple instructors	The latest issues in Biological Sciences (department seminar)
36	○	○		2nd Semester I	Tue.	1	M(R0705) D(R0706)	Special Lecture on Biological Sciences	1	KAWAHARA Hiroyuki NARIKAWA Rei	
37	○	○		2nd Semester I	Wed.	1	M(R0731) D(R0732)	Special Lecture on Biological Sciences	1	TAMURA Koichiro TAKAHASHI Aya	Online registration is not available. This course is also offered in the undergraduate program. Students who took this course in undergraduate program cannot take this course again. To register, please consult with members of the Academic Affair Committee of the Graduate Program.
38	○	○		2nd Semester I	Wed.	2	M(R0353) D(R0354)	Special Lecture on Biological Sciences	1	KANEGAE Takeshi OTANI Tetsuhisa	Online registration is not available. This course is also offered in the undergraduate program. Students who took this course in undergraduate program cannot take this course again. To register, please consult with members of the Academic Affair Committee of the Graduate Program.
39	○	○		2nd Semester I	Thu.	1	M(R0735) D(R0736)	Special Lecture on Biological Sciences	1	*FUKUI Manabu	Online registration is not available. This course is also offered in the undergraduate program. Students who took this course in undergraduate program cannot take this course again. To register, please consult with members of the Academic Affair Committee of the Graduate Program.

Course outline No.	M	D	NA 2026	Semester	Day	Time	Course Number	Course Name	Credit Hours	Instructor(s)	Note (enrollment requirements, subject matter, etc.)
40	○	○		2nd Semester I	Mon.	1	M(R0009) D(R0010)	Special Lecture on Biological Sciences	1	EGUCHI Katsuyuki TAKAYAMA Koji	Online registration is not available. This course is also offered in the undergraduate program. Students who took this course in undergraduate program cannot take this course again. To register, please consult with members of the Academic Affairs Committee of the Graduate Program.
41	○	○		2nd Semester I	Mon.	2	M(R0715) D(R0716)	Special Lecture on Biological Sciences	1	CRONIN Adam	Online registration is not available. This course is also offered in the undergraduate program. Students who took this course in undergraduate program cannot take this course again. To register, please consult with members of the Academic Affairs Committee of the Graduate Program.
42	○	○		Summer intensive			M(R0737) D(R0738)	Special Lecture on Biological Sciences	1	*WAGO Haruhisa	Online registration is not available. This course is also offered in the undergraduate program. Students who took this course in undergraduate program cannot take this course again. To register, please consult with members of the Academic Affairs Committee of the Graduate Program.
43	○	○		Summer intensive			M(R0725) D(R0726)	Special Lecture on Biological Sciences	1	*Florian Reyda	This course is offered in English and also open to undergraduate students.
44	○	○		Summer intensive			M(R0727) D(R0728)	Special Lecture on Biological Sciences	1	*Florian Reyda	This course is offered in English and also open to undergraduate students.
45	○	○		Summer intensive			M(R0719) D(R0720)	Special Lecture on Biological Sciences	1	*Diego Tavares Vasques	This course is also offered in the undergraduate program. Students who took this course previously cannot take this course again.
46	○	○		Summer intensive			M(R0357) D(R0358)	Special Lecture on Biological Sciences	1	*Parvin Shahrestani	This course is offered in English and also open to undergraduate students.
47	○	○		Summer intensive			M(R0367) D(R0368)	Special Lecture on Biological Sciences	1	*Parvin Shahrestani	This course is offered in English and also open to undergraduate students.
48	○	○		1st Semester I	Thu.	3	M(R0387) D(R0388)	Special Lecture on Biological Sciences	1	*Serguei Ketov	Introduction to Applied Mathematics for biologists
49	○	○		1st Semester II	Thu.	3	M(R0405) D(R0406)	Special Lecture on Biological Sciences	1	*Serguei Ketov	Introduction to Applied Mathematics for biologists
50	○	○		2nd Semester I	Thu.	3	M(R0419) D(R0420)	Special Lecture on Biological Sciences	1	*Serguei Ketov	Introduction to Applied Mathematics for biologists
51	○	○		2nd Semester II	Thu.	3	M(R0733) D(R0734)	Special Lecture on Biological Sciences	1	*Serguei Ketov	Introduction to Applied Mathematics for biologists
52	○	○		1st Semester	Mon.	1	M(R0461) D(R0462)	Seminar in Biological Sciences 1 (Molecular Neurobiology 1)	2	ANDO Kanae SAITO Taro ASADA Akiko	Seminar offered in each laboratory
53	○	○		2nd Semester	Mon.	1	M(R0463) D(R0464)	Seminar in Biological Sciences 2 (Molecular Neurobiology 1)	2	ANDO Kanae SAITO Taro ASADA Akiko	Seminar offered in each laboratory
52	○	○		1st Semester	Mon.	2	M(R0465) D(R0466)	Seminar in Biological Sciences 1 (Molecular Neurobiology 2)	2	ANDO Kanae SAITO Taro ASADA Akiko	Seminar offered in each laboratory
53	○	○		2nd Semester	Mon.	2	M(R0467) D(R0468)	Seminar in Biological Sciences 2 (Molecular Neurobiology 2)	2	ANDO Kanae SAITO Taro ASADA Akiko	Seminar offered in each laboratory
52	○	○		1st Semester	Fri.	3	M(R0469) D(R0470)	Seminar in Biological Sciences 1 (Molecular Neurobiology 3)	2	ANDO Kanae SAITO Taro ASADA Akiko	Seminar offered in each laboratory
53	○	○		2nd Semester	Fri.	3	M(R0471) D(R0472)	Seminar in Biological Sciences 2 (Molecular Neurobiology 3)	2	ANDO Kanae SAITO Taro ASADA Akiko	Seminar offered in each laboratory
52	○	○		1st Semester	Fri.	4	M(R0473) D(R0474)	Seminar in Biological Sciences 1 (Molecular Neurobiology 4)	2	ANDO Kanae SAITO Taro ASADA Akiko	Seminar offered in each laboratory
53	○	○		2nd Semester	Fri.	4	M(R0475) D(R0476)	Seminar in Biological Sciences 2 (Molecular Neurobiology 4)	2	ANDO Kanae SAITO Taro ASADA Akiko	Seminar offered in each laboratory
52	○	○		1st Semester	Tue.	4	M(R0485) D(R0486)	Seminar in Biological Sciences 1 (Plant Development and Physiology 1)	2	OKAMOTO Takashi FURUKAWA Toshiko KINOSHITA Atsuko	Seminar offered in each laboratory
53	○	○		2nd Semester	Tue.	4	M(R0487) D(R0488)	Seminar in Biological Sciences 2 (Plant Development and Physiology 1)	2	OKAMOTO Takashi FURUKAWA Toshiko KINOSHITA Atsuko	Seminar offered in each laboratory
52	○	○		1st Semester	Tue.	5	M(R0489) D(R0490)	Seminar in Biological Sciences 1 (Plant Development and Physiology 2)	2	OKAMOTO Takashi FURUKAWA Toshiko KINOSHITA Atsuko	Seminar offered in each laboratory
53	○	○		2nd Semester	Tue.	5	M(R0491) D(R0492)	Seminar in Biological Sciences 2 (Plant Development and Physiology 2)	2	OKAMOTO Takashi FURUKAWA Toshiko KINOSHITA Atsuko	Seminar offered in each laboratory
52	○	○		1st Semester	Fri.	3	M(R0493) D(R0494)	Seminar in Biological Sciences 1 (Plant Development and Physiology 3)	2	OKAMOTO Takashi FURUKAWA Toshiko KINOSHITA Atsuko	Seminar offered in each laboratory
53	○	○		2nd Semester	Fri.	3	M(R0495) D(R0496)	Seminar in Biological Sciences 2 (Plant Development and Physiology 3)	2	OKAMOTO Takashi FURUKAWA Toshiko KINOSHITA Atsuko	Seminar offered in each laboratory
52	○	○		1st Semester	Fri.	4	M(R0497) D(R0498)	Seminar in Biological Sciences 1 (Plant Development and Physiology 4)	2	OKAMOTO Takashi FURUKAWA Toshiko KINOSHITA Atsuko	Seminar offered in each laboratory
53	○	○		2nd Semester	Fri.	4	M(R0499) D(R0500)	Seminar in Biological Sciences 2 (Plant Development and Physiology 4)	2	OKAMOTO Takashi FURUKAWA Toshiko KINOSHITA Atsuko	Seminar offered in each laboratory
52	○	○		1st Semester	Mon.	1	M(R0501) D(R0502)	Seminar in Biological Sciences 1 (Plant environmental responses 1)	2	KANEGAE Takeshi NARIKAWA Rei	Seminar offered in each laboratory
53	○	○		2nd Semester	Mon.	1	M(R0503) D(R0504)	Seminar in Biological Sciences 2 (Plant environmental responses 1)	2	KANEGAE Takeshi NARIKAWA Rei	Seminar offered in each laboratory
52	○	○		1st Semester	Mon.	2	M(R0505) D(R0506)	Seminar in Biological Sciences 1 (Plant environmental responses 2)	2	KANEGAE Takeshi NARIKAWA Rei	Seminar offered in each laboratory
53	○	○		2nd Semester	Mon.	2	M(R0507) D(R0508)	Seminar in Biological Sciences 2 (Plant environmental responses 2)	2	KANEGAE Takeshi NARIKAWA Rei	Seminar offered in each laboratory
52	○	○		1st Semester	Mon.	1	M(R0509) D(R0510)	Seminar in Biological Sciences 1 (Cytogenetics 1)	2	SAKAI Takaomi ASANO Tsunaki TAKEO Satomi	Seminar offered in each laboratory
53	○	○		2nd Semester	Mon.	1	M(R0511) D(R0512)	Seminar in Biological Sciences 2 (Cytogenetics 1)	2	SAKAI Takaomi ASANO Tsunaki TAKEO Satomi	Seminar offered in each laboratory
52	○	○		1st Semester	Mon.	2	M(R0513) D(R0514)	Seminar in Biological Sciences 1 (Cytogenetics 2)	2	SAKAI Takaomi ASANO Tsunaki TAKEO Satomi	Seminar offered in each laboratory
53	○	○		2nd Semester	Mon.	2	M(R0515) D(R0516)	Seminar in Biological Sciences 2 (Cytogenetics 2)	2	SAKAI Takaomi ASANO Tsunaki TAKEO Satomi	Seminar offered in each laboratory

Course outline No.	M	D	NA 2026	Semester	Day	Time	Course Number	Course Name	Credit Hours	Instructor(s)	Note (enrollment requirements, subject matter, etc.)
52	○	○		1st Semester	Mon.	1	M(R0517) D(R0518)	Seminar in Biological Sciences 1 (Evolutionary Genetics 1)	2	TAKAHASHI Aya NOZAWA Masafumi	Seminar offered in each laboratory
53	○	○		2nd Semester	Mon.	1	M(R0519) D(R0520)	Seminar in Biological Sciences 2 (Evolutionary Genetics 1)	2	TAKAHASHI Aya NOZAWA Masafumi	Seminar offered in each laboratory
52	○	○		1st Semester	Mon.	2	M(R0521) D(R0522)	Seminar in Biological Sciences 1 (Evolutionary Genetics 2)	2	TAKAHASHI Aya NOZAWA Masafumi	Seminar offered in each laboratory
53	○	○		2nd Semester	Mon.	2	M(R0523) D(R0524)	Seminar in Biological Sciences 2 (Evolutionary Genetics 2)	2	TAKAHASHI Aya NOZAWA Masafumi	Seminar offered in each laboratory
52	○	○		1st Semester	Mon.	1	M(R0525) D(R0526)	Seminar in Biological Sciences 1 (Molecular Genetics 1)	2	EHIRA Shigeki OHBAYASHI Ryudo	Seminar offered in each laboratory
53	○	○		2nd Semester	Mon.	1	M(R0527) D(R0528)	Seminar in Biological Sciences 2 (Molecular Genetics 1)	2	EHIRA Shigeki OHBAYASHI Ryudo	Seminar offered in each laboratory
52	○	○		1st Semester	Mon.	2	M(R0529) D(R0530)	Seminar in Biological Sciences 1 (Molecular Genetics 2)	2	EHIRA Shigeki OHBAYASHI Ryudo	Seminar offered in each laboratory
53	○	○		2nd Semester	Mon.	2	M(R0531) D(R0532)	Seminar in Biological Sciences 2 (Molecular Genetics 2)	2	EHIRA Shigeki OHBAYASHI Ryudo	Seminar offered in each laboratory
52	○	○		1st Semester	Mon.	1	M(R0533) D(R0534)	Seminar in Biological Sciences 1 (Animal Ecology 1)	2	CRONIN Adam OKAMURA Yu	Seminar offered in each laboratory
53	○	○		2nd Semester	Tue.	4	M(R0535) D(R0536)	Seminar in Biological Sciences 2 (Animal Ecology 1)	2	CRONIN Adam OKAMURA Yu	Seminar offered in each laboratory
52	○	○		1st Semester	Mon.	2	M(R0537) D(R0538)	Seminar in Biological Sciences 1 (Animal Ecology 2)	2	CRONIN Adam OKAMURA Yu	Seminar offered in each laboratory
53	○	○		2nd Semester	Tue.	5	M(R0539) D(R0540)	Seminar in Biological Sciences 2 (Animal Ecology 2)	2	CRONIN Adam OKAMURA Yu	Seminar offered in each laboratory
52	○	○		1st Semester	Fri.	3	M(R0541) D(R0542)	Seminar in Biological Sciences 1 (Plant Ecology 1)	2	SUZUKI Jun-ichiro	Seminar offered in each laboratory
53	○	○		2nd Semester	Fri.	3	M(R0543) D(R0544)	Seminar in Biological Sciences 2 (Plant Ecology 1)	2	SUZUKI Jun-ichiro	Seminar offered in each laboratory
52	○	○		1st Semester	Fri.	4	M(R0545) D(R0546)	Seminar in Biological Sciences 1 (Plant Ecology 2)	2	SUZUKI Jun-ichiro	Seminar offered in each laboratory
53	○	○		2nd Semester	Fri.	4	M(R0547) D(R0548)	Seminar in Biological Sciences 2 (Plant Ecology 2)	2	SUZUKI Jun-ichiro	Seminar offered in each laboratory
52	○	○		1st Semester	Fri.	6	M(R0549) D(R0550)	Seminar in Biological Sciences 1 (Plant Ecology 3)	2	SUZUKI Jun-ichiro	Seminar offered in each laboratory
53	○	○		2nd Semester	Fri.	6	M(R0551) D(R0552)	Seminar in Biological Sciences 2 (Plant Ecology 3)	2	SUZUKI Jun-ichiro	Seminar offered in each laboratory
52	○	○		1st Semester	Wed.	6	M(R0561) D(R0562)	Seminar in Biological Sciences 1 (Developmental Biology 1)	2	FUKUDA Kimiko TAKATORI Naohito	Seminar offered in each laboratory
53	○	○		2nd Semester	Wed.	6	M(R0563) D(R0564)	Seminar in Biological Sciences 2 (Developmental Biology 1)	2	FUKUDA Kimiko TAKATORI Naohito	Seminar offered in each laboratory
52	○	○		1st Semester	Wed.	7	M(R0565) D(R0566)	Seminar in Biological Sciences 1 (Developmental Biology 2)	2	FUKUDA Kimiko TAKATORI Naohito	Seminar offered in each laboratory
53	○	○		2nd Semester	Wed.	7	M(R0567) D(R0568)	Seminar in Biological Sciences 2 (Developmental Biology 2)	2	FUKUDA Kimiko TAKATORI Naohito	Seminar offered in each laboratory
52	○	○		1st Semester	Tue.	6	M(R0569) D(R0570)	Seminar in Biological Sciences 1 (Developmental Biology 3)	2	FUKUDA Kimiko TAKATORI Naohito	Seminar offered in each laboratory
53	○	○		2nd Semester	Tue.	6	M(R0571) D(R0572)	Seminar in Biological Sciences 2 (Developmental Biology 3)	2	FUKUDA Kimiko TAKATORI Naohito	Seminar offered in each laboratory
52	○	○		1st Semester	Tue.	5	M(R0577) D(R0578)	Seminar in Biological Sciences 1 (Systematic Zoology 1)	2	EGUCHI Katsuyuki SUGIURA Kenta	Seminar offered in each laboratory
53	○	○		2nd Semester	Tue.	4	M(R0579) D(R0580)	Seminar in Biological Sciences 2 (Systematic Zoology 1)	2	EGUCHI Katsuyuki SUGIURA Kenta	Seminar offered in each laboratory
52	○	○		1st Semester	Tue.	6	M(R0581) D(R0582)	Seminar in Biological Sciences 1 (Systematic Zoology 2)	2	EGUCHI Katsuyuki SUGIURA Kenta	Seminar offered in each laboratory
53	○	○		2nd Semester	Tue.	5	M(R0583) D(R0584)	Seminar in Biological Sciences 2 (Systematic Zoology 2)	2	EGUCHI Katsuyuki SUGIURA Kenta	Seminar offered in each laboratory
52	○	○		1st Semester	Fri.	3	M(R0585) D(R0586)	Seminar in Biological Sciences 1 (Systematic Botany 1)	2	TAKAYAMA Koji KATO Hidetoshi FUJIWARA Tao	Seminar offered in each laboratory
53	○	○		2nd Semester	Fri.	3	M(R0587) D(R0588)	Seminar in Biological Sciences 2 (Systematic Botany 1)	2	TAKAYAMA Koji KATO Hidetoshi FUJIWARA Tao	Seminar offered in each laboratory
52	○	○		1st Semester	Fri.	4	M(R0589) D(R0590)	Seminar in Biological Sciences 1 (Systematic Botany 2)	2	TAKAYAMA Koji KATO Hidetoshi FUJIWARA Tao	Seminar offered in each laboratory
53	○	○		2nd Semester	Fri.	4	M(R0591) D(R0592)	Seminar in Biological Sciences 2 (Systematic Botany 2)	2	TAKAYAMA Koji KATO Hidetoshi FUJIWARA Tao	Seminar offered in each laboratory
52	○	○		1st Semester	Mon.	5	M(R0593) D(R0594)	Seminar in Biological Sciences 1 (Environmental Microbiology 1)	2	HARUTA Shin	Seminar offered in each laboratory
53	○	○		2nd Semester	Mon.	5	M(R0595) D(R0596)	Seminar in Biological Sciences 2 (Environmental Microbiology 1)	2	HARUTA Shin	Seminar offered in each laboratory
52	○	○		1st Semester	Mon.	6	M(R0597) D(R0598)	Seminar in Biological Sciences 1 (Environmental Microbiology 2)	2	HARUTA Shin	Seminar offered in each laboratory
53	○	○		2nd Semester	Mon.	6	M(R0599) D(R0600)	Seminar in Biological Sciences 2 (Environmental Microbiology 2)	2	HARUTA Shin	Seminar offered in each laboratory
52	○	○		1st Semester	Fri.	3	M(R0601) D(R0602)	Seminar in Biological Sciences 1 (Cellular Biochemistry 1)	2	KAWAHARA Hiroyuki OTANI Tetsuhisa YOKOTA Naoto	Seminar offered in each laboratory
53	○	○		2nd Semester	Fri.	3	M(R0603) D(R0604)	Seminar in Biological Sciences 2 (Cellular Biochemistry 1)	2	KAWAHARA Hiroyuki OTANI Tetsuhisa YOKOTA Naoto	Seminar offered in each laboratory
52	○	○		1st Semester	Fri.	4	M(R0605) D(R0606)	Seminar in Biological Sciences 1 (Cellular Biochemistry 2)	2	KAWAHARA Hiroyuki OTANI Tetsuhisa YOKOTA Naoto	Seminar offered in each laboratory
53	○	○		2nd Semester	Fri.	4	M(R0607) D(R0608)	Seminar in Biological Sciences 2 (Cellular Biochemistry 2)	2	KAWAHARA Hiroyuki OTANI Tetsuhisa YOKOTA Naoto	Seminar offered in each laboratory
52	○	○		1st Semester	Mon.	1	M(R0435) D(R0436)	Seminar in Biological Sciences 1 (Mathematical and Computational Biology 1)	2	TAMURA Koichiro TACHIKI Yuuya	Seminar offered in each laboratory
53	○	○		2nd Semester	Mon.	1	M(R0437) D(R0438)	Seminar in Biological Sciences 2 (Mathematical and Computational Biology 1)	2	TAMURA Koichiro TACHIKI Yuuya	Seminar offered in each laboratory
52	○	○		1st Semester	Mon.	2	M(R0573) D(R0574)	Seminar in Biological Sciences 1 (Mathematical and Computational Biology 2)	2	TAMURA Koichiro TACHIKI Yuuya	Seminar offered in each laboratory
53	○	○		2nd Semester	Mon.	2	M(R0575) D(R0576)	Seminar in Biological Sciences 2 (Mathematical and Computational Biology 2)	2	TAMURA Koichiro TACHIKI Yuuya	Seminar offered in each laboratory
52	○	○		1st Semester	Mon.	1	M(R0921) D(R0922)	Seminar in Biological Sciences 1 (Molecular Regulation of Aging 1)	2	ISHIGAMI Akihito	Seminar offered in each laboratory
53	○	○		2nd Semester	Mon.	1	M(R0923) D(R0924)	Seminar in Biological Sciences 2 (Molecular Regulation of Aging 1)	2	ISHIGAMI Akihito	Seminar offered in each laboratory
52	○	○		1st Semester	Mon.	2	M(R0925) D(R0926)	Seminar in Biological Sciences 1 (Molecular Regulation of Aging 2)	2	ISHIGAMI Akihito	Seminar offered in each laboratory

Course outline No.	M	D	NA 2026	Semester	Day	Time	Course Number	Course Name	Credit Hours	Instructor(s)	Note (enrollment requirements, subject matter, etc.)
53	○	○		2nd Semester	Mon.	2	M(R0927) D(R0928)	Seminar in Biological Sciences 2 (Molecular Regulation of Aging 2)	2	ISHIGAMI Akihito	Seminar offered in each laboratory
54	○	○		At all times			M(R0609) D(R0610)	Special Experiment in Biological Sciences (Experimental Techniques 1)	1	Multiple instructors	This course is for non-biology major students to learn basic experimental methods in each field of biological science
54	○	○		At all times			M(R0611) D(R0612)	Special Experiment in Biological Sciences (Experimental Techniques 2)	1	Multiple instructors	This course is for non-biology major students to learn basic experimental methods in each field of biological science
54	○	○		At all times			M(R0613) D(R0614)	Special Experiment in Biological Sciences (Experimental Techniques 3)	1	Multiple instructors	This course is for non-biology major students to learn basic experimental methods in each field of biological science
54	○	○		At all times			M(R0615) D(R0616)	Special Experiment in Biological Sciences (Experimental Techniques 4)	1	Multiple instructors	This course is for non-biology major students to learn basic experimental methods in each field of biological science
54	○	○		At all times			M(R0617) D(R0618)	Special Experiment in Biological Sciences (Experimental Techniques 5)	1	Multiple instructors	This course is for non-biology major students to learn basic experimental methods in each field of biological science
54	○	○		At all times			M(R0619) D(R0620)	Special Experiment in Biological Sciences (Experimental Techniques 6)	1	Multiple instructors	This course is for non-biology major students to learn basic experimental methods in each field of biological science
55	○	○		At all times			M(R0621) D(R0622)	Special Practice in Biological Sciences (Research Techniques 1)	2	Multiple instructors	Various experimental methods in each field of biological science and practical research methods
55	○	○		At all times			M(R0623) D(R0624)	Special Practice in Biological Sciences (Research Techniques 2)	2	Multiple instructors	Various experimental methods in each field of biological science and practical research methods
55	○	○		At all times			M(R0625) D(R0626)	Special Practice in Biological Sciences (Research Techniques 3)	2	Multiple instructors	Various experimental methods in each field of biological science and practical research methods
55	○	○		At all times			M(R0627) D(R0628)	Special Practice in Biological Sciences (Research Techniques 4)	2	Multiple instructors	Various experimental methods in each field of biological science and practical research methods
55	○	○		At all times			M(R0629) D(R0630)	Special Practice in Biological Sciences (Research Techniques 5)	2	Multiple instructors	Various experimental methods in each field of biological science and practical research methods
55	○	○		At all times			M(R0631) D(R0632)	Special Practice in Biological Sciences (Research Techniques 6)	2	Multiple instructors	Various experimental methods in each field of biological science and practical research methods
56	○	○		1st Semester	Thu.	6-7	M(R0633) D(R0634)	Advanced Experimental Techniques in Biological Sciences 1 (Molecular Neurobiology)	2	ANDO Kanae SAITO Taro ASADA Akiko	Advanced research technologies in different branches of biological sciences
57	○	○		2nd Semester	Thu.	6-7	M(R0635) D(R0636)	Advanced Experimental Techniques in Biological Sciences 2(Molecular Neurobiology)	2	ANDO Kanae SAITO Taro ASADA Akiko	Advanced research technologies in different branches of biological sciences
56	○	○		1st Semester	Thu.	6-7	M(R0641) D(R0642)	Advanced Experimental Techniques in Biological Sciences 1(Plant Development and Physiology)	2	OKAMOTO Takashi FURUKAWA Toshiko KINOSHITA Atsuko	Advanced research technologies in different branches of biological sciences
57	○	○		2nd Semester	Thu.	6-7	M(R0643) D(R0644)	Advanced Experimental Techniques in Biological Sciences 2(Plant Development and Physiology)	2	OKAMOTO Takashi FURUKAWA Toshiko KINOSHITA Atsuko	Advanced research technologies in different branches of biological sciences
56	○	○		1st Semester	Thu.	6-7	M(R0645) D(R0646)	Advanced Experimental Techniques in Biological Sciences 1 (Plant environmental responses)	2	KANEGAE Takeshi NARIKAWA Rei	Advanced research technologies in different branches of biological sciences
57	○	○		2nd Semester	Thu.	6-7	M(R0647) D(R0648)	Advanced Experimental Techniques in Biological Sciences 2 (Plant environmental responses)	2	KANEGAE Takeshi NARIKAWA Rei	Advanced research technologies in different branches of biological sciences
56	○	○		1st Semester	Thu.	6-7	M(R0649) D(R0650)	Advanced Experimental Techniques in Biological Sciences 1(Cytogenetics)	2	SAKAI Takaomi ASANO Tsunaki TAKEO Satomi	Advanced research technologies in different branches of biological sciences
57	○	○		2nd Semester	Thu.	6-7	M(R0651) D(R0652)	Advanced Experimental Techniques in Biological Sciences 2(Cytogenetics)	2	SAKAI Takaomi ASANO Tsunaki TAKEO Satomi	Advanced research technologies in different branches of biological sciences
56	○	○		1st Semester	Thu.	6-7	M(R0653) D(R0654)	Advanced Experimental Techniques in Biological Sciences 1 (Evolutionary Genetics)	2	TAKAHASHI Aya NOZAWA Masafumi	Advanced research technologies in different branches of biological sciences
57	○	○		2nd Semester	Thu.	6-7	M(R0655) D(R0656)	Advanced Experimental Techniques in Biological Sciences 2 (Evolutionary Genetics)	2	TAKAHASHI Aya NOZAWA Masafumi	Advanced research technologies in different branches of biological sciences
56	○	○		1st Semester	Thu.	6-7	M(R0657) D(R0658)	Advanced Experimental Techniques in Biological Sciences 1 (Molecular Genetics)	2	EHIRA Shigeki OHBAYASHI Ryudo	Advanced research technologies in different branches of biological sciences
57	○	○		2nd Semester	Thu.	6-7	M(R0659) D(R0660)	Advanced Experimental Techniques in Biological Sciences 2(Molecular Genetics)	2	EHIRA Shigeki OHBAYASHI Ryudo	Advanced research technologies in different branches of biological sciences
56	○	○		1st Semester	Thu.	6-7	M(R0661) D(R0662)	Advanced Experimental Techniques in Biological Sciences 1(Animal Ecology)	2	CRONIN Adam OKAMURA Yu	Advanced research technologies in different branches of biological sciences
57	○	○		2nd Semester	Thu.	6-7	M(R0663) D(R0664)	Advanced Experimental Techniques in Biological Sciences 2 (Animal Ecology)	2	CRONIN Adam OKAMURA Yu	Advanced research technologies in different branches of biological sciences
56	○	○		1st Semester	Thu.	6-7	M(R0665) D(R0666)	Advanced Experimental Techniques in Biological Sciences 1(Plant Ecology)	2	SUZUKI Jun-ichiro	Advanced research technologies in different branches of biological sciences
57	○	○		2nd Semester	Thu.	6-7	M(R0667) D(R0668)	Advanced Experimental Techniques in Biological Sciences 2 (Plant Ecology)	2	SUZUKI Jun-ichiro	Advanced research technologies in different branches of biological sciences
56	○	○		1st Semester	Thu.	6-7	M(R0673) D(R0674)	Advanced Experimental Techniques in Biological Sciences 1(Developmental Biology)	2	FUKUDA Kimiko TAKATORI Naohito	Advanced research technologies in different branches of biological sciences
57	○	○		2nd Semester	Thu.	6-7	M(R0675) D(R0676)	Advanced Experimental Techniques in Biological Sciences 2(Developmental Biology)	2	FUKUDA Kimiko TAKATORI Naohito	Advanced research technologies in different branches of biological sciences
56	○	○		1st Semester	Thu.	6-7	M(R0677) D(R0678)	Advanced Experimental Techniques in Biological Sciences 1(Systematic Zoology)	2	EGUCHI Katsuyuki SUGIURA Kenta	Advanced research technologies in different branches of biological sciences
57	○	○		2nd Semester	Thu.	6-7	M(R0679) D(R0680)	Advanced Experimental Techniques in Biological Sciences 2(Systematic Zoology)	2	EGUCHI Katsuyuki SUGIURA Kenta	Advanced research technologies in different branches of biological sciences
56	○	○		1st Semester	Thu.	6-7	M(R0681) D(R0682)	Advanced Experimental Techniques in Biological Sciences 1 (Systematic Botany)	2	TAKAYAMA Koji KATO Hidetoshi FUJIWARA Tao	Advanced research technologies in different branches of biological sciences
57	○	○		2nd Semester	Thu.	6-7	M(R0683) D(R0684)	Advanced Experimental Techniques in Biological Sciences 2 (Systematic Botany)	2	TAKAYAMA Koji KATO Hidetoshi FUJIWARA Tao	Advanced research technologies in different branches of biological sciences
56	○	○		1st Semester	Thu.	6-7	M(R0685) D(R0686)	Advanced Experimental Techniques in Biological Sciences 1(Environmental Microbiology)	2	HARUTA Shin	Advanced research technologies in different branches of biological sciences
57	○	○		2nd Semester	Thu.	6-7	M(R0687) D(R0688)	Advanced Experimental Techniques in Biological Sciences 2 (Environmental Microbiology)	2	HARUTA Shin	Advanced research technologies in different branches of biological sciences

Course outline No.	M	D	NA 2026	Semester	Day	Time	Course Number	Course Name	Credit Hours	Instructor(s)	Note (enrollment requirements, subject matter, etc.)
56	○	○		1st Semester	Thu.	6・7	M(R0689) D(R0690)	Advanced Experimental Techniques in Biological Sciences 1(Cellular Biochemistry)	2	KAWAHARA Hiroyuki OTANI Tetsuhisa YOKOTA Naoto	Advanced research technologies in different branches of biological sciences
57	○	○		2nd Semester	Thu.	6・7	M(R0691) D(R0692)	Advanced Experimental Techniques in Biological Sciences 2(Cellular Biochemistry)	2	KAWAHARA Hiroyuki OTANI Tetsuhisa YOKOTA Naoto	Advanced research technologies in different branches of biological sciences
56	○	○		1st Semester	Thu.	6・7	M(R0407) D(R0408)	Advanced Experimental Techniques in Biological Sciences 1(Mathematical and Computational Biology)	2	TAMURA Koichiro TACHIKI Yuuya	Advanced research technologies in different branches of biological sciences
57	○	○		2nd Semester	Thu.	6・7	M(R0409) D(R0410)	Advanced Experimental Techniques in Biological Sciences 2(Mathematical and Computational Biology)	2	TAMURA Koichiro TACHIKI Yuuya	Advanced research technologies in different branches of biological sciences
56	○	○		1st Semester	Thu.	6・7	M(R0741) D(R0742)	Advanced Experimental Techniques in Biological Sciences 1(Molecular Regulation of Aging)	2	ISHIGAMI Akihito	Advanced research technologies in different branches of biological sciences
57	○	○		2nd Semester	Thu.	6・7	M(R0743) D(R0744)	Advanced Experimental Techniques in Biological Sciences 2(Molecular Regulation of Aging)	2	ISHIGAMI Akihito	Advanced research technologies in different branches of biological sciences

Program	Course Name	Course Number	Semester	Day	Time	Credit Hours
Master's program	Advanced Lecture on Biological Information	M(R0359)	2nd Semester	Thu.	1	2
Doctoral program	Advanced Lecture on Biological Information	D(R0360)				
Instructor(s)			Note			
Takaomi Sakai, Kanae Ando						
(1) Course policies and topics	Through research papers, the lecture will introduce the background of the neural basis that has been clarified through studies using various laboratory animals, and will also include the latest research results.					
(2) Knowledge/skills to be acquired and learning objectives/course goals	The latest findings on bioinformation, such as the origin of the cranial nervous system, synaptic structure, synaptic transmission, behavioral control by the cranial nervous system, aging and basal metabolism, etc. will be studied.					
(3) Course schedule, subject matter, and classroom activities	<ol style="list-style-type: none"> 1. Learning & Memory 1 (T. Sakai) 2. Learning & Memory 2 (T. Sakai) 3. Learning & Memory 3 (T. Sakai) 4. Learning & Memory 4 (T. Sakai) 5. Learning & Memory 5 (T. Sakai) 6. Learning & Memory 6 (T. Sakai) 7. Learning & Memory 7 (T. Sakai) 8. Learning & Memory 8 (T. Sakai) 9. Organization of the nervous system (K. Ando) 10. Neurons and Glia – The Cells of the Brain (K. Ando) 11. Electrical Signaling in Neurons (K. Ando) 12. Synaptic Transmission and Neurotransmitters (K. Ando) 13. Synaptic Plasticity, Learning, and Memory (K. Ando) 14. Neural Circuits and Behavior (K. Ando) 15. Brain Disorders and Future Directions (K. Ando) 					
(4) Outside-class activities and assignments	(TS) Students are expected to prepare for and review the class and work on reports and other assignments. (KA) Short written assignment and reading.					
(5) Textbooks and course materials	(TS) Handouts and other materials will be distributed as appropriate. (KA) For review: Bear, Mark F., Barry W. Connors, and Michael A. Paradiso. Neuroscience: Exploring the Brain Copies may be found in the English Mini-library					
(6) Assessment and grading	(TS) Evaluation will be made comprehensively based on class participation, reports, etc. (KA) Active class participation and a short written assignment.					
(7) Questions to the instructor (Office hours, etc.)	(TS) No specific office hours are set. If you want to ask questions directly, please make an appointment in advance by e-mail or kibaco messages. (KA) Email questions to Kanae Ando (k_ando@tmu.ac.jp)					
(8) Special note	(TS) Students can take this course in English. Those who wish to take the course in English should contact the lecturers. An instruction will be given in the first lecture. (KA) Classes are given in English.					

Program	Course Name	Course Number	Semester	Day	Time	Credit Hours
Master's program	Advanced Lecture on Biochemistry	R0363	1st Semester	Fri	1	2
Doctoral program	Advanced Lecture on Biochemistry	R0364				
Instructor(s)			Note			
Kawahara, Otani, Okamoto						
(1) Course policies and topics	How Groundbreaking Discoveries Were Made - Focusing on Seminar Discussions					
(2) Knowledge/skills to be acquired and learning objectives/course goals	Modern biochemical and molecular cell biology research builds on the discoveries made by past researchers. Learning about the history of these developments is not only helpful for advancing your current graduate school research but also valuable for gaining a broad understanding of how to formulate problems and solve them. We encourage students to progress in their studies not merely to accumulate knowledge, but to learn in a way that allows them to leverage past successes for their own future research development.					
(3) Course schedule, subject matter, and classroom activities	<p>【Kawahara】 We will select several original research papers reporting groundbreaking discoveries in biochemistry and molecular cell biology, and delve into their content through a journal club format. We aim to present a broad range of papers, from classic works to recent publications, covering molecular biology, cell biology, and biochemistry. For each session, a discussion leader will be designated. The leader will explain the background, data presentation, and analysis of the paper. Simultaneously, all participants will actively engage in discussing: 1) What perspective did the authors have when starting this research? 2) What were the problems to be solved? 3) How did the authors approach these problems? The discussion leader for each session is required to prepare the presentation. All participants are required to read the assigned papers in advance. To facilitate this, reprints of the target papers (approximately 7 papers) will be distributed to everyone during the first lecture. The discussion leader for each paper will be assigned by the second lecture.</p> <p>【Otani】 We will select several original research papers reporting recent technical advances in cell biology. Participants will be divided into groups, propose a research plan that applies these techniques, and present it. The selected papers will be distributed during the first lecture, and participants will be divided into groups. All participants will discuss: 1) What are the characteristics of the technique? 2) What advantages does the technique offer compared to conventional methods? 3) What challenges can be addressed by applying this technique?</p> <p>【Okamoto】 Understand and present each chapter of Animal and Plant Fertilization (Kagaku-Dojin), or present on developmental phenomena of organisms, tissues, or cells relevant to the participant's own research theme.</p> <p>Session 1: Background explanation on pluripotency in cell differentiation / Assignment of papers (Kawahara) Session 2: Development of undifferentiated markers (Kawahara) Session 3: Molecular mechanisms of maintaining the undifferentiated state (Kawahara) Session 4: Establishment of Mouse iPS Cells (Kawahara) Session 5: Establishment of Human iPS Cells (Kawahara) Session 6: Properties and Issues of iPS Cells (Kawahara) Session 7: Current State of Pluripotent Stem Cell Research (Kawahara) Session 8: Background Explanation on Recent Research Techniques in Cell Biology & Assignment of groups (Otani) Session 9: Group Discussion (Otani) Session 10: Group Discussion (Ohtani) Session 11: Presentations (Ohtani) Session 12: Explanation and Chapter Assignments (Okamoto) Session 13: Fertilization in Single-Cell Organisms (Okamoto) Session 14: Fertilization in Animals (Okamoto) Session 15: Fertilization in Plants (Okamoto)</p>					
(4) Outside-class activities and assignments	Preparation and review of the papers will be required.					
(5) Textbooks and course materials	<p>【Kawahara】 Copies of important papers detailing groundbreaking discoveries in biochemistry and molecular cell biology will be distributed in advance. Related materials will also be distributed as appropriate.</p> <p>【Otani】 Papers and other materials will be distributed as appropriate.</p> <p>【Okamoto】 Papers and other materials will be distributed as appropriate.</p>					
(6) Assessment and grading	Grades will be determined by a comprehensive evaluation of class participation, mini-reports, and reports. Assessment for this course will be based on attendance, the degree to which literature reviews are completed, and performance in question-and-answer sessions. Active participation in seminars will be particularly highly valued.					
(7) Questions to the instructor (Office hours, etc.)	<p>Questions will be addressed as needed after scheduling via email.</p> <p>Kawahara: hkawa@tmu.ac.jp (Room 9-488) Okamoto: okamoto-takashi@tmu.ac.jp (Room 8-320) Otani: otani@tmu.ac.jp (Room 9-515)</p>					

(8) Special note

Students can take this course in English. Those who wish to take the course in English should contact the class lecturers.

Program	Course Name	Course Number	Semester	Day	Time	Credit Hours
Master's program	Advanced Lecture on Developmental Biology	R0369	1 st I	Thu.	1	1
Doctoral program	Advanced Lecture on Developmental Biology	R0370				
Instructor(s)			Note			
FUKUDA Kimiko TAKATORI Naohito						
(1) Course policies and topics	Current Research in Developmental Biology The goal of this course is to acquire basic knowledge of developmental biology, to develop the habit of reading papers critically, and to develop the ability to present papers accurately.					
(2) Knowledge/skills to be acquired and learning objectives/course goals	Develop the ability to read papers critically, present them accurately, and ask questions					
(3) Course schedule, subject matter, and classroom activities	Students will read excellent papers on developmental biology, give a presentation on the paper, and discuss. All participants will be asked to speak during the presentation.					
(4) Outside-class activities and assignments	Read and summarize papers outside of class.					
(5) Textbooks and course materials	No specific textbook. Papers will be introduced as appropriate.					
(6) Assessment and grading	Evaluation will focus on active participation, efforts, and attitude in class.					
(7) Questions to the instructor (Office hours, etc.)	Please schedule appointment prior to visiting the lab. takatori-naohito1[at]tmu.ac.jp					
(8) Special note	The class may be offered in English in consultation with the student.					

Program	Course Name	Course Number	Semester	Day	Time	Credit Hours
Master's program	Advanced Lecture on Molecular Biology	R0371	2nd	Fri	1	2
Doctoral program	Advanced Lecture on Molecular Biology	R0372				
Instructor(s)			Note			
Ehira and Ohbayashi						
(1) Course policies and topics	The theme is the latest research of molecular biology for microorganisms. Shigeki Ehira (microbial molecular physiology), and Ryudo Ohbayashi (genome microbiology), are in charge.					
(2) Knowledge/skills to be acquired and learning objectives/course goals	Understand the basics and applications of molecular biology and genome science.					
(3) Course schedule, subject matter, and classroom activities	<p>Advances in sequencing have now revealed the genome structure of many organisms, and molecular biology and genome science techniques are now widely used, from basic fields such as transcriptional analysis and identification of essential genes to medical and industrial fields. And, various metaomics analysis technology such as metagenome analysis which analyzes DNA of microbial community in the environment is developed. In this lecture, we introduce the latest research in several fields of molecular biology and genome science, focusing on the study of microorganisms.</p> <p>Some outside researchers are invited to give an omnibus lecture.</p> <ul style="list-style-type: none"> • microbial ecology • microbial population dynamics • difficult-to-culture microbes • symbiosis • survival strategy • cell-to-cell communication • horizontal gene transfer • regulation of gene expression • regulation of metabolism • cell differentiation • environmental acclimation • metabolic design • genome editing • synthetic biology 					
(4) Outside-class activities and assignments	Students are required to read relevant research articles.					
(5) Textbooks and course materials	No text specified.					
(6) Assessment and grading	Evaluate by active participation in class and reports.					
(7) Questions to the instructor (Office hours, etc.)	We don't set office hours, but if you want to ask a question directly, we will accept it anytime, so please make an appointment by email in advance.					
(8) Special note	Students can take this course in English. Those who wish to take the course in English should contact the lecturers.					

Program	Course Name	Course Number	Semester	Day	Time	Credit Hours
Master's program	Advanced Lecture on Biological Sciences	M(R0377)	1 (Summer intensive)	Sep 14, 15, 16, 17	2,3,4, 5	2
Doctoral program	Advanced Lecture on Biological Sciences	D(R0378)				
Instructor(s)			Note			
YOKOMIZO Hiroyuki						
(1) Course policies and topics	Basic statistical analysis using RStudio for biological systems					
(2) Knowledge/skills to be acquired and learning objectives/course goals	The aim of this course is to develop the statistical knowledge required for data analysis in the biological sciences and to build the skills needed to perform statistical analysis using R.					
(3) Course schedule, subject matter, and classroom activities	<p>【Date】 September 14, 15, 16, and 17, 2026 (each day from the 2nd period) (tentative)</p> <p>【Classroom】 Building 8, Room 287 (tentative)</p> <p>Descriptive statistics and probability distributions (1 class) Populations and samples, the law of large numbers, the central limit theorem (1 class) Statistical hypothesis testing: t-tests (2 classes) Analysis of variance (3 classes) Correlation and regression (1 class) Generalized linear models and generalized linear mixed models (3 classes) Nonparametric tests (2 classes) Principal component analysis (1 class) Case studies using statistical analysis (1 class)</p>					
(4) Outside-class activities and assignments	A total of 15 classes will be offered. Students are expected to review the material distributed in class as part of their out-of-class study.					
(5) Textbooks and course materials	Handouts will be distributed during class. Reference Book Shimada, M., & Abe, M. (2017). Introduction to Statistics with R. Tokyo Kagaku Dojin.					
(6) Assessment and grading	Evaluation will be based on in-class performance (50%) and a written report (50%), according to the indicated weights.					
(7) Questions to the instructor (Office hours, etc.)	Questions outside class hours may be submitted by email (hiroyuki.yokomizo@nies.go.jp).					
(8) Special note	<p>Enrollment is restricted to students in the Biological Sciences Program due to limitations in available equipment. Exercises will be conducted using R and RStudio. If students need to install the software on their own computers, installation instructions will be provided in advance.</p> <p>Because the exercises rely on R, students are expected to be familiar with basic R operations beforehand. Students are strongly advised to take Advanced Lecture on Biological Sciences: An introduction to R programming language for biological systems in preparation for this course.</p> <p>This course is given in Japanese. Students with no Japanese proficiency should consult the instructor by email in advance if they strongly wish to take the course.</p>					

Program	Course Name	Course Number	Semester	Day	Time	Credit Hours
Master's program	Advanced Lecture on Biological Sciences	M(R0365)	1 (Summer intensive)	Aug 31, Sep 1, 2, 3	2,3,4,5	2
Doctoral program	Advanced Lecture on Biological Sciences	D(R0366)				
Instructor(s)			Note			
FUKASAWA Keita						
(1) Course policies and topics	An introduction to R programming language for biological systems					
(2) Knowledge/skills to be acquired and learning objectives/course goals	<ul style="list-style-type: none"> • Acquire the fundamentals of R programming and become able to write and execute simple programs independently. • Prepare data for analysis in R, understand how to efficiently process and summarize large datasets, and learn the basic workflow leading to appropriate visualization depending on the type of dataset. • To prepare students for using R in their own research, this course emphasizes understanding how basic building blocks can be flexibly combined to perform a wide range of analytical tasks. 					
(3) Course schedule, subject matter, and classroom activities	<p>【Date】 August 31, 2026, and September 1, 2, and 3 (each day from the 2nd period) (tentative)</p> <p>【Classroom】 Building 8, Room 287 (tentative)</p> <p>R is a free software environment with strong statistical and graphical functions. It can be used interactively or through scripts, allowing efficient processing of large datasets, reproducible analyses, and numerical simulations using its built-in random-number generators.</p> <p>This course is for beginners in R and programming. It introduces the basic use of R as a programming environment and provides hands-on practice in writing simple programs. The course covers the following topics:</p> <ol style="list-style-type: none"> 1. Preprocessing of experimental and measurement data I 2. Preprocessing of experimental and measurement data II 3. Plotting experimental and measurement data I 4. Plotting experimental and measurement data II 5. Loops and conditionals I 6. Loops and conditionals II 7. Loops and conditionals III 8. Automated data visualization I 9. Automated data visualization II 10. Automated data visualization III 11. Automated data visualization IV 12. Mapping species distributions I 13. Mapping species distributions II 14. Mapping species distributions III 15. Summary <p>The course consists of 15 sessions.</p>					
(4) Outside-class activities and assignments	Students are expected to spend time outside class reviewing and practicing programming, as the course emphasizes hands-on work and independent problem-solving.					
(5) Textbooks and course materials	<p>Reference URL http://takenaka-akio.org/doc/r_auto/index.html</p> <p>References Funao, N. (2016). <i>The R Tips, 3rd Edition: Basic Techniques and Graphics in the R Data Analysis Environment</i>. Ohmsha. Grolemond, G. (2015). <i>Hands-On Programming with R</i>. (M. Ohashi, Supervising Translation; T. Nagao, Translation). O'Reilly Japan.</p>					
(6) Assessment and grading	Evaluation will be based on in-class performance (50%) and a written report (50%), according to the indicated weights.					
(7) Questions to the instructor (Office hours, etc.)	Questions outside class hours may be submitted by email (fukasawa@nies.go.jp).					
(8) Special note	<p>Enrollment is restricted to students in the Biological Sciences Program due to limitations in available equipment. Because the course proceeds step-by-step with integrated exercises, active participation in all sessions is strongly recommended.</p> <p>The course assumes prior completion of <i>Special Course in Biology I (Computer Practice: Basics)</i>, including the ability to copy, move, and rename files, understanding the difference between data files and program files, and handling text files and data exchange with spreadsheet software.</p> <p>This course is given in Japanese. Students with no Japanese proficiency should consult the instructor by email in advance if they strongly wish to take the course.</p>					

Program	Course Name	Course Number	Semester	Day	Time	Credit Hours
Master's program	Special Lecture on Genetic Information	R0391	2nd II	Fri	2	1
Doctoral program	Special Lecture on Genetic Information	R0392				
Instructor(s)			Note			
Tamura, Takahashi and Nozawa			-			
(1) Course policies and topics	Population Genetics and Evolutionary Genetics: Learn how to analyze the genetic variation in populations and molecular phylogeny from theoretical aspects, which underlie many biological disciplines, including genome-scale analysis, systems biology, and conservation biology.					
(2) Knowledge/skills to be acquired and learning objectives/course goals	Students are expected to learn the basic concepts of population genetics and evolutionary genetics, and gain practical knowledge for data analysis.					
(3) Course schedule, subject matter, and classroom activities	Learning the theoretical basis of genetic variation in populations is essential for many biological disciplines, including genome-scale analysis, systems biology, and conservation biology. In this lecture, the concepts of molecular ecology, population genetics, and evolutionary genetics are outlined, along with practical examples applied to actual research and data analysis.					
(4) Outside-class activities and assignments	Students are required to review each class and work on assignments. Students are also expected to read papers in which the theory of population genetics and evolutionary genetics is applied practically.					
(5) Textbooks and course materials	Handouts will be distributed in each class.					
(6) Assessment and grading	Evaluation is based on the degree of participation, quiz during the class, assignments, etc.					
(7) Questions to the instructor (Office hours, etc.)	Questions are always welcome, so please make an appointment in advance by email to Tamura (ktamura@tmu.ac.jp), Takahashi (ayat[at]tmu.ac.jp), or Nozawa (manozawa[at]tmu.ac.jp).					
(8) Special note	Students can take this course in English. Those who wish to take the course in English should contact the lecturers in advance.					

Program	Course Name	Course Number	Semester	Day	Time	Credit Hours
Master's program	Special Lecture on Ecological Science	R0393	II	Fri.	2	1
Doctoral program	Special Lecture on Ecological Science	R0394				
Instructor(s)		Note				
SUZUKI Jun-ichiro OKAMURA Yu		Animal behavior and society, renewal of plant communities				
(1) Course policies and topics	【Methods in Animal Ecology, Plant Community Ecology】 Students will learn different approaches to studying animal ecology, and matter production and inter-specific interactions in plant communities.					
(2) Knowledge/skills to be acquired and learning objectives/course goals	In these lectures, students will develop their ability to study independently, think logically, and communicate in English.					
(3) Course schedule, subject matter, and classroom activities	<p>Methods in Animal Ecology (Okamura).</p> <p>1: Introduction to approaches for the study of animal ecology. 2: Direct approaches: observational, comparative, and experimental studies. 3: Indirect approaches: molecular and theoretical studies. 4: Discussion and synthesis.</p> <p>Studies on plant communities: review of fundamental literature and their reviews (Suzuki). 5: Introduction; Matter production and interspecific interactions in plant communities. 6: Research reviews; matter production in plant communities. 7: Research reviews; interspecific interactions in plant communities. 8: Discussion; Perspectives of studies on plant community.</p>					
(4) Outside-class activities and assignments	Students must learn the target and cited papers and prepare presentations and essays.					
(5) Textbooks and course materials	<p>Students will receive handouts through kibaco(Okamura).</p> <p>Students will receive handouts through kibaco (Suzuki).</p>					
(6) Assessment and grading	<p>Evaluation will be based on both active participation in class and reports (Okamura).</p> <p>The evaluation will be based on the presentation of the target paper (60%) and mutual assessments on the presentation (40%) (Suzuki).</p>					
(7) Questions to the instructor (Office hours, etc.)	If you need advice or have questions, please email (first half: okamura-bs@tmu.ac.jp, second half: jsuzuki@tmu.ac.jp).					
(8) Special note	<p>Students attending the course should have already taken Ecology and Advanced Ecology courses at university.</p> <p>The second half will be given in principally in Japanese with the handouts and slides written in English.</p>					

Program	Course Name	Course Number	Semester	Day	Time	Credit Hours
Master's program	Special Lecture on Responses to Environment	R0397	1 st - I	Fri.	1	1
Doctoral program	Special Lecture on Responses to Environment	R0398				
Instructor(s)			Note			
KANEGAE Takeshi, NARIKAWA Rei						
(1) Course policies and topics	One of the most significant functions of living organisms is to respond to surrounding environmental information. The purpose of this class is to understand the physiological responses and phenomena related to the environment focusing on the light signal that evolved in various organisms such as plants and cyanobacteria and to understand various methods to analyze photoreceptor molecules.					
(2) Knowledge/skills to be acquired and learning objectives/course goals	Part 1: This course will introduce recent research on light sensing in plants. At the end of this course, students will be able to explain how light as environment information is accepted by plant photoreceptors and how information is expressed. Part 2: In this course, students will understand the methods to analyze the photoreceptors in vitro, which would be applicable to the other proteins.					
(3) Course schedule, subject matter, and classroom activities	[Part 1] 1. Photoreceptors 2. Transcriptional and post-transcriptional control 3. RNA modification 4. Adaptive strategy for a weak light environment [Part 2] 1. Cloning and mutagenesis 2. Protein purification 3. Spectroscopy 4. Various biochemical and biophysical studies					
(4) Outside-class activities and assignments	Homework will be given after each class or you should review the last lecture every week.					
(5) Textbooks and course materials	Text: Handouts will be provided.					
(6) Assessment and grading	Assessment: The mean score from Part 1 and Part 2 will be the final grade. Parts 1 & 2: Class participation/discussion 30 %, Quiz or Report submission 70 %					
(7) Questions to the instructor (Office hours, etc.)	Particular office hour is not set. For queries, please make an appointment via e-mail.					
(8) Special note	This class will be offered in Japanese (Class may be offered in English). Those who wish to take the course in English should contact the class lecturer.					

Program	Graduate School of Science		Semester	Day	Time	Credit Hours
	Course Name	Course Number				
Master's program	Special Lecture on Systematics and Evolution	R0373	2nd I	Tue	1	1
Doctoral program	Special Lecture on Systematics and Evolution	R0374				
Instructor(s)			Note			
Takayama and Eguchi						
(1) Course policies and topics	Phylogenetics] Deepen understanding of the field by introducing recent research to explore issues of animal and plant diversity and evolution.					
(2) Knowledge/skills to be acquired and learning objectives/course goals	Learn the thought processes by which researchers use information to understand the lineage and evolution of living organisms.					
(3) Course schedule, subject matter, and classroom activities	(Eguchi) Southeast Asia is considered the most species-diverse region in the world. In many animal groups, however, the speciation is poorly understood. There is also a lack of knowledge about the geographical genetic structure and origin of individual species and lineages. This lecture will cover the recent progress in the classification and phylogeography of terrestrial invertebrates in Southeast Asia. (TAKAYAMA) Use of genomic data in biodiversity analysis will be explained, and recent studies employing genomic information to investigate evolutionary processes in land plants—such as hybridization, introgression, and reticulate evolution—will be introduced. Museomics utilizing plant specimens will also be addressed, highlighting the importance of natural history collections. In addition, the forefront of island biology will be presented to deepen perspectives on plant evolution and diversification.					
(4) Outside-class activities and assignments	To deepen understanding of research by reading short papers and expressing opinions on research directions and issues. It is necessary to make a small report on the main points and impressions of the lecture at home.					
(5) Textbooks and course materials	The lecture proceeds mainly on the handout, and references and papers, etc. are introduced as appropriate.					
(6) Assessment and grading	Evaluate based on participation in classes and reports.					
(7) Questions to the instructor (Office hours, etc.)	Questions are always welcome, so please make an appointment in advance by email. Eguchi: antist@tmu.ac.jp Takayama: takayamak@tmu.ac.jp					
(8) Special note	Students can take this course in English. Those who wish to take the course in English should contact the class lecturers.					

Program	Course Name	Course Number	Semester	Day	Time	Credit Hours
Master's program	Special Lecture on Developmental and Regenerative Biology	R0759	2 nd - Winter Intensive	Dec 9 & 10	2,3,4, 5	1
Doctoral program	Special Lecture on Developmental and Regenerative Biology	R0760				
Instructor(s)			Note			
Guojun Sheng						
(1) Course policies and topics	In this course, you will learn basic principles of how animal bodies are organized and how this organization is reached from a single fertilization egg, through several conserved developmental morphogenetic processes. Emphasis will be given to gastrulation, symmetry-breaking, spatio-temporal information, embryonic-extraembryonic interactions and epithelial-mesenchymal transitions during animal development. You will also learn basic principles of stem cell biology and how stem cell models are being used to study human development. Keywords: animal development, pluripotency, ectoderm, mesoderm, endoderm, anterior-posterior axis, dorsal-ventral axis, gastrulation, EMT					
(2) Knowledge/skills to be acquired and learning objectives/course goals	By taking this course, you will gain understanding of vertebrate body plan and organ/tissue development, and of developmental origins of many human diseases.					
(3) Course schedule, subject matter, and classroom activities	<p>Day1</p> <p>Lecture 1 (90'): Animal body plan</p> <p>Lecture 2 (90'): Early development: from fertilization to gastrulation</p> <p>Lecture 3 (90'): germ layer patterning and differentiation</p> <p>Lecture 4 (90'): seminar open to students and faculty members</p> <p>Day 2</p> <p>Lecture 5 (90'): Extraembryonic tissues in amniotic vertebrates</p> <p>Lecture 6 (90'): epithelial-mesenchymal transition and developmental stem cell biology</p> <p>Lecture 7 (90'): lab practice: collecting chick embryos and identifying developmental structures</p> <p>Lecture 8 (90'): Presentation: describe a developmental process, ask a question and design a "hypothetical research project"</p> <p>Teaching Methods: Combination of theoretical knowledge (day 1 and day 2) and practical training (observation/presentation) (afternoon of day 2)</p>					
(4) Outside-class activities and assignments	Final project: Students will work in groups on designing a simple research project proposal (to be completed within two weeks)					
(5) Textbooks and course materials	Required Textbook (none; but helpful if students have access to Scott Gilbert's Developmental Biology, any edition) required reading (none) Computer requirement: none					
(6) Assessment and grading	Class participation - 70% Final project - 30%					
(7) Questions to the instructor (Office hours, etc.)	Contact: Guojun Sheng Kumamoto University (sheng@kumamoto-u.ac.jp)					
(8) Special note	This is an intensive lecture course given in English. For more information about the course, please email Dr. Kanae Ando (k_ando@tmu.ac.jp) For questions regarding course registration, contact the curriculum coordinator (Dr. Obayashi, daigakuin@biol.se.tmu.ac.jp).					

Program	Course Name	Course Number	Semester	Day	Time	Credit Hours
Master's program	English for Biology	R0421	1 (Summer intensive)	Sep 20, 21, 22	1,2,3, 4,5	2
Doctoral program	English for Biology	R0422				
Instructor(s)		Note				
IIJIMA Yuka						
(1) Course policies and topics	Speaking/Listening					
(2) Knowledge/skills to be acquired and learning objectives/course goals	<p>This course is an English speaking and listening course designed for science students. It aims to develop students' ability to communicate effectively in academic and professional scientific contexts. Through guided practice, students will learn how to give short oral presentations, explain their research clearly, participate in discussions with other researchers, and communicate scientific ideas to non-specialist audiences. The course also encourages students to develop strategies for independent learning and continued improvement in spoken English.</p> <p>By the end of the course, students will be able to:</p> <ul style="list-style-type: none"> • understand and respond appropriately to spoken English in common scientific and academic situations; • give clear, well-structured short oral presentations on their own research in English; • explain research topics, experiments, or data using appropriate scientific vocabulary; • communicate ideas effectively through the appropriate use of intonation, rhythm, and pronunciation; • participate actively in academic discussions and use appropriate English expressions as a conference presenter, session chair, and audience member; • reflect on their performance and use basic learning strategies, including the appropriate use of generative AI, to improve their academic listening and speaking skills. 					
(3) Course schedule, subject matter, and classroom activities	<p>Basic scientific terms and expressions that are not usually covered in general English classes will be introduced and practised. Classes will be conducted in English using an interactive workshop format that emphasises active listening and speaking practice.</p> <ol style="list-style-type: none"> 1. Introduction to English for Specific Purposes (ESP) 2. Professional self-introductions in scientific contexts 3. Numbers and mathematical expressions 4. Laboratory equipment, tables, and graphs 5. Dictation for listening accuracy 6. Listening to and summarising science news podcasts 7. Listening and speaking practice: prosody (intonation and rhythm) 8. Recitation and self-analysis of spoken performance 9. Genre analysis of science news 10. Creating and presenting a science news podcast 11. Presentation skills and pronunciation 12. Useful expressions for presentations and Q&A sessions 13. Chairing an academic session 14. Slide and script writing for mock conference oral presentations 15. Mock conference oral presentations <p>Students are required to use a computer with stable Wi-Fi access and earphones for online reading, listening, writing, speaking, and video and audio recording tasks.</p>					
(4) Outside-class activities and assignments	Homework assignments will include producing transcripts of spoken texts, writing peer feedback comments, and preparing slides and scripts for oral presentations.					
(5) Textbooks and course materials	<p>Reference books:</p> <ul style="list-style-type: none"> •理系英語のライティング (野ロジュディー、アルク) •Judy先生の成功する理系英語プレゼンテーション (野ロジュディー・照井雅子・藤田清士、講談社) •国際学会Englishスピーキング・エクササイズ 口演・発表・応答 (C. S. Langham, 医歯薬出版) •遺伝研メソッドで学ぶ化学英語プレゼンテーション (平田たつみ・タジ・ゴルマン・広海健, dZERO) <p>Course materials will be shared via Kibaco and Google Drive.</p>					
(6) Assessment and grading	<ul style="list-style-type: none"> • Discussion participation: 20% • Listening and speaking assignments: 25% • Mock conference presentation, chairing, and audience interaction: 35% • Portfolio: 20% 					

(7) Questions to the instructor (Office hours, etc.)	Via e-mail.
(8) Special note	The lecturer of this course is Yuka Iijima. This course is given in English.

Program	Course Name	Course Number	Semester	Day	Time	Credit Hours
Master's program	English for Biology	R0423	2 (Winter intensive)	February		2
Doctoral program	English for Biology	R0424				
Instructor(s)			Note			
MASWANA Sayako						
(1) Course policies and topics	Academic Writing					
(2) Knowledge/skills to be acquired and learning objectives/course goals	The goal of this course is to acquire the basic knowledge and skills that students need to write empirical scientific RAs and abstracts in English. The course is for students who are currently writing or are preparing to write empirical scientific research articles (RAs) for academic journals, abstracts for international conferences, theses, and/or dissertations.					
(3) Course schedule, subject matter, and classroom activities	<p>Students will learn important aspects of empirical scientific RAs that consist of Introduction, Methods, Results, and Discussion (IMRaD). They will also analyze empirical scientific RAs from their fields of study for the structure and language features of RAs in order to prepare them to write RAs and/or abstracts effectively for publication. In this course, students will be writing on their own research. The class will be conducted mainly in English.</p> <p>Note: For the RA analysis, students will collect and submit electronic copies of five RAs that meet all the requirements below:</p> <ol style="list-style-type: none"> Original RAs **Reviews are not acceptable. Full-length RAs **NOT letters or short communications RAs on or related to the students' own research RAs published in well-respected journals RAs that consist of the following sections: Introduction, Methodology, Results, and Discussion. (Since these are typical names of sections that appear in empirical scientific RAs, the names of the sections in your RAs do not have to exactly match those section names. For example, the Methodology section may be labeled as "Methods" or "Procedure" in some RAs.) <p>Lesson 1: Course Orientation Lesson 2: Basics of Academic Writing, Paragraphing Lesson 3: Paraphrasing, Summarizing Lesson 4: English for Specific Purposes / OCHA / PAIL Lesson 5: Structure of a Research Article (RA), Introduction (1) Lesson 6: Introduction (2) Lesson 7: Introduction (3), Methodology (1) Lesson 8: Methodology (2) Lesson 9: Current Topics in RA Writing , Corpus Lesson 10: Results & Discussion (1) Lesson 11: Results & Discussion (2) Lesson 12: Results & Discussion (3) Lesson 13: Title / Abstract (1) Lesson 14: Abstract (2) Lesson 15: Other Topics in RA Writing / Review</p>					
(4) Outside-class activities and assignments	Students are expected to prepare for and review each class and work on assignments according to the instructor's directions.					
(5) Textbooks and course materials	(参考書) 理系英語のライティングVer. 2 野ロジュディー、深山晶子、村尾純子、浅野元子 著(発行： 株式会社 アルク)					
(6) Assessment and grading	Class work / active class participation: 25% Short writing and other assignments: 45% Final writing assignment: 30%					
(7) Questions to the instructor (Office hours, etc.)	By e-mail: smaswana@gmail.com					
(8) Special note	The lecturer for this course is Sayako Maswana. This course is given in English.					

Program	Graduate School of Science		Semester	Day	Time	Credit Hours
	Course Name	Course Number				
Master's program	Special Course in Biology II (Communication in English)	R0425	1st	Mon	4	2
Doctoral program	Special Course in Biology II (Communication in English)	R0426				
Instructor(s)			Note			
Elizabeth Zielinska*						
(1) Course policies and topics	Nature Talk I					
(2) Knowledge/skills to be acquired and learning objectives/course goals	Outline: This class aims to focus on topics selected by the students and relevant to their research programs. The facilitator will encourage participants to reflect, restate, rephrase, summarize, question, interpret, emphasize, and confront the topics and issues. She will also explain the relevant grammatical problems.					
(3) Course schedule, subject matter, and classroom activities	<ol style="list-style-type: none"> 1. Introduction; selection of articles dealing with: 2. Biology of living organisms – structure, activities, distribution, space, and time. 3. Biochemistry - the application of chemistry to study biological processes at the cellular and molecular levels. 4. Biodiversity – talking about different kinds of life found in one area, e.g., animals, plants, fungi, and microorganisms. 5. Cell Biology – the study of cell structure and function. 6. Developmental Biology – an exploration of how animals and plants grow and develop. 7. Ecology – we will try to understand the vital connections between plants, animals, and the world around them. 8. Evolutionary Biology – analysis of the evolutionary processes and patterns, especially concerning the diversity of organisms and how they change over time. 9. Genetics – we will seek to understand the patterns of inheritance of specific traits relating to genes and genetic information. 10. Gene Science – research dealing with understanding fundamental units of heredity. 11. Genome Science – looking into the science of an organism's complete set of genetic information. 12. Molecular Biology – the study of the molecular basis of biological activity. 13. Neuroscience - focusing on the brain and its impact on behavior and cognitive functions. 14. Taxonomy – how can we name, describe, and classify organisms that include all the world's plants, animals, and microorganisms? 15. Q & A, a summary of the course. 					
(4) Outside-class activities and assignments	Article reading(s) is(are) scheduled as homework every week of the class.					
(5) Textbooks and course materials	Prints will be given if needed.					
(6) Assessment and grading	Mini tests and class contribution (10%), end semester exam (90%).					
(7) Questions to the instructor (Office hours, etc.)	The lecturer of this course is Ms. Elizabeth Zielinska (eliedutm@tmu.ac.jp). You can contact her by e-mail					
(8) Special note	This course is given in English.					

Program	Graduate School of Science		Semester	Day	Time	Credit Hours
	Course Name	Course Number				
Master's program	Special Course in Biology II (Communication in English)	R0427	2nd	Mon	3	2
Doctoral program	Special Course in Biology II (Communication in English)	R0428				
Instructor(s)			Note			
Elizabeth Zielinska*						
(1) Course policies and topics	How to Create a Persuasive Presentation					
(2) Knowledge/skills to be acquired and learning objectives/course goals	<p>Outline:</p> <p>Fear of Public Speaking in English can sometimes be quite overpowering. This class aims to help you communicate better with fellow researchers and students by reducing nervousness so that other English speakers can better perceive and understand you. At the same time, we will work on pronunciation (process and content) to make the presentation meaningful and persuasive. Finally, the participants will create and deliver final dynamic presentations. As a facilitator, I hope you will enjoy the class, learn to tell stories, incorporate AI in your presentations, have fun, and learn a lot. I look forward to your attendance. Some classes will be conducted online using Zoom.</p>					
(3) Course schedule, subject matter, and classroom activities	<p>Content:</p> <ol style="list-style-type: none"> 1. How do you start your presentation? 2. Online presentations; AI – what to do and what not to do (online). 3. Effective Presentations – required elements. 4. Language used in presentations/vowels and intonation. A story with a twist (homework). 5. Dealing with questions – emphases, rhythm, and stress in speaking. 6. Body language: “Fake it till you make it.” Introducing the topic of your research (homework). 7. Six principles of a good presentation. 8. Body, posture, and personal space. Presenting an experiment (homework). 9. Dress for presentations. 10. PechaKucha (20X20) and 3MT – how to time your delivery. Why is your research important? (homework). 11. Poster presentations at TMU and elsewhere. Theory. 12. Poster presentations – practice. 13. How to prepare a good presentation on your research topic and deliver it in 20 min. (homework) 14. Repeating, recapping, rephrasing, and active listening. Being persuasive. 15. Summary and conclusions. 					
(4) Outside-class activities and assignments	Some homework/short, 3 to 5-slide presentations (see above) will be required.					
(5) Textbooks and course materials	Handouts will be uploaded to Kibaco, if necessary.					
(6) Assessment and grading	<p>Assessment:</p> <p>Weekly presentations (50%), final presentation (50%).</p>					
(7) Questions to the instructor (Office hours, etc.)	The lecturer of this course is Ms. Elizabeth Zielinska (eliedutmu@tmu.ac.jp). You can contact her by e-mail.					
(8) Special note	This course is given in English.					

Program	Graduate School of Science		Semester	Day	Time	Credit Hours
	Course Name	Course Number				
Master's program	Special Course in Biology II (Communication in English)	R0429	2nd	Mon	4	2
Doctoral program	Special Course in Biology II (Communication in English)	R0430				
Instructor(s)			Note			
Elizabeth Zielinska*						
(1) Course policies and topics	Nature Talk II					
(2) Knowledge/skills to be acquired and learning objectives/course goals	<p>Outline:</p> <p>This class aims to focus on topics selected by the students and relevant to their research programs. The facilitator will encourage participants to reflect, restate, rephrase, summarize, question, interpret, emphasize, and confront the topics and issues. She will also explain the relevant grammatical problems.</p> <p>The focus of the week, an article from a scientific journal, will be selected by a volunteer student and delivered to the participants (e-mail, Kibaco, printout). The final written (open book) exam will conclude the classes at the end of the semester. The test might be conducted online. The selected articles will relate to different fields of biology.</p>					
(3) Course schedule, subject matter, and classroom activities	<ol style="list-style-type: none"> 1. Introduction; selection of articles dealing with: 2. Biology of living organisms – structure, activities, distribution, space, and time. 3. Biochemistry - the application of chemistry to study biological processes at the cellular and molecular levels. 4. Biodiversity – talking about different kinds of life found in one area, e.g., animals, plants, fungi, and microorganisms. 5. Cell Biology – the study of cell structure and function. 6. Developmental Biology – an exploration of how animals and plants grow and develop. 7. Ecology – we will try to understand the vital connections between plants, animals, and the world around them. 8. Evolutionary Biology – analysis of the evolutionary processes and patterns, especially concerning the diversity of organisms and how they change over time. 9. Genetics – we will seek to understand the patterns of inheritance of specific traits relating to genes and genetic information. 10. Gene Science – research dealing with understanding fundamental units of heredity. 11. Genome Science – looking into the science of an organism's complete set of genetic information. 12. Molecular Biology – the study of the molecular basis of biological activity. 13. Neuroscience - focusing on the brain and its impact on behavior and cognitive functions. 14. Taxonomy – how can we name, describe, and classify organisms that include all the world's plants, animals, and microorganisms? 15. Q & A, a summary of the course. 					
(4) Outside-class activities and assignments	Article reading(s) is(are) scheduled as homework every week of the class.					
(5) Textbooks and course materials	Prints will be given if needed.					
(6) Assessment and grading	Mini tests and class contribution (10%), end semester exam (90%).					
(7) Questions to the instructor (Office hours, etc.)	The lecturer of this course is Ms. Elizabeth Zielinska (eliedutm@tmu.ac.jp). You can contact her by e-mail.					
(8) Special note	This course is given in English.					

Program	Course Name	Course Number	Semester	Day	Time	Credit Hours
Master's program	Special Course in Biology I	R0433	2	F	2	1
Doctoral program	Special Course in Biology I	R0434				
Instructor(s)		Note				
ANDO Kanae CRONIN Adam		Technique for Research Communication Course in English				
(1) Course policies and topics	During graduate training, it is anticipated that students will make new research discoveries. The ability to effectively communicate research findings to a broad audience can enhance the placement of students toward productive positions within their research community. The purpose of this course is to train and support TMU graduate students in the preparation and delivery of oral presentations.					
(2) Knowledge/skills to be acquired and learning objectives/course goals	At the end of the course, students will be able to effectively share their research through conference-style presentations (15 min talk) and within a 3-minute "elevator pitch". Students will also share and peer-review their presentations with students at partner universities abroad via Collaborative Online International Learning (COIL).					
(3) Course schedule, subject matter, and classroom activities	<p>Format: Didactic lecture & student presentation</p> <p>Tentative schedule:</p> <p>I. Conference style</p> <ol style="list-style-type: none"> 1. Introduction to presentation 2. Lecture (presentation slides) 3. Lecture (presentation delivery) 4. Prepare presentation & rehearsal 5. Conference-style presentation (students play roles of speakers, chairs, referees) <p>II. 3-min talk</p> <ol style="list-style-type: none"> 6. Lecture (3-min talk) 7. Exchange talks via COIL 8. Exchange talks via COIL 					
(4) Outside-class activities and assignments	[Out of class activity requirement] Students will have to work on their presentations and comment on others.					
(5) Textbooks and course materials	<p>Text book and Required Supplies:</p> <p>Science Research Writing: For Native And Non-native Speakers Of English (second Edition) ISBN: 978-1786347848</p> <p>Handout will be distributed in the class.</p>					
(6) Assessment and grading	Assessment: Class participation & presentation 100%.					
(7) Questions to the instructor (Office hours, etc.)	Email to Kanae Ando (k_ando@tmu.ac.jp) and Adam Cronin (adam-l@tmu.ac.jp)					
(8) Special note	This course includes COIL (collaborative online international learning) with classes from partner universities. This course is given in English.					

Program	Course Name	Course Number	Semester	Day	Time	Credit Hours
Master's program	Special Course in Biology I (Computer Practice: Basic)	R0439	1st intensive	April 15, April 22.-	2,3,4, 5-	1
Doctoral program	Special Course in Biology I (Computer Practice: Basic)	R0440				
Instructor(s)			Note			
Nozawa			On the first day, new students are encouraged to participate regardless of whether they register for the course or not.			
(1) Course policies and topics	<p>The students taking this course can learn the basics of large-scale sequencing data analysis, which has been rapidly advanced in recent years. The exercise will take the form of a two-day intensive course.</p> <p>Day 1: Wednesday, April 15 2-5 periods (4 classes)</p> <p>Day 2: Wednesday, April 22 2-5 periods (4 classes)</p> <p>In the first session (Day 1), students will practice how to use TMU network system, such as the Biological Sciences Forum, TMUNER, and the Library Information System. Therefore, new students are encouraged to participate in the program even for students who do not register for this course. Confirm the user ID and password for using our university system (TMUNER) by the starting time at Day 1.</p>					
(2) Knowledge/skills to be acquired and learning objectives/course goals	<ul style="list-style-type: none"> • How to use computers as tools • Basic knowledge on the handling of copyrights and security for using computers • Basic knowledge on bioinformatics and related applications 					
(3) Course schedule, subject matter, and classroom activities	<p>In this course, basics of bioinformatics and its related applications will be introduced for beginners, and the practice will be carried out with real sequence data. The schedule is as follows.</p> <ul style="list-style-type: none"> • Fundamentals of next-generation sequence data analysis <p>*If this exercise cannot be carried out as scheduled due to an inevitable reason, the date, place, and content of the exercise may be changed. In this case, you will be notified by "Biological Sciences Forum" (https://forum.biol.se.tmu.ac.jp/) or e-mail. Students who do not know how to use the Biological Sciences Forum or university e-mail should contact Tamura (ktamura @ tmu.ac.jp) by e-mail.</p>					
(4) Outside-class activities and assignments	<ul style="list-style-type: none"> • Review the content of the exercise and address the issues. 					
(5) Textbooks and course materials	Information will be provided through kibaco.					
(6) Assessment and grading	Attitude (20%) and report (80%)					
(7) Questions to the instructor (Office hours, etc.)	If you have any questions, please email to Nozawa (manozawa [at] tmu.ac.jp).					
(8) Special note	Students can take this course in English. Those who wish to take the course in English should contact the lecturers in advance.					

Program	Course Name	Course Number	Semester	Day	Time	Credit Hours
Master's program	Biology course in planning and management 1	R0443	1st	Tue	2	1
Doctoral program	Biology course in planning and management 1	R0444				
Instructor(s)			Note			
HARUTA Shin Multiple instructors						
(1) Course policies and topics	This course will support the voluntary and spontaneous activities by students. Through the activities related to biological sciences, the course will enhance the development of basic skills in research and business. (Examples: outreach activity, planning of research meetings)					
(2) Knowledge/skills to be acquired and learning objectives/course goals	This course aims to help students acquire "the ability to plan, implement, and evaluate" necessary to conduct research creatively. The course also aims to enable students to be actively involved in various fields as professional researchers, development planners, educators, and managers, and so on in the future.					
(3) Course schedule, subject matter, and classroom activities	<p>Students take the initiative in planning and implementing the following projects while mutually evaluating each other's work. The results of the project will be self- and mutually assessed for the next new project.</p> <ul style="list-style-type: none"> • Outreach activities, including visiting lectures/experiments and production of web content/brochures. • Research introduction and study guidance/consultation for undergraduate and graduate students • Organizing research meetings • Other projects to enhance life science research <p>Students are expected to work in groups, with assistance from the lecturers as needed. Financial support for project implementation may be available.</p>					
(4) Outside-class activities and assignments	Out-of-class learning is necessary for preparing proposals/reports.					
(5) Textbooks and course materials	Past reports can be available at https://biol.fpark.tmu.ac.jp/impgrad/outreach/ .					
(6) Assessment and grading	Evaluation will be based on the proposal and report. The progress of the project may also be subject to evaluation.					
(7) Questions to the instructor (Office hours, etc.)	Questions and consultations will be accepted at any time, both by e-mail and in person. Contact: Shin Haruta (sharuta@tmu.ac.jp) Bldg. 8, Room 434					
(8) Special note	All graduate students in the Department of Biological Sciences are expected to participate. This course is given in English and Japanese.					

Program	Course Name	Course Number	Semester	Day	Time	Credit Hours
Master's program	Biology course in planning and management 2	R0445	2nd	Tue	2	1
Doctoral program	Biology course in planning and management 2	R0446				
Instructor(s)		Note				
HARUTA Shin Multiple instructors						
(1) Course policies and topics	This course will support the voluntary and spontaneous activities by students. Through the activities related to biological sciences, the course will enhance the development of basic skills in research and business. (Examples: outreach activity, planning of research meetings)					
(2) Knowledge/skills to be acquired and learning objectives/course goals	This course aims to help students acquire "the ability to plan, implement, and evaluate" necessary to conduct research creatively. The course also aims to enable students to be actively involved in various fields as professional researchers, development planners, educators, and managers, and so on in the future.					
(3) Course schedule, subject matter, and classroom activities	<p>Students take the initiative in planning and implementing the following projects while mutually evaluating each other's work. The results of the project will be self- and mutually assessed for the next new project.</p> <ul style="list-style-type: none"> • Outreach activities, including visiting lectures/experiments and production of web content/brochures. • Research introduction and study guidance/consultation for undergraduate and graduate students • Organizing research meetings • Other projects to enhance life science research <p>Students are expected to work in groups, with assistance from the lecturers as needed. Financial support for project implementation may be available.</p>					
(4) Outside-class activities and assignments	Out-of-class learning is necessary for preparing proposals/reports.					
(5) Textbooks and course materials	Past reports can be available at https://biol.fpark.tmu.ac.jp/impgrad/outreach/ .					
(6) Assessment and grading	Evaluation will be based on the proposal and report. The progress of the project may also be subject to evaluation.					
(7) Questions to the instructor (Office hours, etc.)	Questions and consultations will be accepted at any time, both by e-mail and in person. Contact: Shin Haruta (sharuta@tmu.ac.jp) Bldg. 8, Room 434					
(8) Special note	All graduate students in the Department of Biological Sciences are expected to participate. This course is given in English and Japanese.					

Program	Graduate School of Science		Semester	Day	Time	Credit Hours
	Course Name	Course Number				
Master's program	Biology Course in International Research Experiences 1	R0447	1st	Tue	3	1
Doctoral program	Biology Course in International Research Experiences 1	R0448				
Instructor(s)			Note			
Fukuda and All faculty member of Department of Biological Sciences						
(1) Course policies and topics	Exercise for international leadership					
(2) Knowledge/skills to be acquired and learning objectives/course goals	Exercise for international leadership					
(3) Course schedule, subject matter, and classroom activities	Students plan events and lectures by themselves in order to acquire international leadership, and take them. It includes long term visits to overseas laboratories, invitation of overseas young researchers, and holding of international symposiums. The integrated study period is over 30 hours regardless of class hours. In the case that it is difficult to go abroad and to invite overseas researchers, the proposal of the event using the Internet is accepted.					
(4) Outside-class activities and assignments	Many activities are conducted outside class hours.					
(5) Textbooks and course materials	There are no regular texts, but they are provided on request.					
(6) Assessment and grading	Evaluate in the activity report.					
(7) Questions to the instructor (Office hours, etc.)	Student can contact the lecturer by e-mail (kokko@tmu.ac.jp).					
(8) Special note	Students can take this course in English.					

Program	Course Name	Course Number	Semester	Day	Time	Credit Hours
Master's program	Biology Course in International Research Experiences 2	R0449	2nd	Tue	3	1
Doctoral program	Biology Course in International Research Experiences 2	R0450				
Instructor(s)			Note			
Fukuda and All faculty member of Department of Biological Sciences						
(1) Course policies and topics	Exercise for international leadership					
(2) Knowledge/skills to be acquired and learning objectives/course goals	Exercise for international leadership					
(3) Course schedule, subject matter, and classroom activities	Students plan events and lectures by themselves in order to acquire international leadership, and take them. It includes long term visits to overseas laboratories, invitation of overseas young researchers, and holding of international symposiums. The integrated study period is over 30 hours regardless of class hours. In the case that it is difficult to go abroad and to invite overseas researchers, the proposal of the event using the Internet is accepted.					
(4) Outside-class activities and assignments	Many activities are conducted outside class hours.					
(5) Textbooks and course materials	There are no regular texts, but they are provided on request.					
(6) Assessment and grading	Evaluate in the activity report.					
(7) Questions to the instructor (Office hours, etc.)	Student can contact the lecturer by e-mail (kokko@tmu.ac.jp).					
(8) Special note	Students can take this course in English.					

Program	Course Name	Course Number	Semester	Day	Time	Credit Hours
Master's program	Biology course in research evaluation 1	M(R0451)	1st Semester	Wed.	1	1
Doctoral program	Biology course in research evaluation 1	D(R0452)				
Instructor(s)		Note				
SUZUKI Jun-ichirou Multiple instructors						
(1) Course policies and topics	Evaluation of research proposals and applications: Through critically reading multiple proposals and reports written by others, students learn how to design stronger research plans and write more effective proposals. The course also provides training in logical critique and in communicating constructive feedback.					
(2) Knowledge/skills to be acquired and learning objectives/course goals	Through this exercise, students will develop autonomous learning skills, logical thinking ability, and communication skills. Using materials such as the application forms for the JSPS Research Fellowship, students will prepare a research plan for their remaining period of study, present it, and engage in mutual critique. After receiving feedback, students will revise their proposals and serve as referees for one another by evaluating proposals written by others. They will then provide the applicants with their evaluations along with clear explanations of the reasons.					
(3) Course schedule, subject matter, and classroom activities	This exercise covers the following topics: What evaluation means in research Principles of effective communication and practice I Principles of effective communication and practice II Fundamentals of information delivery and practice I Fundamentals of information delivery and practice II Academic writing I Academic writing II Key points for clear written expression I Key points for clear written expression II Important aspects to consider in evaluation I Important aspects to consider in evaluation II Implementing peer evaluation I Implementing peer evaluation II The significance of revision based on peer review I The significance of revision based on peer review II					
(4) Outside-class activities and assignments	Students are expected to prepare and revise their proposals outside of class. This requires at least approximately 1.5 hours of preparation (drafting) and review (revision) for each class.					
(5) Textbooks and course materials	Although the book is written in Japanese, students are strongly advised to read Kinoshita, Koreo (1981). "Scientific Writing for the Natural Sciences" (Chuko Shinsho 624, Chuokoron-Shinsha) in advance.					
(6) Assessment and grading	Evaluation will be based on essays and the assessments of proposals conducted through peer review, supplemented by consideration of each student's contributions, including participation in discussions.					
(7) Questions to the instructor (Office hours, etc.)	If you have any questions, please contact Suzuki by email (jsuzuki@tmu.ac.jp). The documents to be prepared and revised in this course include: JSPS Research Fellowship application forms, Research reports, Research plans, and Applications for private research grants. Information on how to obtain the necessary forms will be provided through Kibaco.					
(8) Special note	For items (1) and (4), applications that meet a certain standard may be eligible for research travel support, pending review and approval by the instructor. Students who wish to receive travel support must both participate fully in the exercise and submit an application either to the JSPS Research Fellowship program or to a private research grant. Students with no Japanese proficiency may take this course in English. However, as the majority of participants are Japanese speakers, students should be aware that the content provided in the English version of the course may differ from that offered in the Japanese-language exercises. If you wish to take the course in English, please consult the information provided on Kibaco and contact the instructor by email if you have any questions.					

Program	Course Name	Course Number	Semester	Day	Time	Credit Hours
Master's program	Biology course in research evaluation 2	M(R0453)	2nd Semester	Wed.	1	1
Doctoral program	Biology course in research evaluation 2	D(R0454)				
Instructor(s)			Note			
SUZUKI Jun-ichirou Multiple instructors						
(1) Course policies and topics	Evaluation of research presentation: Through evaluating the research presentations of others, students will develop an understanding of what constitutes a clear and effective presentation and enhance their own presentation skills.					
(2) Knowledge/skills to be acquired and learning objectives/course goals	Through this exercise, students will cultivate learning skills, logical thinking, and communication abilities. Students will attend an academic conference or research presentation session as audience members, listen to multiple presentations, and evaluate their content. The results of these evaluations, along with the reasoning behind them, will be compiled into a written report.					
(3) Course schedule, subject matter, and classroom activities	<p>The following points of evaluation will be addressed in this exercise.</p> <ol style="list-style-type: none"> 1. About the title: the title as the shortest possible abstract 2. Introduction: research objectives and goals I 3. Introduction: research objectives and goals II 4. Introduction: research context and prior studies I 5. Introduction: research context and prior studies II 6. Materials and Methods: explanation of experiments, surveys, and data analyses conducted I 7. Materials and Methods: explanation of experiments, surveys, and data analyses conducted II 8. Results: description of findings from experiments and surveys I 9. Results: description of findings from experiments and surveys II 10. Results: graphical representation and verbal explanation of results I 11. Results: graphical representation and verbal explanation of results II 12. Discussion: interpretation of results in relation to the objectives I 13. Discussion: interpretation of results in relation to the objectives II 14. Discussion: evaluation of results in comparison with prior studies I 15. Discussion: evaluation of results in comparison with prior studies II 					
(4) Outside-class activities and assignments	The course guidance and detailed information will be provided via Kibaco. Students are required to attend an academic conference or research presentation session and, outside of class, prepare and submit an evaluation report based on the presentations they observe.					
(5) Textbooks and course materials	Materials required for the course will be distributed via Kibaco. References Kinoshita, K. (1981). Scientific Writing for the Natural Sciences (Chuko Shinsho 624). Chuokoron-Shinsha. Glasman-Deal, H. (2009). Science Research Writing for Non-Native Speakers of English. ICP.					
(6) Assessment and grading	Grades will be determined based on the evaluation reports of presentations given at academic conferences or research presentation sessions.					
(7) Questions to the instructor (Office hours, etc.)	If you have any questions, please contact the instructor by email (jsuzuki@tmu.ac.jp). Information regarding the schedule will be communicated via Kibaco.					
(8) Special note	Students with no Japanese proficiency may take this course in English. However, as the majority of participants are Japanese speakers, students should be aware that the content provided in the English version of the course may differ from that offered in the Japanese-language exercises. If you wish to take the course in English, please consult the information provided on Kibaco and contact the instructor by email if you have any questions.					

Program	Graduate School of Science		Semester	Day	Time	Credit Hours
	Course Name	Course Number				
Master's program	External experience in Biological Sciences 1	R0693	As Needed	—	—	1 or 2
Doctoral program	External experience in Biological Sciences 1	R0694				
Instructor(s)			Note			
Multiple instructors						
(1) Course policies and topics	External experience in Biological Sciences					
(2) Knowledge/skills to be acquired and learning objectives/course goals	This course is to encourage students to acquire to work experience, activity, and practical training outside the university at companies, government offices, various organizations, etc., and credits are granted if certain requirements are met. Students find their own host institutions. The practical work experience must be related to biology, generally 30 hours or more in duration, and must be approved by the host institution. There are several other requirements for approval, so prospective students should consult with a member of the Academic Affairs Committee.					
(3) Course schedule, subject matter, and classroom activities	The course will be offered at the request of the student. Students must submit a preliminary application to the Academic Affairs Committee at least 6 weeks prior to the start of the course for approval. After the preliminary application is approved, the course will be offered as a new course.					
(4) Outside-class activities and assignments	The out-of-class learning will be required.					
(5) Textbooks and course materials	Printouts will be given out if necessary.					
(6) Assessment and grading	Evaluation will be based on the practical training logbook and practical training report submitted to the instructor in charge, as well as oral examination and confirmation.					
(7) Questions to the instructor (Office hours, etc.)	If you have any questions, please contact Dr. Obayashi (daigakuin@biol.se.tmu.ac.jp), a member of the Graduate School Academic Affairs Committee.					
(8) Special note	Students will need to find their own internship hosts. Students may take this course in English.					

Program	Graduate School of Science			Semester	Day	Time	Credit Hours
	Course Name	Course Number					
Master's program	External experience in Biological Sciences 2	R0695 (2units)	R0411 (1unit)	As Needed	—	—	1 or 2
Doctoral program	External experience in Biological Sciences 2	R0696 (2units)	R0412 (1unit)				
Instructor(s)			Note				
Multiple instructors							
(1) Course policies and topics	External experience in Biological Sciences 2						
(2) Knowledge/skills to be acquired and learning objectives/course goals	This course is to encourage students to acquire to work experience, activity, and practical training outside the university at companies, government offices, various organizations, etc., and credits are granted if certain requirements are met. Students find their own host institutions. The practical work experience must be related to biology, generally 30 hours or more in duration, and must be approved by the host institution. There are several other requirements for approval, so prospective students should consult with a member of the Academic Affairs Committee (Dr. Obayashi (daigakuin@biol.se.tmu.ac.jp)).						
(3) Course schedule, subject matter, and classroom activities	The course will be offered at the request of the student. Students must submit a preliminary application to the Academic Affairs Committee at least 6 weeks prior to the start of the course for approval. After the preliminary application is approved, the course will be offered as a new course.						
(4) Outside-class activities and assignments	The out-of-class learning will be required.						
(5) Textbooks and course materials	Printouts will be given out if necessary.						
(6) Assessment and grading	Evaluation will be based on the practical training logbook and practical training report submitted to the instructor in charge, as well as oral examination and confirmation.						
(7) Questions to the instructor (Office hours, etc.)	If you have any questions, please contact Dr. Obayashi (daigakuin@biol.se.tmu.ac.jp), a member of the Graduate School Academic Affairs Committee.						
(8) Special note	Students will need to find their own internship hosts. Students may take this course in English.						

Program	Graduate School of Science		Semester	Day	Time	Credit Hours
	Course Name	Course Number				
Master's program	Internship	R0931 (2units) R0929 (1unit)	As Needed	—	—	1 or 2
Doctoral program	Internship	R0932 (2units) R0930 (1unit)				
Instructor(s)		Note				
Obayashi and others						
(1) Course policies and topics	Students will work at their internship workplace, such as companies, administrative agencies, and NPO. Students must secure their own internship employer.					
(2) Knowledge/skills to be acquired and learning objectives/course goals	Gain knowledge and skills from a planned work experience in the student's chosen career fields..					
(3) Course schedule, subject matter, and classroom activities	Students will spend five days (40 hours) or more at their internship placement. The internships should be taken during between semesters.					
(4) Outside-class activities and assignments	Research about the internship placement.					
(5) Textbooks and course materials	Depends on internship placement.					
(6) Assessment and grading	Log of Work Activities, reports, evaluation from Internship Advisors.					
(7) Questions to the instructor (Office hours, etc.)	Email to graduate program committee members.					
(8) Special note	<p>1unit: 5 days (40h) or more, less than 8 days (60h), one credit 2 units: 8 days (60 h) or more, two credits</p> <p>Students should submit a detailed internship plan more than six weeks before the start date. Please contact Dr. Obayashi (daigakuin@biol.se.tmu.ac.jp), a member of the Graduate School Academic Affairs Committee.</p> <p>Students can take this course in English.</p>					

Program	Graduate School of Science		Semester	Day	Time	Credit Hours
	Course Name	Course Number				
Master's program	Special Seminar in Biological Sciences 1	R0457	1st	Fri	5	1
Doctoral program	Special Seminar in Biological Sciences 1	R0458				
Instructor(s)		Instructor(s)				
All faculty member of Department of Biological Sciences						
(1) Course policies and topics	<p>Latest Topics in Biological Sciences As a seminar series in the Department of Biological Sciences, faculty member and guest researchers will introduce their research.</p>					
(2) Knowledge/skills to be acquired and learning objectives/course goals	<p>In graduate studies, it is necessary to learn how research is carried out by examining many examples of cutting-edge research. In addition, they need to learn about cutting-edge knowledge, methods, and techniques in life science research across a variety of fields that cannot be found in textbooks, as well as the questions that need to be answered in the life sciences in the future. The goal is to learn the state of the art across various fields through expertise in the life sciences.</p>					
(3) Course schedule, subject matter, and classroom activities	<p>An omnibus format will be used to teach the latest research in metabolic biology, microbiology, cell biology, plant ecology, plant environmental responses, plant embryology, plant phylogenetics, and molecular neurobiology through faculty members or guest scientists. The schedule will be announced via email and the department website.</p>					
(4) Outside-class activities and assignments	<p>Read the abstract of the research introduction in advance.</p>					
(5) Textbooks and course materials	<p>No textbook will be provided. Necessary materials will be distributed in each class.</p>					
(6) Assessment and grading	<p>Evaluation will be based on active class participation.</p>					
(7) Questions to the instructor (Office hours, etc.)	<p>If you have any questions regarding the course contents, please contact the course coordinator (Dr. Obayashi, ryudohbys@tmu.ac.jp). Students may nominate speakers for talks in English: please contact Dr. Ando for more detail about nomination (k_ando@tmu.ac.jp).</p>					
(8) Special note	<p>This course includes lectures in both Japanese and English. All graduate students, both in the master's and doctoral programs, are encouraged to take this course each year.</p>					

Program	Graduate School of Science		Semester	Day	Time	Credit Hours
	Course Name	Course Number				
Master's program	Special Seminar in Biological Sciences 2	R0459	2nd	Fri	5	1
Doctoral program	Special Seminar in Biological Sciences 2	R0460				
Instructor(s)		Instructor(s)				
All faculty member of Department of Biological Sciences						
(1) Course policies and topics	<p>Latest Topics in Biological Sciences As a seminar series in the Department of Biological Sciences, faculty member and guest researchers will introduce their research.</p>					
(2) Knowledge/skills to be acquired and learning objectives/course goals	<p>In graduate studies, it is necessary to learn how research is carried out by examining many examples of cutting-edge research. In addition, they need to learn about cutting-edge knowledge, methods, and techniques in life science research across a variety of fields that cannot be found in textbooks, as well as the questions that need to be answered in the life sciences in the future. The goal is to learn the state of the art across various fields through expertise in the life sciences.</p>					
(3) Course schedule, subject matter, and classroom activities	<p>An omnibus format will be used to teach the latest research in metabolic biology, microbiology, cell biology, plant ecology, plant environmental responses, plant embryology, plant phylogenetics, and molecular neurobiology through faculty members or guest scientists. The schedule will be announced via email and the department website.</p>					
(4) Outside-class activities and assignments	<p>Read the abstract of the research introduction in advance.</p>					
(5) Textbooks and course materials	<p>No textbook will be provided. Necessary materials will be handed out in each class.</p>					
(6) Assessment and grading	<p>Evaluation will be based on active class participation.</p>					
(7) Questions to the instructor (Office hours, etc.)	<p>If you have any questions regarding the course contents, please contact the course coordinator (Dr. Obayashi, ryudohbys@tmu.ac.jp). Students may nominate speakers for talks in English: please contact Dr. Ando for more detail about nomination (k_ando@tmu.ac.jp).</p>					
(8) Special note	<p>This course includes lectures in both Japanese and English. All graduate students, both in the master's and doctoral programs, are encouraged to take this course each year.</p>					

Program	Course Name	Course Number	Semester	Day	Time	Credit Hours
Master's program	Special Lecture on Biological Sciences	R0731	2 nd I	Wed	1	1
Doctoral program	Special Lecture on Biological Sciences	R0732				
Instructor(s)		Note				
Tamura and Takahashi		This course is a common course with the undergraduate program.				
(1) Course policies and topics	This course covers some current research topics in evolutionary genetics.					
(2) Knowledge/skills to be acquired and learning objectives/course goals	By the end of the class, students should understand how research proceeds in the field and learn how logical discussions are conducted. Also students should be able to develop their own ideas and opinions related to the topics.					
(3) Course schedule, subject matter, and classroom activities	<p>Following topics will be discussed in the class:</p> <ol style="list-style-type: none"> 1. Genes involved in speciation (AT) 2. Evolution of adaptive traits (AT) 3. Genome-wide genetic mapping (AT) 4. Genes in conflict (AT) 5. Evolution of sex chromosomes (KT) 6. Evolution of physiological traits (KT) 7. Evolution of meiotic recombination (KT) 8. Reviews (AT & KT) 					
(4) Outside-class activities and assignments	Students are expected to review and conduct self-learning on materials related to the topics as out-of-classwork.					
(5) Textbooks and course materials	Handouts will be provided before or during the class.					
(6) Assessment and grading	Final grade will be determined by class participation.					
(7) Questions to the instructor (Office hours, etc.)	Particular office hour is not allocated, but students can make appointments by email.					
(8) Special note	<p>This course is for students who are not graduates of Tokyo Metropolitan University. Permission of the curriculum coordinator (Dr. Obayashi, daigakuin@biol.se.tmu.ac.jp) is necessary for the registration.</p> <p>This course is given in English.</p>					

Program	Course Name	Course Number	Semester	Day	Time	Credit Hours
Master's program	Special Lecture on Biological Sciences	R0353	2 nd -I	Wed	2	1
Doctoral program	Special Lecture on Biological Sciences	R0354				
Instructor(s)			Note			
Kanegae and Otani						
(1) Course policies and topics	One of the most significant functions of living organisms is to respond to surrounding environmental information. The purpose of this class is to understand the physiological phenomena exhibited by animals and plants, primarily to acquire knowledge about physiological changes in response to information on the external environment.					
(2) Knowledge/skills to be acquired and learning objectives/course goals	Part 1: This course will provide opportunity to learn the physiology of epithelia, with particular emphasis on epithelial barrier and homeostasis. Students will be introduced to cutting-edge topics in epithelial biology, accompanied with historical reflections of the research field. Part 2: At the end of this course, students will be able to explain how light as environment information is accepted by plant photoreceptors and how information is expressed.					
(3) Course schedule, subject matter, and classroom activities	[Part 1] Animal physiology (Otani) 1. Epithelial barrier and intercellular junctions 2. Epithelial packing and paracellular transport 3. Epithelial homeostasis 4. Cell competition [Part 2] Plant physiology (Kanegae) 5. Diversity of photoreceptors 6. Transcriptional regulation of photomorphogenesis 7. Post-transcriptional regulation of photomorphogenesis 8. Adaptation for environmental light condition					
(4) Outside-class activities and assignments	Homework will be given after each class and you are expected to review the last lecture every week.					
(5) Textbooks and course materials	Lecture materials will be uploaded to kibaco by the day before.					
(6) Assessment and grading	Assessment: The mean score from Part 1 and Part 2 will be the final grade. Part 1: Presentation and discussion 20 %, Quiz or Report submission 80 %. Part 2: Quiz or Report submission 40 %, Examination 60 %.					
(7) Questions to the instructor (Office hours, etc.)	Particular office hour is not set. For queries, please make an appointment via e-mail.					
(8) Special note	This course is for students who are not graduates of Tokyo Metropolitan University. To register for this course, ask for permission from the curriculum coordinator (Dr. Obayashi, daigakuin@biol.se.tmu.ac.jp). This course is given in English.					

Program	Course Name	Course Number	Semester	Day	Time	Credit Hours
Master's program	Special Lecture on Biological Sciences	R0735	2 nd -I	Thu	1	1
Doctoral program	Special Lecture on Biological Sciences	R0736				
Instructor(s)			Note			
*Fukui						
(1) Course policies and topics	This special lecture is the classes for the students of biological sciences course, dealing with basic knowledge in environmental microbiology and microbial genetics. Students will be strongly encouraged to ask questions and express opinions.					
(2) Knowledge/skills to be acquired and learning objectives/course goals	The aims of this course are to learn phylogenetic and physiological diversity of microorganisms. You will learn the role of microorganisms in natural environments and relationships between microbe-microbe, microbe-plant, microbe-animal, and microbe-human. You will also learn molecular mechanisms of bacterial responses to environmental changes.					
(3) Course schedule, subject matter, and classroom activities	<ol style="list-style-type: none"> 1. Phylogeny of Bacteria and Archaea 2. Diversity of Bacteria and Archaea 3. Microbial ecology 4. Applied microbiology 5. Bacterial genome 6. Acclimation to environmental changes in bacteria 7. Conclusion and Discussion 1 8. Conclusion and Discussion 2 <p>The course will be conducted in a lecture format.</p>					
(4) Outside-class activities and assignments	Students are expected to prepare each lecture by reading texts or research articles.					
(5) Textbooks and course materials	<p>Hand-outs will be provided in the class.</p> <p>Books for reference: Brock: Biology of Microorganisms (Madigan et al., Pearson Edu.) Microbiology: An Evolving Science (Slonczewski & Foster, W. W. Norton & Company)</p>					
(6) Assessment and grading	Evaluation will be based on a final report. Presentation and discussion in the class are also considered.					
(7) Questions to the instructor (Office hours, etc.)	by appointment through e-mail Fukui: mnbfukui[at]gmail.com					
(8) Special note	<p>Students should have taken General Microbiology and Microbiology.</p> <p>This course is for students who are not graduates of Tokyo Metropolitan University. To register for this course, ask for permission from the curriculum coordinator (Dr. Obayashi, daigakuin@biol.se.tmu.ac.jp).</p> <p>This course is given in English.</p>					

Program	Graduate School of Science	Graduate School of Science and Engineering	Semester	Day	Time	Credit Hours
	Course Name					
Master's program	Special Lecture on Biological Sciences		2nd I	Mon	1	1
Doctoral program	Special Lecture on Biological Sciences					
	R0010					
Instructor(s)			Note			
Takayama and Eguchi			This course is a common course with the undergraduate program.			
(1) Course policies and topics	Phylogenetic evolution, phylogeography This course will deepen students' understanding of animal and plant diversity, evolution, geographic distribution, and their causes, focusing on the research being conducted by the faculty members themselves.					
(2) Knowledge/skills to be acquired and learning objectives/course goals	To deepen understanding of how researchers formulate a research theme, plan and conduct research, and to apply this understanding to the planning and execution of the participant's own research.					
(3) Course schedule, subject matter, and classroom activities	(Takayama) We explain the usefulness of genomic data for analyzing the diversity of land plants and introduce studies that clarify the processes underlying the establishment of distributions, particularly in sea-drifted seed dispersal plants, as well as research on plant evolution on oceanic islands. In addition, we provide an overview of the natural environment of the Bonin (Ogasawara) Islands and discuss studies on the natural environment of the archipelago and the evolutionary processes of its endemic plants. (Eguchi) . We will present our findings on the discovery of cryptic species, classification, and geographic genetic structure of insects, arachnids, and polypods in Southeast Asia. We will also introduce our overseas field research sites, including how we conduct our research in the field and how we have established an international collaborative research system.					
(4) Outside-class activities and assignments	(Takayama) Review of the distributed handouts is mandatory. (Eguchi) Ask students to read a short paper and express their opinions on the research orientation, issues, etc. to deepen their understanding of the research.					
(5) Textbooks and course materials	Lectures will be given mainly by handouts, and references and papers will be introduced as necessary.					
(6) Assessment and grading	Evaluation will be based on class participation and reports.					
(7) Questions to the instructor (Office hours, etc.)	(Takayama) If you would like to ask questions, please make an appointment in advance by emailing takayamak@tmu.ac.jp (Eguchi.) If you wish to ask questions in person, please make an appointment in advance by e-mail (antist@tmu.ac.jp) as we accept questions at any time.					
(8) Special note	This course is for students who are not graduates of Tokyo Metropolitan University. To register for this course, ask for permission from the curriculum coordinator (Dr. Obayashi, daigakuin@biol.se.tmu.ac.jp). Students who wish to enroll in this course should consult with their advisor and the instructor in charge of the course in advance. This course is given in English.					

Program	Course Name	Course Number	Semester	Day	Time	Credit Hours
Master's program	Special Lecture on Biological Sciences	R0715	2-I	M.	2	1
Doctoral program	Special Lecture on Biological Sciences	R0716				
Instructor(s)			Note			
CRONIN Adam						
(1) Course policies and topics	Many organisms live together in groups, and group-living conveys a wide range of benefits. Coordination of actions in group-living organisms represents a complex challenge, yet group-living species manage to achieve remarkable tasks, such as building complex structures, coordinated movements over long distances, and advanced decision making. Explaining how this is achieved is the focus of complex systems biology.					
(2) Knowledge/skills to be acquired and learning objectives/course goals	In this course we will explore how individuals in groups can coordinate activities to produce outcomes far exceeding that which any individual could do alone. In many cases these tasks are achieved with no distinct leadership or top-down control, but via interactions at the local level, which produce emergent phenomena at the level of the group. Studies of collective behaviour are important for understanding diverse phenomena such as movements of human crowds, telecommunication networks, and the development of artificial swarm intelligence.					
(3) Course schedule, subject matter, and classroom activities	<ol style="list-style-type: none"> 1. Group living 2. Group formation 3. Information 4. Feedback 5. Organisation 6. Decision making 7. Composition 8. Presentations/discussion 					
(4) Outside-class activities and assignments	Students will be given occasional tasks to perform outside of class during the semester and are expected to do research related to their selected project theme throughout the course.					
(5) Textbooks and course materials	Collective Animal Behaviour (2010) by David J. T. Sumpter (ISBN: 9780691148434). Other relevant literature will be presented and discussed in class.					
(6) Assessment and grading	Assessment will be based on a written assignment based on one or more components of the course and in-class presentations.					
(7) Questions to the instructor (Office hours, etc.)	There are not set office hours: please visit my office if you have any questions or send queries by email.					
(8) Special note	<p>This course will be conducted in English. Students should prepare all materials in English and will have the opportunity to discuss among themselves and with the general class in English.</p> <p>This class is for graduates of other universities. The permission of curriculum coordinator (Dr. Obayashi, daigakuin@biol.se.tmu.ac.jp) is required for the registration. Discuss with your supervisor and class teachers in advance.</p>					

Program	Course Name	Course Number	Semester	Day	Time	Credit Hours
Master's program	Special Lecture on Biological Sciences	R0725	1 (Summer Intensive)	Aug 6,7	1-4	1
Doctoral program	Special Lecture on Biological Sciences	R0726				
Instructor(s)		Note				
Florian Barton Reyda						
(1) Course policies and topics	<p>Course title: Parasitology Lecturer: Florian Reyda Class Location: 8-247 Aug 6, 7, 10, & 12 (Please register both R0725 and R0727 to get credits.) Times: 8:50-10:20; 10:30-noon; 13:00-14:30; 14:40-16:10,</p> <p>[Course description]This course will focus on the biology, life cycles, and identification of protozoan and animal parasites of humans and other animals. Emphasis will be placed on groups of particular medical and/or economic importance and/or local significance. This course will consist both of lectures and laboratory exercises involving examination of parasite specimens using compound light microscopy.</p>					
(2) Knowledge/skills to be acquired and learning objectives/course goals	<p>[Objectives] The overall goal of this course is for students to gain an introductory knowledge of parasitology: Upon completion of this course students should be able to:</p> <ol style="list-style-type: none"> 1. To discuss the biology of parasitic animals, with emphasis on the major protozoan and metazoan parasite groups. 2. To articulate several problems and aspects of the parasitic relationship. 3. To describe the diversity and ubiquitous distribution of animal parasites. 4. To describe the impact of parasitism on human welfare. 5. To employ observational skills in the laboratory, in particular with the microscope. 6. To be able to obtain parasites by performing dissections on fish hosts. 					
(3) Course schedule, subject matter, and classroom activities	<p><Tentative schedule> <Tentative schedule> Thursday, Aug 6, 2026 08:50-10:20 (Lecture) Introduction of professor and students, Lecture 1 on terminology, significance of parasitism, amoebas, Giardia 10:30-12:00 (Lab) Lab 1 on amoebas and Giardia 13:00-14:30 (Lecture) Lecture 2 on trypanosomes (Trypanosoma), and Leishmania 14:40-16:10 (Lab) Lab 2 Trypanosomes and kins, Discuss research paper (Cryptosporidium paper)</p> <p>Friday, Aug 7, 2026 08:50-10:20 (Lecture) Exam covering day1 contents; Lecture 3 on Malaria (Plasmodium) 10:30-12:00 (Lab) Lab3 Apicomplexans including Plasmodium and malaria 13:00-14:30 (Lecture) Lecture 4 on Platyhelminthes, liver, lung and blood flukes 14:40-16:10 (Lab) Lab4 exercise on Platyhelminthes, liver, lung and blood flukes Discussion on research paper: 2 Sessions and Ruth 1990 frog deformities, time to be determined</p> <p>Monday, Aug 10, 2026 08:50-10:20 (Lecture) Exam covering day 2 contents, Lecture 5 on Platyhelminthes and tapeworms 10:30-12:00 (Lab) Lab5 exercise on Platyhelminthes and tapeworms 13:00-14:30 (Lecture) Lecture 6 on nematodes: ascarids, hookworms and pinworms 14:40-16:10 (Lab) Lab6 exercise on nematodes: ascarids, hookworms and pinworms Discussion on research paper: 3 Anisakiasis in Tokyo, Time to be determined</p> <p>Wednesday, Aug 12, 2026 08:50-10:20 (Lecture) Exam covering day 3 contents, Lecture 7 on parasitic antholopods: copepods, fleas, lice, mites, ticks, miscellaneous parasitic phylla 10:30-12:00 (Lab) Lab8 exercise on fish dissection 13:00-14:30 (Lab) Bring computers; begin work on species writing assignment; study 14:40-16:10 (Lab) Take exam covering day 4 contents via email no later than 9 pm Aug 25th Japan time</p> <p>Wednesday, Sep 9th, 2026 The species writing assignment should be submitted to me via email, no later than 9 pm, Sep 10th, Japan time.</p>					
(4) Outside-class activities and assignments	Students should study content at the end of each day in order to be ready for the exam that that will take place the following morning.					

(5) Textbooks and course materials	There is no required textbook but each of the labs contains reference information and reference images. I will also provide outside reading materials. Students should bring blank sheets of paper and a pencil for laboratory exercises.
(6) Assessment and grading	Students will be graded on class participation, daily exams, completion of laboratory exercises (both questions and drawings), 1-paragraph summaries of research articles, and participation in in-class discussions.
(7) Questions to the instructor (Office hours, etc.)	Instructor: Dr. Florian Reyda Email: florian.reyda@oneonta.edu Office Hours: I will be available in person during each of the course meetings, and always responsive to e-mail queries. For more information about course contents, please contact Dr. Kanae Ando (k_ando@tmu.ac.jp). For questions about course registration, please email Dr. Obayashi (daigakuin@biol.se.tmu.ac.jp).
(8) Special note	Please note that this course MUST be taken in conjunction with R0727. If you register for just one of them, no credit will be given. This syllabus is subject to change at any time. Please see Kibaco for the latest information. This course is given in English.

Program	Course Name	Course Number	Semester	Day	Time	Credit Hours
Master's program	Special Lecture on Biological Sciences	R0727	1 (Summer Intensive)	Aug 10, 12	1-4	1
Doctoral program	Special Lecture on Biological Sciences	R0728				
Instructor(s)		Note				
Florian Barton Reyda						
(1) Course policies and topics	<p>Course title: Parasitology Lecturer: Florian Reyda Class Location: 8-247 Aug 6, 7, 10, & 12 (Please register both R0725 and R0727 to get credits.) Times: 8:50-10:20; 10:30-noon; 13:00-14:30; 14:40-16:10,</p> <p>[Course description]This course will focus on the biology, life cycles, and identification of protozoan and animal parasites of humans and other animals. Emphasis will be placed on groups of particular medical and/or economic importance and/or local significance. This course will consist both of lectures and laboratory exercises involving examination of parasite specimens using compound light microscopy.</p>					
(2) Knowledge/skills to be acquired and learning objectives/course goals	<p>[Objectives] The overall goal of this course is for students to gain an introductory knowledge of parasitology: Upon completion of this course students should be able to:</p> <ol style="list-style-type: none"> 1. To discuss the biology of parasitic animals, with emphasis on the major protozoan and metazoan parasite groups. 2. To articulate several problems and aspects of the parasitic relationship. 3. To describe the diversity and ubiquitous distribution of animal parasites. 4. To describe the impact of parasitism on human welfare. 5. To employ observational skills in the laboratory, in particular with the microscope. 6. To be able to obtain parasites by performing dissections on fish hosts. 					
(3) Course schedule, subject matter, and classroom activities	<p><Tentative schedule> <Tentative schedule> Thursday, Aug 6, 2026 08:50-10:20 (Lecture) Introduction of professor and students, Lecture 1 on terminology, significance of parasitism, amoebas, Giardia 10:30-12:00 (Lab) Lab 1 on amoebas and Giardia 13:00-14:30 (Lecture) Lecture 2 on trypanosomes (Trypanosoma), and Leishmania 14:40-16:10 (Lab) Lab 2 Trypanosomes and kins, Discuss research paper (Cryptosporidium paper)</p> <p>Friday, Aug 7, 2026 08:50-10:20 (Lecture) Exam covering day1 contents; Lecture 3 on Malaria (Plasmodium) 10:30-12:00 (Lab) Lab3 Apicomplexans including Plasmodium and malaria 13:00-14:30 (Lecture) Lecture 4 on Platyhelminthes, liver, lung and blood flukes 14:40-16:10 (Lab) Lab4 exercise on Platyhelminthes, liver, lung and blood flukes Discussion on research paper: 2 Sessions and Ruth 1990 frog deformities, time to be determined</p> <p>Monday, Aug 10, 2026 08:50-10:20 (Lecture) Exam covering day 2 contents, Lecture 5 on Platyhelminthes and tapeworms 10:30-12:00 (Lab) Lab5 exercise on Platyhelminthes and tapeworms 13:00-14:30 (Lecture) Lecture 6 on nematodes: ascarids, hookworms and pinworms 14:40-16:10 (Lab) Lab6 exercise on nematodes: ascarids, hookworms and pinworms Discussion on research paper: 3 Anisakiasis in Tokyo, Time to be determined</p> <p>Wednesday, Aug 12, 2026 08:50-10:20 (Lecture) Exam covering day 3 contents, Lecture 7 on parasitic antholopods: copepods, fleas, lice, mites, ticks, miscellaneous parasitic phylla 10:30-12:00 (Lab) Lab8 exercise on fish dissection 13:00-14:30 (Lab) Bring computers; begin work on species writing assignment; study 14:40-16:10 (Lab) Take exam covering day 4 contents via email no later than 9 pm Aug 25th Japan time</p> <p>Wednesday, Sep 9th, 2026 The species writing assignment should be submitted to me via email, no later than 9 pm, Sep 10th, Japan time.</p>					
(4) Outside-class activities and assignments	Students should study content at the end of each day in order to be ready for the exam that that will take place the following morning.					

(5) Textbooks and course materials	There is no required textbook but each of the labs contains reference information and reference images. I will also provide outside reading materials. Students should bring blank sheets of paper and a pencil for laboratory exercises.
(6) Assessment and grading	Students will be graded on class participation, daily exams, completion of laboratory exercises (both questions and drawings), 1-paragraph summaries of research articles, and participation in in-class discussions.
(7) Questions to the instructor (Office hours, etc.)	<p>Instructor: Dr. Florian Reyda Email: florian.reyda@oneonta.edu Office Hours: I will be available in person during each of the course meetings, and always responsive to e-mail queries. For more information about course contents, please contact Dr. Kanae Ando (k_ando@tmu.ac.jp). For questions about course registration, please email Dr. Obayashi (daigakuin@biol.se.tmu.ac.jp).</p>
(8) Special note	<p>Please note that this course MUST be taken in conjunction with R0725. If you register for just one of them, no credit will be given. This syllabus is subject to change at any time. Please see Kibaco for the latest information. This course is given in English.</p>

Program	Course Name	Course Number	Semester	Day	Time	Credit Hours
Master's program	Special Lecture on Biological Sciences	R0719	1 (Summer Intensive)	Aug 27, 28	2-5	1
Doctoral program	Special Lecture on Biological Sciences	R0720				
Instructor(s)		Note				
Diego Tavares Vasques						
(1) Course policies and topics	<p>Course Title: Introduction to Plants Systematics and Taxonomy Instructor: Diego Tavares Vasques Dates: Aug 27 & Aug 28, 2, 3, 4 & 5 periods</p>					
(2) Knowledge/skills to be acquired and learning objectives/course goals	<p>By taking this course, you will not only learn basic key-concepts of evolution and plants diversity (important to understanding many other subfields in Biology) but also step-up your baggage knowledge, connecting it to practice experiences in this field.</p> <p>Keywords Plant diversity, evolution, systematics, Plant taxonomy 植物多様性、進化論、系統分類学、植物分類学</p>					
(3) Course schedule, subject matter, and classroom activities	<p>Schedule Day 1 Unit 1: Introductions, and Plants Systematics 2限- Course explanation - Concept of evolution in Biology 3限- Introduction to plants' diversity - Evidences of Evolution - History and definition of Taxonomy and Systematics Unit 2: Herbaria 4限 Practice 1: Herbaria construction 5限 Groups division and projects decision/ planning</p> <p>Day2 Extra Practice: Visit to the Makino Herbarium (this practice may not be done, depending on the availability of the herbarium at the day) Unit 3: Plant Systematic Studies 2限- Introduction to some research on the field of plant systematics 3限- Phylogenetic tree reconstruction 4限 Practice 2: Reading and Drawing Phylogenies 5限 Groups presentation</p> <p>Teaching Methods Day 1 focus on learning of basic concepts, such as natural selection, adaptation, plant taxonomy and systematics. Students will learn what are phylogenetic trees and how plants diversity is organized in taxonomic categories. We will have a practice class on how to produce herbarium specimens. On day 2, students will be introduced to the diversity of mosses and ferns, while discussing changes in the life history of land plants and while learning how to describe sterile structures (i.e., leaves and stem) in the body of these plants. We will have a practice on reading and drawing of phylogenetic trees. The last two periods will be dedicated for short oral presentations on the taxonomy and systematics of the taxonomical family groups were assigned to.</p> <p>Final project Students will work in groups on designing a simple research project proposal under the topic "NATURAL HISTORY COLLECTIONS AND THE FUTURE OF TAXONOMY".</p>					
(4) Outside-class activities and assignments	Further instructions will be uploaded to https://dtvasques.wordpress.com/					
(5) Textbooks and course materials	<p>Required Textbook None - required reading will be provided by the professor.</p> <p>Computer requirements Students are asked to download and install the following applications before the first class: • ImageJ - https://imagej.nih.gov/ij/ • RStudio - https://rstudio.com/ • Google Chrome</p>					

Further instructions will be uploaded to <https://dtvasques.wordpress.com/>

Reference Books

Dawkins, R., & Wong, Y. (2010). *The ancestor's tale: A pilgrimage to the dawn of life*. Hachette UK.
Judd, W. S., Campbell, C. S., Kellog, E. A., Stevens, P. F., & Donoghue, M. J. (2015). *Plant Systematics: A Phylogenetic Approach*. Sinauer, 1st ed.
Ridley, M. (2004). *Evolution*. Oxford University press.
Simpson, M. G. (2010). *Plant systematics*. Academic press.

(6) Assessment and grading

Method of Evaluation
Class participation - 30%
Final project (final presentation) - 70%

(7) Questions to the instructor
(Office hours, etc.)

Dr. Diego Tavares Vasques
The University of Tokyo – Graduate School of Sciences, Koishikawa Botanical Garden
dtvasques@g.ecc.u-tokyo.ac.jp

For questions about course registration, please email Dr. Obayashi (daigakuin@biol.se.tmu.ac.jp).

(8) Special note

This course is given in English.

Program	Course Name	Course Number	Semester	Day	Time	Credit Hours
Master's program	Special Lecture on Biological Sciences	R0357	1 (Summer Intensive)	Aug 17, 18	1-4	1
Doctoral program	Special Lecture on Biological Sciences	R0358				
Instructor(s)		Note				
Parvin Shahrestani						
(1) Course policies and topics	<p>[Course Title] Biology of Aging [Instructor] Parvin Shahrestani [Class Period] August 17 - 20 *Please register both R0357 and R0367 to earn credits.</p>					
(2) Knowledge/skills to be acquired and learning objectives/course goals	<p>[Welcome message and course description: Welcome to the Biology of Aging course! As an evolutionary geneticist, I agree with Theodosius Dobzansky that "nothing in biology makes sense except in the light of evolution." As you'll see in this course, evolutionary biology can help us understand why humans age and what we can do to reduce the impact of aging. In order to understand the evolutionary theories of aging, we will also cover some basics of evolutionary mechanisms. In addition to the evolutionary theories of aging, we will discuss cellular and molecular damage hypotheses for aging and organ system changes that occur during human aging. This course will include class discussions and every student will be expected to speak frequently during the class. I recognize that this can be uncomfortable for some of you, due to it being new and also due to potential language barriers, but we will take time to create a safe space in which it will be okay to make mistakes. The only expectation is that you participate, in whatever way you can, so that we can practice and learn together. Before starting my current faculty position at the California State University in Fullerton, I completed my PhD at the University of California in Irvine and my postdoctoral training at Cornell University in New York. Currently, my evolution and genomics research team focuses on the interactions among aging, immunity, and microbiomes in fruit flies. Throughout the course, and also after, please feel free to reach out to me by email.</p>					
(3) Course schedule, subject matter, and classroom activities	<p>Tentative Course Schedule: The exact course schedule will be announced prior to the start of the class. However, these are the topics that we will cover. Module 1 topic: Damage-based hypotheses for aging (Aug 17, 1-4限) Module 1 learning objectives: <ul style="list-style-type: none"> ● Differentiate aging versus age-related diseases ● Name and describe molecular and cellular damage hypotheses for aging Module 1 learning materials, activities and assessments: <ul style="list-style-type: none"> ● The reading materials, in-class activities, and assessments for Module 1 will be posted here. Module 2 topic: Evolutionary theories of aging (Aug 18, 1-4限) Module 2 learning objectives: <ul style="list-style-type: none"> ● Explain mechanisms of evolution: mutation, gene flow, genetic drift, natural selection ● Use the evolutionary theories of aging to make predictions about aging and longevity ● Describe evidence for the evolutionary theories of aging Module 2 learning materials, activities and assessments: <ul style="list-style-type: none"> ● The reading materials, in-class activities, and assessments for Module 2 will be posted here. Module 3 topic: Human aging (Aug 19, 1-4限) Module 3 learning objectives: <ul style="list-style-type: none"> ● Describe age-related deterioration and disease of human organ systems ● Practice providing peer feedback and asking questions during research presentations Module 3 learning materials, activities and assessments: <ul style="list-style-type: none"> ● The reading materials, in-class activities, and assessments for Module 3 will be posted here. Module 4 topic: Modulating aging (anti-aging efforts) (Aug 20, 1-4限) Module 4 learning objectives: <ul style="list-style-type: none"> ● Describe the relationship between the aging hypotheses and approaches to modulating aging Module 4 learning materials, activities and assessments: <ul style="list-style-type: none"> ● The reading materials, in-class activities, and assessments for Module 3 will be posted in Kibaco. </p>					
(4) Outside-class activities and assignments	<p>Out of class activity requirement: Students should complete the required reading assignments prior to coming to the class meeting (except the first day of class). You should also review this syllabus in detail so that you can be prepared for our daily plans. Please use the live version of the syllabus (it will be shared with you as a Google doc when the course begins) instead of downloading it because I may change some details and add links. Prior to starting</p>					

	<p>this class, students are expected to review some basic biology terminology (see Review Terminology section below).</p>
(5) Textbooks and course materials	<p>Textbooks: There is no textbook for this course. Reading materials will be provided in class. Materials: Please bring an electronic device to class (laptop computer, iPad, smartphone) and also bring pen and paper for taking notes.</p>
(6) Assessment and grading	<p>Assessment: Students will be graded on attendance, in-class participation, in-class discussions, in-class presentations, and quizzes.</p>
(7) Questions to the instructor (Office hours, etc.)	<p>Office hour: To be announced Instructor email: pshahrestani@fullerton.edu</p>
(8) Special note	<p>This course MUST be taken in conjunction with R0367. Dates and times may be subject to change. Please see Kibaco for the latest information.</p> <p>For more information about course contents, please contact Dr. Kanae Ando (k_ando@tmu.ac.jp). For questions about course registration, please email Dr. Obayashi (daigakuin@biol.se.tmu.ac.jp).</p> <p>This course is given in English.</p>

Program	Course Name	Course Number	Semester	Day	Time	Credit Hours
Master's program	Special Lecture on Biological Sciences	R0367	1 (Summer Intensive)	Aug 19, 20	1-4	1
Doctoral program	Special Lecture on Biological Sciences	R0368				
Instructor(s)		Note				
Parvin Shahrestani						
(1) Course policies and topics	<p>[Course Title] Biology of Aging [Instructor] Parvin Shahrestani [Class Period] August 17 - 20 *Please register both R0357 and R0367 to earn credits.</p>					
(2) Knowledge/skills to be acquired and learning objectives/course goals	<p>[Welcome message and course description: Welcome to the Biology of Aging course! As an evolutionary geneticist, I agree with Theodosius Dobzansky that "nothing in biology makes sense except in the light of evolution." As you'll see in this course, evolutionary biology can help us understand why humans age and what we can do to reduce the impact of aging. In order to understand the evolutionary theories of aging, we will also cover some basics of evolutionary mechanisms. In addition to the evolutionary theories of aging, we will discuss cellular and molecular damage hypotheses for aging and organ system changes that occur during human aging. This course will include class discussions and every student will be expected to speak frequently during the class. I recognize that this can be uncomfortable for some of you, due to it being new and also due to potential language barriers, but we will take time to create a safe space in which it will be okay to make mistakes. The only expectation is that you participate, in whatever way you can, so that we can practice and learn together. Before starting my current faculty position at the California State University in Fullerton, I completed my PhD at the University of California in Irvine and my postdoctoral training at Cornell University in New York. Currently, my evolution and genomics research team focuses on the interactions among aging, immunity, and microbiomes in fruit flies. Throughout the course, and also after, please feel free to reach out to me by email.</p>					
(3) Course schedule, subject matter, and classroom activities	<p>Tentative Course Schedule: The exact course schedule will be announced prior to the start of the class. However, these are the topics that we will cover. Module 1 topic: Damage-based hypotheses for aging (Aug 17, 1-4限) Module 1 learning objectives: • Differentiate aging versus age-related diseases • Name and describe molecular and cellular damage hypotheses for aging Module 1 learning materials, activities and assessments: • The reading materials, in-class activities, and assessments for Module 1 will be posted here. Module 2 topic: Evolutionary theories of aging (Aug 18, 1-4限) Module 2 learning objectives: • Explain mechanisms of evolution: mutation, gene flow, genetic drift, natural selection • Use the evolutionary theories of aging to make predictions about aging and longevity • Describe evidence for the evolutionary theories of aging Module 2 learning materials, activities and assessments: • The reading materials, in-class activities, and assessments for Module 2 will be posted here. Module 3 topic: Human aging (Aug 19, 1-4限) Module 3 learning objectives: • Describe age-related deterioration and disease of human organ systems • Practice providing peer feedback and asking questions during research presentations Module 3 learning materials, activities and assessments: • The reading materials, in-class activities, and assessments for Module 3 will be posted here. Module 4 topic: Modulating aging (anti-aging efforts) (Aug 20, 1-4限) Module 4 learning objectives: • Describe the relationship between the aging hypotheses and approaches to modulating aging Module 4 learning materials, activities and assessments: • The reading materials, in-class activities, and assessments for Module 3 will be posted in Kibaco.</p>					
(4) Outside-class activities and assignments	<p>Out of class activity requirement: Students should complete the required reading assignments prior to coming to the class meeting (except the first day of class). You should also review this syllabus in detail so that you can be prepared for our daily plans. Please use the live version of the syllabus (it will be shared with you as a Google doc when the course begins) instead of downloading it because I may change some details and add links. Prior to starting</p>					

	<p>this class, students are expected to review some basic biology terminology (see Review Terminology section below).</p>
(5) Textbooks and course materials	<p>Textbooks: There is no textbook for this course. Reading materials will be provided in class. Materials: Please bring an electronic device to class (laptop computer, iPad, smartphone) and also bring pen and paper for taking notes.</p>
(6) Assessment and grading	<p>Assessment: Students will be graded on attendance, in-class participation, in-class discussions, in-class presentations, and quizzes.</p>
(7) Questions to the instructor (Office hours, etc.)	<p>Office hour: To be announced Instructor email: pshahrestani@fullerton.edu</p>
(8) Special note	<p>This course MUST be taken in conjunction with R0357. Dates and times may be subject to change. Please see Kibaco for the latest information.</p> <p>For more information about course contents, please contact Dr. Kanae Ando (k_ando@tmu.ac.jp). For questions about course registration, please email Dr. Obayashi (daigakuin@biol.se.tmu.ac.jp).</p> <p>This course is given in English.</p>

Program	Course Name	Course Number	Semester	Day	Time	Credit Hours
Master's program	Special Lecture on Biological Sciences	R0387	1-I	Thu	3	1
Doctoral program	Special Lecture on Biological Sciences	R0388				
Instructor(s)			Note			
Ketov Serguei						
(1) Course policies and topics	The course will provide a systematic introduction to Applied Mathematics from the very beginning, no prior knowledge is required from students. It will help students to understand basic concepts of mathematics. In the course, logical quantitative thinking and mathematical tools, which are necessary in various fields of science and engineering, will be introduced.					
(2) Knowledge/skills to be acquired and learning objectives/course goals	This course introduces applied mathematics from the first principles to the advanced level without mathematical rigour common to formal textbooks and lectures in mathematics, The emphasis is made on mathematical foundations and skills needed for using mathematics in practical applications. Numerous examples are discussed instead of proving theorems. The purpose of this course is to help students to understand and master the fundamentals of mathematics and acquire the necessary mathematical skills to deal with familiar phenomena in various branches of science and engineering.					
(3) Course schedule, subject matter, and classroom activities	Tentative Course Schedule: 1. Real and complex numbers, basic operations with numbers 2. Plane geometry and trigonometry 3. Coordinates in flat 2 and 3 dimensions, change of coordinates 4. Geometry in 3 flat dimensions 5. General vector spaces 6. Euclidean spaces, translations and rotations 7. Linear algebra 8. Summary					
(4) Outside-class activities and assignments	After each lecture, students should review their notes for 30 minutes on the same day, and on the day before the next week's lecture, they should review their previous notes for 10 minutes to see if there are any questions that need to be answered. In addition, students should try to work on the examples and exercises covered in the lectures by themselves.					
(5) Textbooks and course materials	These are original lectures, there is no textbook. Lecture materials will be distributed during the class. Reference books and other materials will be introduced in the first lecture.					
(6) Assessment and grading	Grades are based on reports and activity of students. Reports are needed to assess understanding, and these will be counted toward the grade.					
(7) Questions to the instructor (Office hours, etc.)	If you have any questions, feel free to ask them during the lectures or by sending an email message to ketov@tmu.ac.jp.					
(8) Special note	Mathematical skills are necessary for almost any course of lectures in science and engineering. For questions about course registration, please email Dr. Obayashi (daigakuin@biol.se.tmu.ac.jp). This course is given in English.					

Program	Course Name	Course Number	Semester	Day	Time	Credit Hours
Master's program	Special Lecture on Biological Sciences	R0405	1-II	Thu	3	1
Doctoral program	Special Lecture on Biological Sciences	R0406				
Instructor(s)			Note			
Ketov Serguei						
(1) Course policies and topics	The course will provide a systematic introduction to Applied Mathematics, no prior knowledge is required from students. It will help students to understand basic concepts of mathematics. In the course, logical quantitative thinking and mathematical tools, which are necessary in various fields of science and engineering, will be introduced.					
(2) Knowledge/skills to be acquired and learning objectives/course goals	This course introduces applied mathematics from the first principles to the advanced level without mathematical rigour common to formal textbooks and lectures in mathematics, The emphasis is made on mathematical foundations and skills needed for using mathematics in practical applications. Numerous examples are discussed instead of proving theorems. The purpose of this course is to help students to understand and master the fundamentals of mathematics and acquire the necessary mathematical skills to deal with familiar phenomena in various branches of science and engineering.					
(3) Course schedule, subject matter, and classroom activities	<ol style="list-style-type: none"> 1. Matrices and their properties 2. Operations with matrices 3. Groups and symmetry transformations 4. General Lie groups and Lie algebras 5. Orthogonal and unitary Lie groups and their Lie algebras 6. Homogeneous spaces 7. Representation theory of groups and algebras 8. Summary 					
(4) Outside-class activities and assignments	After each lecture, students should review their notes for 30 minutes on the same day, and on the day before the next week's lecture, they should review their previous notes for 10 minutes to see if there are any questions that need to be answered. In addition, students should try to work on the examples and exercises covered in the lectures by themselves.					
(5) Textbooks and course materials	These are original lectures, there is no textbook. Lecture materials will be distributed during the class. Reference books and other materials will be introduced in the first lecture.					
(6) Assessment and grading	Grades are based on reports and activity of students. Reports are needed to assess understanding, and these will be counted toward the grade.					
(7) Questions to the instructor (Office hours, etc.)	If you have any questions, feel free to ask them during the lectures or by sending an email message to ketov@tmu.ac.jp.					
(8) Special note	<p>Mathematical skills are necessary for almost any course of lectures in science and engineering.</p> <p>Though the best preparation for this course is a completion of the Introduction to Applied Mathematics 1, this course is open to other students who did not take the first course of Applied Mathematic but are confident with linear algebra.</p> <p>For questions about course registration, please email Dr. Obayashi (daigakuin@biol.se.tmu.ac.jp).</p> <p>This course is given in English.</p>					

Program	Course Name	Course Number	Semester	Day	Time	Credit Hours
Master's program	Special Lecture on Biological Sciences	R0419	2-I	Thu	3	1
Doctoral program	Special Lecture on Biological Sciences	R0420				
Instructor(s)			Note			
Ketov Serguei						
(1) Course policies and topics	The course is a continuation of the systematic introduction to Applied Mathematics 1 and 2. It will help students to understand basic concepts of mathematics. In the course, logical quantitative thinking and mathematical tools, which are necessary in various fields of science and engineering, will be introduced.					
(2) Knowledge/skills to be acquired and learning objectives/course goals	This course introduces applied calculus and applied geometry with less mathematical rigour that is common to formal textbooks and lectures in mathematics, The emphasis is made on mathematical foundations and skills needed for using mathematics in practical applications. Numerous examples are discussed instead of proving theorems. The purpose of this course is to help students to understand and master the fundamentals of mathematics and acquire the necessary mathematical skills to deal with familiar phenomena in various branches of science and engineering.					
(3) Course schedule, subject matter, and classroom activities	<ol style="list-style-type: none"> 1. Review of Applied Mathematics I and II 2. Functions of many variables, differentiation and integration 3. Examples of functions, derivatives and integrals 4. Linear differential operators in two and three dimensions 5. Linear differential equations 6. Special functions and special differential equations 7. Probability theory and distributions 8. Summary 					
(4) Outside-class activities and assignments	After each lecture, students should review their notes for 30 minutes on the same day, and on the day before the next week's lecture, they should review their previous notes for 10 minutes to see if there are any questions that need to be answered. In addition, students should try to work on the examples and exercises covered in the lectures by themselves.					
(5) Textbooks and course materials	These are original lectures, there is no textbook. Lecture materials will be distributed during the class. Reference books and other materials will be introduced in the first lecture.					
(6) Assessment and grading	Grades are based on reports and activity of students. Reports are needed to assess understanding, and these will be counted toward the grade.					
(7) Questions to the instructor (Office hours, etc.)	If you have any questions, feel free to ask them during the lectures or by sending an email message to ketov@tmu.ac.jp .					
(8) Special note	<p>Mathematical skills are necessary for almost any course of lectures in science and engineering.</p> <p>Though the best preparation for this course is a completion of the Introduction to Applied Mathematics 1 and 2, this course is open to other students who did not take the Introduction to Applied Mathematics 1 and/or 2 but are confident with linear algebra and matrices.</p> <p>For questions about course registration, please email Dr. Obayashi (daigakuin@biol.se.tmu.ac.jp).</p> <p>This course is given in English.</p>					

Program	Course Name	Course Number	Semester	Day	Time	Credit Hours
Master's program	Special Lecture on Biological Sciences	R0733	2-II	Thu	3	1
Doctoral program	Special Lecture on Biological Sciences	R0734				
Instructor(s)			Note			
Ketov Serguei						
(1) Course policies and topics	The course is a continuation of the systematic introduction to Applied Mathematics 1, 2 and 3. It will help students to understand basic concepts of mathematics. In the course, logical quantitative thinking and mathematical tools, which are necessary in various fields of science and engineering, will be introduced.					
(2) Knowledge/skills to be acquired and learning objectives/course goals	This course introduces applied calculus and applied geometry with less mathematical rigour that is common to formal textbooks and lectures in mathematics, The emphasis is made on mathematical foundations and skills needed for using mathematics in practical applications. Numerous examples are discussed instead of proving theorems. The purpose of this course is to help students to understand and master the fundamentals of mathematics and acquire the necessary mathematical skills to deal with familiar phenomena in various branches of science and engineering.					
(3) Course schedule, subject matter, and classroom activities	<ol style="list-style-type: none"> 1. Complex analysis and analyticity 2. Nonlinear differential equations, separation of variables 3. Partial differential equations, examples 4. Topology and geometry, tensors and differential forms 5. Riemann manifolds, metric and Christoffel symbols 6. Riemann curvature tensor and covariant derivatives 7. Numerical methods in calculus and analysis 8. Summary 					
(4) Outside-class activities and assignments	After each lecture, students should review their notes for 30 minutes on the same day, and on the day before the next week's lecture, they should review their previous notes for 10 minutes to see if there are any questions that need to be answered. In addition, students should try to work on the examples and exercises covered in the lectures by themselves.					
(5) Textbooks and course materials	These are original lectures, there is no textbook. Lecture materials will be distributed during the class. Reference books and other materials will be introduced in the first lecture.					
(6) Assessment and grading	Grades are based on reports and activity of students. Reports are needed to assess understanding, and these will be counted toward the grade.					
(7) Questions to the instructor (Office hours, etc.)	If you have any questions, feel free to ask them during the lectures or by sending an email message to ketov@tmu.ac.jp .					
(8) Special note	<p>Mathematical skills are necessary for almost any course of lectures in science and engineering.</p> <p>This course is designed for students who completed the Introduction to Applied Mathematics 3 but is also open to other students who are confident with linear algebra, matrices and calculus.</p> <p>For questions about course registration, please email Dr. Obayashi (daigakuin@biol.se.tmu.ac.jp).</p> <p>This course is given in English.</p>					

Program	Graduate School of Science		Semester	Day	Time	Credit
	Course Name	Course Number				
Master's program	Advanced Experimental Techniques in Biological Sciences 1 —	Number assigned to each laboratory	1st			2
Doctoral program	Advanced Experimental Techniques in Biological Sciences 1	Number assigned to each laboratory				
Instructor(s)			Note			
All faculty member of Department of Biological Sciences						
(1) Course policies and topics	In graduate school, various abilities are acquired through research. To carry out the research, it is necessary not only to repeat experiments by receiving guidance from supervisors but also to acquire deep expertise, wide interest, latest experimental technology and the principle, research ethics and various laws to be observed. In this course, students learn essential knowledge and advanced technology in accordance with each research. This class is indispensable to raising the specialty in the life science field.					
(2) Knowledge/skills to be acquired and learning objectives/course goals	Students receive practical instruction on the knowledge gained in the past related to each research, the latest experimental techniques, data processing, etc., and guidance on acquiring the specialized knowledge necessary for further research development. The guidance is carried out according to each research field and the progress of the research.					
(3) Course schedule, subject matter, and classroom activities	Learn what it means to study, the ethics to study, the dangers to avoid in research, the techniques to study.					
(4) Outside-class activities and assignments	Many activities are out of class.					
(5) Textbooks and course materials	Text is defined by each class. Materials will be distributed as appropriate.					
(6) Assessment and grading	Evaluate in approach to research and conduct of research.					
(7) Questions to the instructor (Office hours, etc.)	Contact each laboratory for questions.					
(8) Special note	The implementation is not always following the timetables. Please contact your supervisor. Students should take the courses offered by their own laboratories. Students can take this course in English.					

Program	Graduate School of Science		Semester	Day	Time	Credit
	Course Name	Course Number				
Master's program	Advanced Experimental Techniques in Biological Sciences 2	Number assigned to each laboratory	2nd	—	—	2
Doctoral program	Advanced Experimental Techniques in Biological Sciences 2	Number assigned to each laboratory				
Instructor(s)			Note			
All faculty member of Department of Biological Sciences						
(1) Course policies and topics	Learn the significance and ethical considerations of publishing research data. Also, students learn how to present research data. Ask questions about other people's presentations and make suggestions for better research. Enhance professional expertise in life sciences by presenting their research and making appropriate suggestions for other people's research.					
(2) Knowledge/skills to be acquired and learning objectives/course goals	The research in graduate school explores cutting-edge knowledge in the life sciences. To further develop the research, it is vital to carry out experiments and obtain valuable advice from other people. In order to do that, it is necessary to present research in a way that others can understand easily. In addition, it is also essential to be able to give professional advice and constructive criticism for the research presentation of other people. It is a course necessary for understanding and mastering the more advanced life science field on the subject of own research.					
(3) Course schedule, subject matter, and classroom activities	Learn the skills to present research. Learn what research presentations are easy for others to understand					
(4) Outside-class activities and assignments	Reading papers, summarizing presentations, etc., are carried out outside the class hours.					
(5) Textbooks and course materials	There is no textbook. Use the science paper of students' choice.					
(6) Assessment and grading	It is evaluated by the result of the paper presentation and whether it is positively asked and criticized.					
(7) Questions to the instructor (Office hours, etc.)	Contact each laboratory if students have any questions.					
(8) Special note	It is conducted in each laboratory. All graduate students are expected to take this course. If more than one seminar is held in the same laboratory in each period, or if students wish to take a course in a related laboratory, they should receive guidance from their supervisor.					
Students can take this course in English.						

Program	Graduate School of Science		Semester	Day	Time	Credit
	Course Name	Course Number				
Master's program	Special Experiment in Biological Sciences	Number assigned to each Experimental Techniques	As Needed	—	—	1
Doctoral program	Special Experiment in Biological Sciences	Number assigned to each Experimental Techniques				
Instructor(s)			Note			
All faculty member of Department of Biological Sciences						
(1) Course policies and topics	Basic Experimental Techniques					
(2) Knowledge/skills to be acquired and learning objectives/course goals	To acquire basic experimental methods in the field of biology. Students majoring in fields other than biological sciences are eligible.					
(3) Course schedule, subject matter, and classroom activities	Basic Experimental Techniques 1: Ecology and Microbiology Basic Experimental Techniques 2: Biochemistry and Cell Biology Basic Experimental Techniques 3: Neurobiology Basic Experimental Techniques 4: Developmental Biology Basic Experimental Techniques 5: Genetics Basic Experimental Techniques 6: Taxonomy					
(4) Outside-class activities and assignments	Study outside of class as needed.					
(5) Textbooks and course materials	Prints will be given if needed.					
(6) Assessment and grading	Reports may be required.					
(7) Questions to the instructor (Office hours, etc.)	Students can contact Dr. Obayashi, daigakuin@biol.se.tmu.ac.jp .					
(8) Special note	Students must obtain permission from their academic advisors and the Educational Affairs Committee. Please contact the curriculum coordinator (Dr. Obayashi, daigakuin@biol.se.tmu.ac.jp).					

Program	Graduate School of Science		Semester	Day	Time	Credit
	Course Name	Course Number				
Master's program	Special Practice in Biological Sciences II	Number assigned to each Research Techniques	As Needed	—	—	2
Doctoral program	Special Practice in Biological Sciences II	Number assigned to each Research Techniques				
Instructor(s)			Note			
All faculty member of Department of Biological Sciences						
(1) Course policies and topics	Research Method					
(2) Knowledge/skills to be acquired and learning objectives/course goals	Students learn various experimental and research practices in the biological science field. It is a practical course for students who need to take it for special reasons, and it is tailored to each student.					
(3) Course schedule, subject matter, and classroom activities	Research Technique 1: Ecology and Microbiology Research Technique 2: Biochemistry and Cell Biology Research Technique 3: Neurobiology Research Technique 4: Developmental Biology Research Technique 5: Genetics Research Technique 6: Taxonomy					
(4) Outside-class activities and assignments	Study outside of class as needed.					
(5) Textbooks and course materials	Prints will be given if needed.					
(6) Assessment and grading	Reports may be required.					
(7) Questions to the instructor (Office hours, etc.)	Students can contact Dr. Obayashi, daigakuin@biol.se.tmu.ac.jp .					
(8) Special note	Students must obtain permission from their academic advisors and the Educational Affairs Committee. Contact Dr. Obayashi, daigakuin@biol.se.tmu.ac.jp .					

Program	Graduate School of Science		Semester	Day	Time	Credit
	Course Name	Course Number				
Master's program	Advanced Experimental Techniques in Biological Sciences 1 —	Number assigned to each laboratory	1st			2
Doctoral program	Advanced Experimental Techniques in Biological Sciences 1	Number assigned to each laboratory				
Instructor(s)			Note			
All faculty member of Department of Biological Sciences						
(1) Course policies and topics	In graduate school, various abilities are acquired through research. To carry out the research, it is necessary not only to repeat experiments by receiving guidance from supervisors but also to acquire deep expertise, wide interest, latest experimental technology and the principle, research ethics and various laws to be observed. In this course, students learn essential knowledge and advanced technology in accordance with each research. This class is indispensable to raising the specialty in the life science field.					
(2) Knowledge/skills to be acquired and learning objectives/course goals	Students receive practical instruction on the knowledge gained in the past related to each research, the latest experimental techniques, data processing, etc., and guidance on acquiring the specialized knowledge necessary for further research development. The guidance is carried out according to each research field and the progress of the research.					
(3) Course schedule, subject matter, and classroom activities	Learn what it means to study, the ethics to study, the dangers to avoid in research, the techniques to study.					
(4) Outside-class activities and assignments	Many activities are out of class.					
(5) Textbooks and course materials	Text is defined by each class. Materials will be distributed as appropriate.					
(6) Assessment and grading	Evaluate in approach to research and conduct of research.					
(7) Questions to the instructor (Office hours, etc.)	Contact each laboratory for questions.					
(8) Special note	The implementation is not always following the timetables. Please contact your supervisor. Students should take the courses offered by their own laboratories. Students can take this course in English.					

Program	Graduate School of Science		Semester	Day	Time	Credit
	Course Name	Course Number				
Master's program	Advanced Experimental Techniques in Biological Sciences 2	Number assigned to each laboratory	2nd	—	—	2
Doctoral program	Advanced Experimental Techniques in Biological Sciences 2	Number assigned to each laboratory				
Instructor(s)			Note			
All faculty member of Department of Biological Sciences						
(1) Course policies and topics	Learn the significance and ethical considerations of publishing research data. Also, students learn how to present research data. Ask questions about other people's presentations and make suggestions for better research. Enhance professional expertise in life sciences by presenting their research and making appropriate suggestions for other people's research.					
(2) Knowledge/skills to be acquired and learning objectives/course goals	The research in graduate school explores cutting-edge knowledge in the life sciences. To further develop the research, it is vital to carry out experiments and obtain valuable advice from other people. In order to do that, it is necessary to present research in a way that others can understand easily. In addition, it is also essential to be able to give professional advice and constructive criticism for the research presentation of other people. It is a course necessary for understanding and mastering the more advanced life science field on the subject of own research.					
(3) Course schedule, subject matter, and classroom activities	Learn the skills to present research. Learn what research presentations are easy for others to understand					
(4) Outside-class activities and assignments	Reading papers, summarizing presentations, etc., are carried out outside the class hours.					
(5) Textbooks and course materials	There is no textbook. Use the science paper of students' choice.					
(6) Assessment and grading	It is evaluated by the result of the paper presentation and whether it is positively asked and criticized.					
(7) Questions to the instructor (Office hours, etc.)	Contact each laboratory if students have any questions.					
(8) Special note	It is conducted in each laboratory. All graduate students are expected to take this course. If more than one seminar is held in the same laboratory in each period, or if students wish to take a course in a related laboratory, they should receive guidance from their supervisor.					
Students can take this course in English.						