Academic Year 2025

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 2025.

General Courses for All Majors
(Graduate School of Science & Graduate School of Science and Engineering)

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

2025 Graduate School Course Catalog
General courses of the Graduate School of Science

＊M = master's courses, D = doctoral courses
＊NA 2025 = Courses not offered in the academic year 2025

Course outline No.	M	D	NA 2025	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	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.

2025 Graduate School Course Catalog
Graduate School of Science (Mathematical Sciences)

＊M = master's courses, D = doctoral courses
＊NA 2025 = Courses not offered in the academic year 2025
＊☆：Students may retake the same course if respective courses provide different subject matter.
＊◎ ：Required course for the major

Course outline No.	M	D	NA 2025	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	KANEMITSU Akihiro	This course is also offered in the undergraduate program
3	○			2nd Semester	Mon.	3	M(R0013)	☆Special Lectures in Algebra	2	UEHARA Hokuto	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	Tue.	4	M(R0015)	☆Special Lectures in Geometry	2	FUKAYA Tomohiro	This course is also offered in the undergraduate program
6	○			2nd Semester	Thu.	2	M(R0016)	☆Special Lectures in Geometry	2	AKAHO Manabu	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	SEKI Yukihiro	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 Yukihiro	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
	○	(○)	△				M(R0023)	☆Advanced Topics in Algebra 1	1		
13	○	(○)		1st Semester	Mon.	2	M(R0095)	☆Advanced Topics in Algebra 2	2	TSUMURA Hirofumi	
14	○	(○)		2nd Semester	Thu.	3	M(R0025)	☆Advanced Topics in Geometry 1	1	KAZUKAWA Daisuke	
15	○	(○)		1st Semester	Tue.	4	M(R0027)	☆Advanced Topics in Geometry 2	2	KOBAYASHI Masanori	
	○	(○)	△				M(R0029)	☆Advanced Topics in Analysis 1	1		
16	○	(○)		1st Semester	Mon.	4	M(R0031)	☆Advanced Topics in Analysis 2	2	SHIMOJO Masahiko	
17	○	(○)		2nd Semester	Fri.	4	M(R0049)	☆Advanced Topics in Applied Mathematics 1	1	SATO Shun	
	○	(○)	△				M(R0051)	☆Advanced Topics in Applied Mathematics 2	2		
	○	(○)						☆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		
18	○	(○)		1st Semester	Wed.	3	M(R0033)	◎Exercises in Mathematical Sciences	1	SAKAI Takashi	Searching and collecting information on mathematics
19	○			Summer intensive			M(R0034)	◎Seminar in Mathematical Sciences 1	3	Multiple instructors	
19	○			Winter intensive			M(R0035)	◎Seminar in Mathematical Sciences 2	3	Multiple instructors	
19	○			Summer intensive			M(R0036)	◎Seminar in Mathematical Sciences 3	3	Multiple instructors	
19	○			Winter intensive			M(R0037)	◎Seminar in Mathematical Sciences 4	3	Multiple instructors	
21	○			Intensive course (period TBD)			M(R0045) 1 unit M(R0047) 2 units	☆Internship	1 or 2	Multiple instructors	
22	○			Intensive course (period TBD)			M(R0817) 1 unit M(R0819) 2 units	☆Internship	1 or 2	Multiple instructors	
	(○)	○	△				D(R0024)	☆Advanced Topics in Algebra 1	1		
13	(○)	○		1st Semester	Mon.	2	D(R0096)	☆Advanced Topics in Algebra 2	2	TSUMURA Hirofumi	
14	(○)	○		2nd Semester	Thu.	3	D(R0026)	☆Advanced Topics in Geometry 1	1	KAZUKAWA Daisuke	

Course outline No.	M	D	NA 2025	Semester	Day	Time	Course Number	Course Name	Credit Hours	Instructor(s)	Note (enrollment requirements, subject matter, etc.)
15	(○)	○		1st Semester	Tue.	4	D(R0028)	☆Advanced Topics in Geometry 2	2	KOBAYASHI Masanori	
	(○)	○	△				D(R0030)	☆Advanced Topics in Analysis 1	1		
16	(○)	○		1st Semester	Mon.	4	D(R0032)	☆Advanced Topics in Analysis 2	2	SHIMOJO Masahiko	
17	(○)	○		2nd Semester	Fri.	4	D(R0050)	☆Advanced Topics in Applied Mathematics 1	1	SATO Shun	
	(○)	○	△				D(R0052)	☆Advanced Topics in Applied Mathematics 2	2		
	(○)	○						☆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		
18		○		1st Semester	Wed.	3	D(R0038)	Special Exercises in Mathematical Sciences	1	SAKAI Takashi	Searching and collecting information on mathematics
20		○		Summer intensive			D(R0039)	◎Advanced Seminar in Mathematical Sciences 1	4	Multiple instructors	
20		○		Winter intensive			D(R0040)	◎Advanced Seminar in Mathematical Sciences 2	4	Multiple instructors	
20		○		Summer intensive			D(R0041)	◎Advanced Seminar in Mathematical Sciences 3	3	Multiple instructors	
20		○		Winter intensive			D(R0042)	◎Advanced Seminar in Mathematical Sciences 4	3	Multiple instructors	
20		○		Summer intensive			D(R0043)	◎Advanced Seminar in Mathematical Sciences 5	2	Multiple instructors	
20		○		Winter intensive			D(R0044)	◎Advanced Seminar in Mathematical Sciences 6	2	Multiple instructors	
21		○		Intensive course (period TBD)			D(R0046) 1 unit D(R0048) 2 units	☆External Experience in Mathematical Sciences	1 or 2	Multiple instructors	
22		○		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
KANEMITSU Akihiro	This course is also offered in the undergraduate program.

(1) Course policies and topics	Basics on Lie algebras will be explained. Especially, the structure and the classification of semisimple Lie algebras are explained.
(2) Knowledge/skills to be acquired and learning objectives/course goals	The learning objectives are to learn basic knowledge on Lie algebras, and to acquire an ability to solve problems by using this knowledge.
(3) Course schedule, subject matter, and classroom activities	1. Definition of Lie algebras 2. Examples of Lie algebras 3. Subalgebras and Ideals 4. Solvable Lie algebras and nilpotent Lie algebras 5. Lie's theorem and Cartan's theorem 6. Cartan's criterion and Killing forms 7. Representations of semisimple Lie algebras and their reducibility 8. Weyl's theorem 9. Representations of sl(2) 10. Root decomposition 11. Properties of root decomposition 12. Root system 13. Simple roots, bases 14. Weyl group 15. Dynkin diagrams and the classification of root systems
(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	James E. Humphreys, Introduction to Lie algebras and representation theory, Springer-Verlag William Fulton, Joe Harris, Representation theory: a first course, Springer
(6) Assessment and grading	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 linear algebra. Some knowledge on groups and commutative algebras will be helpful.

Program	Course Name	Course Number	Semester	Day	Time	Credit Hours
Master's program	Special Lectures in Algebra	M(R0013)	2nd Semester	Mon.	3	2
Doctoral program						

Instructor(s)	Note
UEHARA Hokuto	This course is also offered in the undergraduate program.

(1) Course policies and topics	Definitions and examples of triangulated categories will be lectured while introducing basic concepts related to additive and abelian categories. Basic knowledge of category theory will be assumed.
(2) Knowledge/skills to be acquired and learning objectives/course goals	The course will focus on the following topics and expose students to the world of related areas of triangulated categories. additive category, abelian category, stable category of Frobenius category, derived category, triangulated category (Basic knowledge and understanding of specialized fields, comprehensive problem-solving skills, and logical thinking)
(3) Course schedule, subject matter, and classroom activities	1 to 3. Additive categories and abelian categories 4 to 6. Definition of triangulated categories 7 to 9. Derived categories and derived functors 10 to 12. Frobenius categories and its stable categories 13 to 15. Various examples (Subjects may be changed according to the students' situation) Assignments will be made to check the level of understanding.
(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	D. Happel, Triangulated categories in the representation theory of finite dimensional algebras, LMS 119. T. Holm; P. Jørgensen, Triangulated categories: definitions, properties, and examples. Triangulated categories, LMS 375.
(6) Assessment and grading	Evaluation will be based on homework assignments, end-of-term reports, and class participation (100%). Homework assignments and end-of-term reports will be evaluated based on the students' understanding of specialized knowledge and their ability to think about problems from multiple perspectives, identify the essence of the problem to be solved, and formulate their own ideas logically, while comprehensively utilizing such knowledge. (Basic knowledge and understanding of specialized fields, ability to think about problems comprehensively and logically)
(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	Basic knowledge of category theory, “Algebra A” and “Algebra B”, especially rings and modules is desirable.

Program	Course Name	Course Number	Semester	Day	Time	Credit Hours
Master's program	Special Lectures in Geometry (1)	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	The plan of this course is the following: 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	No textbooks will be used. 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
(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 preferable to have some basic knowledge of topological spaces and group theory This class is common to the undergraduate courses. Students who already have the unit of Undergraduate Special Lectures on Geometry (1) cannot take this class.

Program	Course Name	Course Number	Semester	Day	Time	Credit Hours
Master's program	Special Lectures in Geometry (2)	M(R0014)	2nd Semester	Tue.	4	2
Doctoral program						

Instructor(s)	Note
FUKAYA Tomohiro	This course is also offered in the undergraduate program

(1) Course policies and topics	Hyperbolic Geometry Hyperbolic geometry is one of the non-Euclidean geometry that does not satisfy the parallel postulate. It is an important example of Riemannian geometry. It is related with complex analysis, and group actions.
(2) Knowledge/skills to be acquired and learning objectives/course goals	One can learn the basic concept of Riemann geometry through hyperbolic geometry.
(3) Course schedule, subject matter, and classroom activities	The plan of this course is the following: 1-2. linear fractional transformation 3-4. Upper Half-Plane Model 5-6. Hyperbolic Plane Model 7. Hyperbolic Trigonometry 8. Ideal Boundary 9. Classification of Isometries 10. Gauss-Bonnet Theorem 11-12. Tiling of the Hyperbolic Plane 13-14-15. Hyperbolic groups in the sense of Gromov
(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	References up to the 12th session: "Hyperbolic Geometry," Introduction to Modern Mathematics, Kenji Fukaya, Iwanami Shoten, 2004 (in Japanese) References from the 13th session onwards: "Geometry of Discrete Groups," Koji Fujiwara, Asakura Shoten, 2021 (in Japanese) "Introduction to Coarse Geometry," SGC Library, Science-sha, 2019 (in Japanese)
(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 preferable to have some basic knowledge of topological spaces and group theory This class is common to the undergraduate courses.

Program	Course Name	Course Number	Semester	Day	Time	Credit Hours
Master's program	Special Lectures in Geometry	M(R0016)	2nd Semester	Thu.	2	2
Doctoral program						

Instructor(s)	Note
AKAHO Manabu	This course is also offered in the undergraduate program.

(1) Course policies and topics	(1) In this course, after learning the basics of manifolds, we will introduce the basic concepts necessary to understand the content of more advanced modern geometry. Each topic is independent, so you can learn according to your interests.
(2) Knowledge/skills to be acquired and learning objectives/course goals	(2) The specific content is as shown in the lesson plan below. (Knowledge and understanding of specialized fields, comprehensive problem-solving skills, logical thinking skills) The goal is to be able to read specialized books and papers on modern geometry by studying each topic.
(3) Course schedule, subject matter, and classroom activities	(3) Our plan is the following. (However, there may be slight changes depending on the progress.) §1 Manifolds 1. Manifolds 2. Tangent vectors 3. Differential forms §2 Hodge theory 4. Cartan's formula 5. Harmonic forms §3 Differential geometry 6. Levi-Civita connections 7. Parallel tranceforms 8. Summary of the first half §4 Vector bundles 9. Vector bundles 10. Connections §5 Complex manifolds 11. Differential forms on complex manifolds 12. Kahler manifolds §6 Lie groups 13. Lie groups 14. Lie algebras 15. Summary
(4) Outside-class activities and assignments	(4) Preparation and review on the lecture notes and references
(5) Textbooks and course materials	(5) H. Konno, Differential Geometry, The University of Tokyo Press In addition, standard reference books will be provided for each topic during class.
(6) Assessment and grading	(6) Participation and activity (40%), report (60%)
(7) Questions to the instructor (Office hours, etc.)	(7) See the following web page: https://pseudoholomorphic.fpark.tmu.ac.jp/
8) Special note	(8) It is desirable to like manifolds.

Program	Course Name	Course Number	Semester	Day	Time	Credit Hours
Master's program	Special Lectures in Analysis	M(R0017)	1st 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	Topic: Fundamentals of Functional Analysis This lecture will enable students to appreciate the benefits of understanding the basics of functional analysis as abstract definitions and concepts, and to deepen their understanding through specific examples.
(2) Knowledge/skills to be acquired and learning objectives/course goals	1. Students will become able to systematically understand the rigorous theory of functional analysis, acquire basic knowledge of its methodology, and understand how to develop it logically. 2. Students will become able to comprehensively utilize the ideas and methods of functional analysis and apply them to solving various problems from a multifaceted perspective.
(3) Course schedule, subject matter, and classroom activities	Lecture plan and content (Some content may be omitted or added depending on the progress of the lecture.) 1. Normed vector spaces, Banach spaces and their examples 2. Linear operators 3. Hilbert spaces 4. Orthogonal projection, Riesz representation theorem 5. The Hahn-Banach extension theorem, dual spaces and their examples 6. Weak and weak* topologies 7. Baire category theorem, open mapping theorem, closed graph theorem 8. Uniform boundedness principle, Banach-Steinhaus theorem 9. Locally convex spaces 10. Hahn-Banach separation theorem 11. Introduction to spectrum theory 12. Compact operators 13. Fredholm alternative theorem 14. Spectrum of self-adjoint operators 15. Summary 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.
(4) Outside-class activities and assignments	Report problems will be assigned regularly. At least three hours of preparation and review per week is required.
(5) Textbooks and course materials	References ・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	Evaluation will be based on quizzes taking place every session and on final examination.
(7) Questions to the instructor (Office hours, etc.)	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
(8) Special note	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.

Program	Course Name	Course Number	Semester	Day	Time	Credit Hours
Master's program	*Special Lectures in Analysis	M(R0018)	1 st 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 (3)	M(R0019)	2	Mon.	2	2
Doctoral program						

Instructor(s)	Note
SEKI Yukihiro	This course is also offered in the undergraduate program

(1) Course policies and topics	We study basic materials on distribution theory, Sobolev spaces and their applications to differential equations.
(2) Knowledge/skills to be acquired and learning objectives/course goals	The purpose of this lecture is to learn the basic materials on the distribution theory, Sobolev spaces and their applications to partial differential equations. Moreover, this course aims to improve one's knowledge on the subject and the logical mathematical thinking.
(3) Course schedule, subject matter, and classroom activities	1.Lebesgue spaces, mollifier 2.Distribution, derivatives of distribution 3.The rapidly decreasing functions, the inversion formula of the Fourier transform 4.Tempered distributions and their Fourier transform 5.Sobolev spaces and their fundamental properties 6.Sobolev's embedding theorem 7.Sobolev's inequality, the compactness theorem 8.Elliptic boundary value problems (Part 1) 9. Elliptic boundary value problems (Part 2) 10.Extension theorem 11.Elliptic regularity theory for weak solutions (Part 1) 12.Elliptic regularity theory for weak solutions (Part 2) 13.Eigenvalue problems 14.Fredholm theory 15.Summary This is a lecture-centered course. Solving exercises (report) helps students in understanding the subject.
(4) Outside-class activities and assignments	Complementary notes will be provided in kibaco when necessary, for which each student should register by the first lecture. Making original notes by yourself will help you to understand the subject. Deep consideration of definitions and examples are recommended.
(5) Textbooks and course materials	1.A course in Sobolev Spaces -with applications to Partial Differential Equations, by S. Miyajima, KyoritsuShuppan, Co., Ltd. (in Japanese) 2. Functional Analysis and Partial Differential Equations, by H. Brezis, Springer (e-Book is available at the Mathematical Library) 3. Partial Differential Equations, by L.C. Evans, Amer. Mas. Soc.
(6) Assessment and grading	Evaluation is performed by two intermediate reports and a final report. The problems will be uploaded to kibaco.
(7) Questions to the instructor (Office hours, etc.)	Office hour is Time 5 on Monday.
(8) Special note	Basic knowledges in the Lebesgue integration theory and the functional analysis are required. Confirm basic knowledge on the theory of Hilbert spaces.

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 Monday.
(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 (2)	M(R0021)	Second Semester	.Tue.	3	2
Doctoral program						

Instructor(s)	Note
Yukihiro Uchida	This course is also offered in the undergraduate program.

(1) Course policies and topics	This course will provide basics on algebraic number theory from the viewpoint of algorithmic number theory. As applications, two factoring methods, the quadratic sieve and the number field sieve will be explained.
(2) Knowledge/skills to be acquired and learning objectives/course goals	Students learn basics on algebraic number theory (prime ideal decomposition, finiteness of the ideal class group, Dirichlet's unit theorem, and so on) with related number theoretic algorithms. They also learn factoring algorithms such as the quadratic sieve and the number field sieve.
(3) Course schedule, subject matter, and classroom activities	The schedule of this course is below. The following schedule may be changed according to circumstances. 1. Introduction and guidance 2. Integral extensions and integrally closed domains 3. Algebraic extensions and conjugates 4. Norms and traces 5. Discriminants 6. Noetherian rings 7. Dedekind rings 8. Prime ideal decomposition 9. Prime ideal decomposition of a prime number in a number field 10. Lattices 11. Minkowski's theorem 12. Finiteness of the ideal class group 13. Dirichlet's unit theorem 14. Quadratic sieve 15. Number field sieve
(4) Outside-class activities and assignments	The contents of each lecture should be reviewed. Some assignments will be given.
(5) Textbooks and course materials	There are no specific texts. As references, three books are suggested below and other references will be suggested if necessary. P. Samuel, Algebraic Theory of Numbers, Hermann, 1970. F. Jarvis, Algebraic Number Theory, Springer, 2014. R. Crandall, C. Pomerance, Prime Numbers: A Computational Perspective, Springer, 2nd ed., 2005.
(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	- The prerequisite for this course is 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 fundamentals of computational number theory and the basic mathematics of quantum computers with applications to modern cryptography.
(2) Knowledge/skills to be acquired and learning objectives/course goals	Modern cryptography has its mathematical scientific foundations in the theory of computation and computational number theory. The purpose of this course is to acquire knowledge of representative number theory algorithms in modern cryptography from the standpoint of applied algebra. In addition, we will learn the basic mathematics and representative quantum algorithms, which have recently attracted attention from the viewpoint of evaluating the security of cryptographic schemes currently in use.
(3) Course schedule, subject matter, and classroom activities	The class schedule is as follows. However, it may be changed depending on the situation. 1. Introduction and guidance 2. Fundamentals of computation theory 3. Primality tests 4. Elliptic curves 5. A primality proving algorithm using elliptic curves 6. Prime factorization algorithms 7. Applications to cryptography 8. Mid-term summary and report 9. Basics of quantum computers 10. Mathematical model of quantum computers 11. A simple quantum computer 12. Deutsch-Jozsa's decision algorithm 13. Grover's search algorithm 14. Shor's prime factorization algorithm 15. Final 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.)	If you have any questions, they are always welcome. Email address: uchiyama-shigenori@tmu.ac.jp
(8) Special note	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.

Program	Course Name	Course Number	Semester	Day	Time	Credit Hours
Master's program	Advanced Topics in Algebra 2	M(R0095)	First Semester	Mon.	2	2
Doctoral program	Advanced Topics in Algebra 2	D(R0096)				

Instructor(s)	Note
TSUMURA Hirofumi	

(1) Course policies and topics	The main topic of this course is to define elliptic functions, which appear in various fields of mathematics, and introduce the basic theory of their properties in complex analysis.
(2) Knowledge/skills to be acquired and learning objectives/course goals	As an extension of periodic functions such as exponential functions and trigonometric functions, define elliptic functions and study their double periodicity. Additionally, define elliptic curves and learn about their relationship with elliptic functions. The goal is to acquire the basic theory of elliptic functions and its applications.
(3) Course schedule, subject matter, and classroom activities	The schedule of this course is as follows. The following schedule may be subject to change. 1-2: Complex trigonometric functions, complex periodic functions 3-5: Elliptic functions, Weierstrass's Pe-function 6-9: Elliptic integrals, lemniscate, Eisenstein series 10-12: Structure of the field of elliptic functions 13-14: Elliptic curves 15: Summary and exercises
(4) Outside-class activities and assignments	Solve the practice problems given during class.
(5) Textbooks and course materials	A. Hurwitz and R. Courant: Vorlesungen Über Allgemeine Funktionentheorie Und Elliptische Funktionen (Ulan Press), 2012 J. H. Silverman and J. Tate: Rational Points on Elliptic Curves (Springer), 1992
(6) Assessment and grading	Exercises 70%, class participation and activity 30%
(7) Questions to the instructor (Office hours, etc.)	Inquire via the email address provided during class for consultations.
(8) Special note	This course is related to complex analysis and algebras.

Program	Course Name	Course Number	Semester	Day	Time	Credit Hours
Master's program	Advanced Topics in Geometry 1	M(R0025)	2nd Semester	Thu.	3	1
Doctoral program	Advanced Topics in Geometry 1	D(R0026)				

Instructor(s)	Note
KAZUKAWA Daisuke	

(1) Course policies and topics	We will study about the concentration of measure phenomenon and the convergence theory of metric measure spaces based on it.
(2) Knowledge/skills to be acquired and learning objectives/course goals	The concentration of measure phenomenon is, roughly speaking, a bias of measure observed in some high-dimensional spaces. Gromov linked this phenomenon to the convergence theory of spaces and initiated the study of behavior of sequences of high-dimensional Riemannian manifolds or metric measure spaces. In this lecture, we will briefly learn about the concentration of measure phenomenon and show recent developments in the convergence theory. Through lectures and assignments, students will deepen their understanding of this topic. Students will also understand the research directions and interests of this topic and experience the forefront of research.
(3) Course schedule, subject matter, and classroom activities	Course schedule: 1. Preliminaries on fundamental notions 2. Concentration of measure phenomenon on the unit sphere 3. Riemannian geometry and Convergence theory 4. Box distance 5. Observable distance 6. Pyramid 7. High-dimensional sphere and Gaussian space 8. Scaling problem and Some solutions Classes will be conducted in lecture form. Exercises will be given as needed during the lecture.
(4) Outside-class activities and assignments	Review each lecture.
(5) Textbooks and course materials	Takashi Shioya, Invitation to the geometry of metric measure spaces, SGC library (Japanese). Takashi Shioya, Metric Measure Geometry, European Mathematical Society. Misha Gromov, Metric Structures for Riemannian and Non-Riemannian Spaces, Birkhäuser Boston. Michel Ledoux, The Concentration of Measure Phenomenon, American Mathematical Society. Shouhei Honda, Convergence of manifolds, Asakura Publishing (Japanese)
(6) Assessment and grading	40% class participation, 60% reports.
(7) Questions to the instructor (Office hours, etc.)	Let me explain about this in the first lecture.
(8) Special note	It will be nice if you know about measure theory and Riemannian geometry.

Program	Course Name	Course Number	Semester	Day	Time	Credit Hours
Master's program	*Advanced Topics in Geometry 2	M(R0027)	1st Semester	Tue.	4	2
Doctoral program	*Advanced Topics in Geometry 2	D(R0028)				

Instructor(s)	Note
KOBAYASHI Masanori	

(1) Course policies and topics	This course is a lecture on tropical geometry. Although the course is mainly concerned with algebraic geometry, applied mathematical aspects of tropical algebra will also be covered.
(2) Knowledge/skills to be acquired and learning objectives/course goals	The objective of this course is to provide students with the knowledge and skills necessary to understand the concepts and theorems fundamental to tropical geometry.
(3) Course schedule, subject matter, and classroom activities	The first half of the class will cover local theory and the second half will cover global theory. 1. Tropicalization 2--3. Tropical algebra 4. Convex polyhedra 5--7. Tropical hypersurfaces 8--9. Tropical schemes 10. Tropical manifolds 11. Tropical curves 12. The Riemann--Roch theorem 13-15. Related topics
(4) Outside-class activities and assignments	Students will be required to submit a brief review of the class at appropriate times. Students are encouraged to study by themselves by reading reference books on topics not explained in detail in class.
(5) Textbooks and course materials	Introduction to Tropical Geometry, D. Maclagan and B. Sturmfels, AMS 2016 Tropical Geometry, G. Mikhalkin and J. Rau, draft, 2018 Max Plus at Work, B. Heidergott, G. Jan Olsder, J. van der Woude, Princeton Univ. Press, 2006
(6) Assessment and grading	Grading will be based on reports (60%) and a simple assignment (40%).
(7) Questions to the instructor (Office hours, etc.)	Office hours will be explained in the first class.
(8) Special note	This course is related to basic knowledge of commutative algebra and algebraic geometry.

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
SHIMOJO Masahiko	

(1) Course policies and topics	This is an introductory lecture on nonlinear systems of parabolic partial differential equations, specifically reaction-diffusion equations.
(2) Knowledge/skills to be acquired and learning objectives/course goals	First, we will understand the classification of reaction-diffusion systems and the comparison principles related to cooperative and competitive systems. As an application, we will demonstrate the stability of steady-state solutions based on the structure of order-preserving dynamical systems. Next, we will learn the stability analysis of steady-state solutions using the linearized stability principle. To prepare for this, we will study the eigenfunction expansion of the Laplacian, which will help us understand the phenomenon known as Turing instability. Furthermore, we will explore fundamental concepts related to traveling waves and spreading phenomena of the initial value problem for reaction-diffusion equations.
(3) Course schedule, subject matter, and classroom activities	1. Derivation of the diffusion equation 2. Maximum principle for a single parabolic equation 3. Comparison principles for cooperative and competitive systems 4. Stability of steady-state solutions in reaction-diffusion systems 5. Classification of reaction-diffusion systems 6. Dynamical systems and phase diagrams 7. Limit sets 8. Lyapunov functions 9. Linear stability principle 10. Eigenfunction expansion 11. Stability of steady-state solutions in nonlinear parabolic equations 12. Stability of steady-state solutions in reaction-diffusion systems 13. Turing instability 14. Traveling waves in a single parabolic equation 15. spreading speed and asymptotic behavior
(4) Outside-class activities and assignments	Reading the distributed materials in advance or reviewing them afterward will be efficient. Questions about the lecture content are highly encouraged.
(5) Textbooks and course materials	References (lecture notes) are handed out at every class.
(6) Assessment and grading	Evaluation will be based on the assessment of submitted reports (100%).
(7) Questions to the instructor (Office hours, etc.)	Consultation hours will be announced in the first lecture. Regardless of these hours, the lecturer is available for discussion whenever present in the office.
(8) Special note	The lecture will be easier to follow with basic knowledge of functional analysis and differential equations.

Program	Course Name	Course Number	Semester	Day	Time	Credit Hours
Master's program	Advanced Topics in Applied Mathematics 1	M(R0049)	2nd Semester	Fri.	4	1
Doctoral program	Advanced Topics in Applied Mathematics 1	D(R0050)				

Instructor(s)	Note
Shun Sato	

(1) Course policies and topics	This is a 1 credit lecture on applied mathematics. This lecture helps to follow trends and new discoveries in a wide area of mathematics, which includes those outside your main research area, and make use of new developments in your own research. This year's lecture will focus on the mathematical aspects of sophisticated 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 Splitting and Composition methods 3 Symplectic integrators for Hamiltonian systems (part 1) 4 Symplectic integrators for Hamiltonian systems (part 2) 5 Conservative/Dissipative methods for conservative/dissipative systems (part 1) 6 Conservative/Dissipative methods for conservative/dissipative systems (part 2) 7 Exponential integrators for semilinear differential equations 8 Further topics
(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	1. Searching and collecting information of mathematical research: - How to use library services and electronic journals 2. Searching and collecting information of mathematical research: - 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	- 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	(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). (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. (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. (4) A certificate of completion signed by the organizer is required. (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.
(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	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. A Credit will be accredited based on the suitability with the above purpose of the course, the organizer's evaluation, and the report.
(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	Students can take multiple credits of this course (up to 2 credits in each semester). The credits of this course are valid for graduation credits. The implementation periods are ・ 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	(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). (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. (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. (4) A certificate of completion signed by the organizer is required. (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.
(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	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. A Credit will be accredited based on the suitability with the above purpose of the course, the organizer's evaluation, and the report.
(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	Students can take multiple credits of this course. The credits of this course are valid for graduation credits. The implementation periods are ・ 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, and the course should constitute more than half of work experience.

2025 Graduate School Course Catalog
Graduate School of Science (Physics)

＊M = master's courses, D = doctoral courses
＊NA 2025 = Courses not offered in the academic year 2025

Course outline No.	M	D	NA 2025	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	*KETOV Serguei	This course is also offered in the undergraduate program
2	○			1st Semester	Fri.	4	M(R0102)	Statistical physics	2	HATTORI Kazumasa	
3	○			1st Semester	Fri.	2	M(R0103)	Field theory	2	MOTOHASHI Hayato	
4	○			1st Semester	Thu.	3	M(R0105)	Nuclear physics	2	HYODO Tetsuo	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	SHUDO Akira	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	*AZUMA Toshiyuki	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
	○	○	△				M(R0099) D(R0100)	Advanced high energy theoretical physics	1		
16	○	○		2nd Semester Ⅰ	Thu.	3	M(R0125) D(R0126)	Advanced subatomic physics	1	HYODO Tetsuo	
	○	○	△				M(R0131) D(R0132)	Advanced high energy astrophysics Ⅰ	1	FUJITA Yutaka	
17	○	○		2nd Semester Ⅰ	Fri.	3	M(R0133) D(R0134)	Advanced high energy astrophysics Ⅱ	1	FUJITA Yutaka	
18	○	○					M(R0141) D(R0142)	Advanced nonlinear physics	1	SHUDO Akira	Register during the 1st semester registration period
19	○	○		1st Semester Ⅱ	Tue.	3	M(R0117) D(R0118)	Advanced statistical mechanics	1	ARAHATA Emiko	
20	○	○		1st Semester Ⅰ	Wed.	3	M(R0115) D(R0116)	Advanced quantum many body system	1	NOMOTO Takuya	
21	○	○		2nd Semester Ⅰ	Mon.	3	M(R0145) D(R0146)	Advanced physics of superconductivity	1	HOTTA Takashi	
	○	○	△				M(R0123) D(R0124)	Advanced physics of magnetism	1	HOTTA Takashi	
	○	○	△				M(R0119) D(R0120)	Advanced high energy physics Ⅰ	1	KAKUNO Hidekazu	
22	○	○		1st Semester Ⅱ	Fri.	3	M(R0121) D(R0122)	Advanced high energy physics Ⅱ	1	KAKUNO Hidekazu	
	○	○	△				M(R0153) D(R0154)	Advanced atomic physics Ⅰ	1	*AZUMA Toshiyuki	
23	○	○		2nd Semester Ⅰ	Wed.	4	M(R0155) D(R0156)	Advanced atomic physics Ⅱ	1	TANUMA Hajime	
	○	○	△				M(R0127) D(R0128)	Advanced astrophysics Ⅰ	1	EZOE Yuichiro	
24	○	○		1st Semester Ⅰ	Fri.	3	M(R0129) D(R0130)	Advanced astrophysics Ⅱ	1	ISHISAKI Yoshitaka	
	○	○	△				M(R0149) D(R0150)	Advanced correlated electron physics Ⅰ	1	MATSUDA Tatsuma	
25	○	○		2nd Semester Ⅰ	Wed.	4	M(R0135) D(R0136)	Advanced correlated electron physics Ⅱ	1	MIZUGUCHI Yoshikazu	
	○	○	△				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
26	○	○		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
	○	○	△				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
27	○	○		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
28	○	○		2nd Semester Ⅰ	Thu.	2	M(R0139) D(R0140)	Advanced English for science	1	MORI Hiroyuki	
29	○	○		2nd Semester	Wed.	1	M(R0163) D(R0164)	Advanced Molecula Spectroscopy	2	KANYA Reika	This course is offered for Physics and Chemistry majors
30	○	○		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
31	○	○		1st Semester	Tue.	2	M(R0167) D(R0168)	Advanced Theoretical Chemistry	2	NAKATANI Naoki	This course is offered for Physics and Chemistry majors
34	○			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 2025	Semester	Day	Time	Course Number	Course Name	Credit Hours	Instructor(s)	Note (enrollment requirements, subject matter, etc.)
34	○			2nd Semester	*	*	M(R0174) 2nd M(R0331) 1st	Advanced seminar physics II	2	All instructors	For first-year master's students
34	○			1st Semester	*	*	M(R0175) 1st M(R0332) 2nd	Advanced seminar in physics III	2	All instructors	For second-year master's students
34	○			2nd Semester	*	*	M(R0176) 2nd M(R0333) 1st	Advanced seminar in physics IV	2	All instructors	For second-year master's students
35	○			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
35	○			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
35	○			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
35	○			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
36	○			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
36	○			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
36	○			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
36	○			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 rovides 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 rovides a different subject matter.
	○	○			TBA	TBA		Selected topics in physics I	1	TBA	The credit hours will be added if the course rovides a different subject matter.
	○	○			TBA	TBA		Selected topics in physics II	2	TBA	The credit hours will be added if the course rovides 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
32	○	○		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.
33	○	○		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.
37		○		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
37		○		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
37		○		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
37		○		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
38		○		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
39		○		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
39		○		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
39		○		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
39		○		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
40		○		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
KETOV Serguei	This course is also offered in the undergraduate program

(1) Course policies and topics	Einstein's theory of general relativity is systematically introduced, starting from the first principles. Knowledge of classical mechanics is a prerequisite. The lectures include a brief introduction to Riemannian geometry. Topics include motion of particles in curved space-time, Einstein's equations, black holes, standard cosmology of the Universe, and gravitational waves. The lectures are original and self-contained. Students should make notes during the lectures. Homework will be provided.
(2) Knowledge/skills to be acquired and learning objectives/course goals	The key objectives and skills to be acquired by students include basic knowledge of general relativity theory and ability to do related calculations by using theoretical tools.
(3) Course schedule, subject matter, and classroom activities	Schedule and subjects of lectures: [1-2] review of special relativity theory, [3] basic principles of general covariance and equivalence, [4] topology and geometry of Riemann manifolds, [5] parallel transport and covariant derivatives, [6] Riemann curvature tensors, [7] distances and geodesic lines in curved space-time, [8] energy-momentum tensor of matter, [9] Einstein equations, [10] black holes, [11] gravitational waves, [12] gravitational redshift, [13] Solar system in general relativity, [14] standard cosmological model of the Universe, [15] Observational cosmology
(4) Outside-class activities and assignments	Homework reports are optional (not mandatory).
(5) Textbooks and course materials	The lectures are original (from the teacher) and will be given in English. There is no textbook.
(6) Assessment and grading	Class participation and written test results at the end of the term will be comprehensively judged and evaluated. All materials are allowed for the test. Those who did not attend 2/3 or more of the lectures will not be subject to grade evaluation.
(7) Questions to the instructor (Office hours, etc.)	Office hours for questions and consultations with the teacher are on Mondays between 13:00-14:30 (reservations by email are recommended). Email address: ketov@tmu.ac.jp
(8) Special note	A Japanese-English vocabulary of special words will be provided to each student. The lectures are related to particle physics theory, general relativity theory and space theory.

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	Slides pdf files will be uploaded in kibaco before every class 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	References: "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. “Statistical Physics of fields" M. Carder, Cambridge University Press, Cambridge. “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. Other reference books will be given in class as needed.
(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	Nuclear physics	R0105	1st Semester	Thu.	3	2
Doctoral program						

2Instructor(s)	Note
HYODO Tetsuo	This course is also offered in the undergraduate program

(1) Course policies and topics	We explain the properties of atomic nuclei and their constituent hadrons from both the basic theoretical framework and experimental facts, and learn the physics of "strong force", one of the basic forces of the nature.
(2) Knowledge/skills to be acquired and learning objectives/course goals	We study the basic contents of atomic nuclei and hadrons, and gain knowledge of their theoretical and experimental methods. We learn that the atomic nucleus, which is a microscopic substance that defines an element at the center of an atom, exhibits various properties by itself, and that the strong force has different properties than the gravitational and electromagnetic forces that dominate the macroscopic system. We learn the nucleons (protons and neutrons) that are the constituents of atomic nuclei, the general structure and basic properties of the strongly interacting particle, hadrons, and the basics of quantum chromodynamics which governs the quarks and gluons (Comprehensive problem thinking ability, logical thinking ability).
(3) Course schedule, subject matter, and classroom activities	The atomic nucleus, a microscopic material in the atom, shows various phenomena involving strong and electroweak interactions as a many-body system of hadrons (mesons and baryons). Hadrons are a composite system of elementary particles, quarks and gluons. Nuclear hadron physics that spans these two layers should be understood in principle by quantum chromodynamics, which is the first principle of the strong interaction, but it is not so simple by the dual structure of strong force. In this lecture, we explain the physics of the strong interaction, from the basic properties of atomic nuclei to the structure and properties of hadrons, which are many-body systems of quarks, as well as quark confinement and spontaneous breaking of chiral symmetry. 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 particule 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	Solve the exercises specified during the lecture and submit them as a report.
(5) Textbooks and course materials	The course follows the lecture nots uploaded on the web. References will be introduced during the course.
(6) Assessment and grading	Based on the report and attendance.
(7) Questions to the instructor (Office hours, etc.)	Office hours are not specified. Questions are welcome before and after the class. Send e-mail for appointment, or send questions via e-mail.
(8) Special note	Knowledge of quantum mechanics is a prerequisite. It is desirable to have basic knowledge of “Particle and nuclei”. Closely related with “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	Lecture 1: Chapter 1 – Introduction: An Overview of Elementary Particle Physics Lecture 2: Chapter 2 – Quantum Field Theory (Quantum Mechanics, Path Integral, Symmetry) Lecture 3: Chapter 2 – Quantum Field Theory (Locality + Special Relativity + Quantum Mechanics = Quantum Field Theory, Continuous Global Symmetries and Conservation Laws) Lecture 4: Chapter 3 – Abelian Gauge Theories (Gauge Symmetry, Coupling of Gauge Fields and Matter) Lecture 5: Chapter 3 – Abelian Gauge Theories (Quantum Electrodynamics (QED) and Specific Calculation Examples) Lecture 6: Chapter 3 – Abelian Gauge Theories (Digression: Renormalizability and Effective Field Theories) Lecture 7: Chapter 4 – Non-Abelian Gauge Theories (SU(2) Gauge Symmetry, Strong Force, Quantum Chromodynamics (QCD), Asymptotic Freedom) Lecture 8: Chapter 4 – Non-Abelian Gauge Theories (Spontaneous Breaking of Global Symmetries, Nucleons and Mesons) Lecture 9: Chapter 5 – What is Mass? (Weak Interactions, Massive Vector Bosons and Spontaneous Breaking of Gauge Symmetry) Lecture 10: Chapter 5 – What is Mass? (The Origin of Elementary Particle Mass, Electroweak Unification and the Higgs Field) Lecture 11: Chapter 6 – The Standard Model of Elementary Particles (Standard Model Lagrangian, Generations, and CP Symmetry) 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?) 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)) 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)) Lecture 15 – Discussion of Exercises
(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	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: 1. “An Introduction to the Standard Model of Particle Physics" by W. Cottingham and D. Greenwood 2. 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 netron 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	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: Summery
(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	The lectures will cover topics which are necessary for those who will be engaging to the fundamental or development research on solid materials. 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 Basically, these lectures will be given by the face to face classes.
(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	・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	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. 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)
(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	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. 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 The class will be conducted mainly by lectures.
(4) Outside-class activities and assignments	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	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. 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 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.
(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	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	Course Name	Course Number	Semester	Day	Time	Credit Hours
Master's program	Selected topics in Physics and chemistry Ⅰ(Advanced experimental technique in physics D)	R0159	2nd Semester II	Mon.	3	1
Doctoral program	Selected topics in Physics and chemistry Ⅰ(Advanced experimental technique in physics D)	R0160				

Instructor(s)	Note
AZUMA Toshiyuki	This course is offered for Physics and Chemistry majors

(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	Based on the knowledge of thermo-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: Physics of dilute gases Lecture 2: Vacuum measurement Lecture 3: Principles of vacuum pumps Lecture 4: Vacuum system design Lecture 5: Vacuum materials and components Lecture 6: Practical application of vacuum systems (high-energy accelerator) Lecture 7: Practical application of vacuum systems (mass-analysis system) Lecture 8: Practical application of vacuum systems (surface physics)
(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 (40%) and attendance (60%).
(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 subatomic physics	R0125	2nd Semester I	Thu.	3	1
Doctoral program	Advanced subatomic physics	R0126				

Instructor(s)	Note
HYODO Tetsuo	

(1) Course policies and topics	Theme: Scattering theory and structure of hadron resonances. This lecture introduces a theoretical framework to describe scattering and resonance phenomena which appear in various fields of physics. We then discuss the applications with the examples in hadron physics.
(2) Knowledge/skills to be acquired and learning objectives/course goals	We gain knowledge of the basics of resonance physics and its importance in hadron physics. As a theoretical framework for understanding the structure of resonances, we learn the scattering theory, Feshbach resonance theory, and nonrelativistic effective field theory.
(3) Course schedule, subject matter, and classroom activities	The strong interaction, which is one of the fundamental forces of nature, governs the diverse physics of particles called hadrons. In particular, various excitations induce resonances in the low energy region, and it is necessary to understand their structures. In this lecture, we aim to understand the structure of hadron resonances, and introduce theoretical methods for describing scattering and resonance phenomena from general viewpoints. First, we introduce the basics of dealing with resonance phenomena based on quantum mechanics, and explain the scattering theory and theory of Feshbach resonance. We then introduce non-relativistic effective field theories which are useful for describing actual systems such as hadrons, and the method to discuss the structure of resonance states through the quantity called compositeness. Course schedule Lecture 1: Introduction: resonances in hadron physics Lecture 2: Resonances in quantum mechanics Lecture 3: Basics of scattering theory Lecture 4: Resonances in scattering theory Lecture 5: Theory of Feshbach resonance Lecture 6: Nonrelativistic effective field theories Lecture 7: Compositeness and weak-binding relation Lecture 8: Summary and solutions to exercises
(4) Outside-class activities and assignments	Solve the exercises specified during the lecture and submit them as a report.
(5) Textbooks and course materials	The course follows the lecture nots uploaded on the web. References will be introduced during the course.
(6) Assessment and grading	Based on the report.
(7) Questions to the instructor (Office hours, etc.)	Office hours are not specified. Questions are welcome before and after the class. Send e-mail for appointment, or send questions via e-mail.
(8) Special note	It is desirable to have basic knowledge of nuclear hadron physics and quantum field theory, but the necessary contents will be explained during the course.

Program	Course Name	Course Number	Semester	Day	Time	Credit Hours
Master's program	Advanced high energy astrophysics II	R0133	2nd Semester I	Fri.	3	1
Doctoral program	Advanced high energy astrophysics II	R0134				

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 spherically symmetric accretion and accretion disks, which are gravitational energy release mechanisms, based on fluid mechanics, and Fermi first- and second-order particle acceleration based on special relativity.
(3) Course schedule, subject matter, and classroom activities	1. Overview of high-energy astrophysics 2. Review of fluid dynamics 3. Spherically symmetric accretion 4. Accretion disk I 5. Accretion disk II 6. Accretion disk III 7. Cosmic ray acceleration I 8. Cosmic ray acceleration II
(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.
(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 I”, in which specific phenomena such as radiation processes are dealt with.

Program	Course Name	Course Number	Semester	Day	Time	Credit Hours
Master's program	Advanced nonlinear physics	R0141	Summer intensive			1
Doctoral program	Advanced nonlinear physics	R0142				

Instructor(s)	Note
SHUDO Akira	Register during the 1st semester registration period

(1) Course policies and topics	Even if we follow determinism such as differential equations, their behavior can be random and unpredictable. Chaos in dynamical systems is a common phenomenon that is universally observed in natural phenomena, and it is also a basic language in natural science. Here, I will introduce the basic idea of chaos in dynamical systems, and introduce some methods to understand nonintegrable dynamical systems.
(2) Knowledge/skills to be acquired and learning objectives/course goals	・This course provides an overview of the evolution of undergraduate mechanics and its progress to the present day. ・Students will learn the basic concepts and some methods to understand nonlinear dynamics, especially non-integrable Hamiltonian dynamical systems.
(3) Course schedule, subject matter, and classroom activities	Part 1: The development of classical mechanics Part 2: Dynamical systems theory and statistical mechanics Part 3: Hamiltonian dynamical systems and integrability Part 4: Nonintegrable dynamical systems Part 5: Initial sensitivities and chaos Part 6: Horseshoe dynamics and entropy of dynamical systems The class will be conducted mainly in lecture format. During the class time, there will be time for questions and to check the level of understanding.
(4) Outside-class activities and assignments	Students will be asked to submit reports as needed to ensure understanding of each lesson.
(5) Textbooks and course materials	If necessary, reference books and literature will be introduced in the lecture and handouts will be distributed.
(6) Assessment and grading	Grades will be based on reports given during the class and at the end of the class.
(7) Questions to the instructor (Office hours, etc.)	If you have any questions, please feel free to ask me. However, if you want to ask a question directly, please make an appointment in advance by e-mail.
(8) Special note	There is no strong relationship with other graduate courses.

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	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 Superconductivity	R0145	2nd Semester I	Mon.	3	1
Doctoral program	Advanced Physics of Superconductivity	R0146				

Instructor(s)	Note
HOTTA Takashi	

(1) Course policies and topics	This lecture introduces a theory of superconductivity, which is a typical many-body phenomenon, from a more advanced point of view. Through the understanding of superconductivity, students learn general ideas for elucidating phenomena based on hierarchical structures in physics.
(2) Knowledge/skills to be acquired and learning objectives/course goals	Students gain knowledge of the BCS theory of superconductivity, the Migdal-Eliashberg theory, and electromagnetic response of superconductors.
(3) Course schedule, subject matter, and classroom activities	Lecture 1: Experimental facts, hierarchy in the theory of superconductivity, BCS Hamiltonian Lecture 2: BCS theory (1): Cooper instability, Gor'kov approximation, anomalous Green's function Lecture 3: BCS theory (2): Gap equation, thermodynamic potential, specific heat, size of the Cooper pair Lecture 4: Electromagnetic response (1): Meissner effect Lecture 5: Electromagnetic response (2): Vertex corrections, gauge invariance Lecture 6: Electron-phonon Hamiltonian and Migdal approximation Lecture 7: Migdal-Eliashberg theory (1) Lecture 8: Migdal-Eliashberg theory (2) 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.
(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 II	R0121	1st Semester II	Fri.	3	1
Doctoral program	Advanced High Energy Physics II	R0122				

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 performances of particle detectors and accelerators that are used in energy frontier experiments.
(3) Course schedule, subject matter, and classroom activities	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 II	R0155	2nd Semester I	Wed.	4	1
Doctoral program	Advanced Atomic Physics II	R0156				

Instructor(s)	Note
TANUMA Hajime	

(1) Course policies and topics	Interactions and low energy collisions between atoms and molecules will be explained based on fundamental knowledge for structure and spectroscopy of atoms and molecules.
(2) Knowledge/skills to be acquired and learning objectives/course goals	Understanding of classical, semi-classical, and quantum scattering theory for atoms and molecules
(3) Course schedule, subject matter, and classroom activities	1. Interaction potentials between atoms and molecules 2. Classical and quantum theory of scattering 3. Semi-classical theory of scattering 4. Typical potential scattering experiments 5. Non-adiabatic transition theory 6. Some simple potential crossing models 7. Application for charge transfer collisions of highly charged ions 8. Questions 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	Course Name	Course Number	Semester	Day	Time	Credit Hours
Master's program	Advanced Correlated Electron Physics II	R0135	2nd Semester I	Wed.	4	1
Doctoral program	Advanced Correlated Electron Physics II	R0136				

Instructor(s)	Note
MIZUGUCHI Yoshikazu	

(1) Course policies and topics	In this class, we will study the history and methods of research for new superconducting materials. Particularly, strategies for new material design are the focus of this class.
(2) Knowledge/skills to be acquired and learning objectives/course goals	We will study the background of the research on new superconductors and the probes to investigate superconducting properties, mechanisms, crystal structure, valence states, etc. This class will cover the topics of classical superconductors and recent discoveries of new superconductors. The goal of this class is to learn the method and concept of new material design and prediction of the functionalities.
(3) Course schedule, subject matter, and classroom activities	This class will be conducted in English using presentation slides. Since many Japanese and international students are expected to take this class, we will use both English and Japanese when discussion and Q and A. The plan of the lecture contents is summarized below. (1) History of the discoveries of new superconductors and unconventional mechanisms. (2) Experimental methods to study superconducting properties and mechanisms. (3) Crystal structure analysis (4) High pressure studies (5) Material design: layered superconductors (6) Material design: elemental substitution and tuning of superconducting properties (7) Exercise of material design (8) Discussion on the designed materials
(4) Outside-class activities and assignments	We will share the presentation slides in advance. Please study with the slides before/after the class.
(5) Textbooks and course materials	Announced in the first lecture.
(6) Assessment and grading	Two reports will be used for the credit evaluation.
(7) Questions to the instructor (Office hours, etc.)	Office hour is 10:30-11:30 on Monday. Before coming, please make an appointment by e-mail.
(8) Special note	To take this class, knowledges about physics, condensed matter physics are needed.

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	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	[Course schedule, subject matter] 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 [Classroom activities] 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.
(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	Convenient dictionary sites: Weblio (http://ejje.weblio.jp/) ALC (http://www.alc.co.jp/)
(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	Since the class will be more like an exercise than a lecture, it is desirable to actively ask questions during the class. Note that this class will be provided in Japanese to non-English native students.

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	This class is taught by instructors or faculty members with practical experience. 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: (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. 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.

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	【Course Plan and Content】Dependent on the location of the internship. 【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.
(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	This class is taught by instructors or faculty members with practical experience. (Unit Requirement) The specified subject allows for overlapping enrollment. It can be added to the units required for graduation. (Enrollment Requirements) (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. (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). (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. (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). (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. (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. (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.

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.

2025 Graduate School Course Catalog
Graduate School of Science (Chemistry)

＊M = master's courses, D = doctoral courses
＊NA 2025 = Courses not offered in the academic year 2025

Course outline No.	M	D	NA 2025	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 MOTEKI Nobuhiro OURA Yasuji	
3	○			1st Semester	Wed.	2	M(R0223)	Advanced Organic Chemistry	2	NOMURA Kotohiro KUSUMOTO Shuhei DOI Ryohei SOLIMAN Mehawed Abdellatif Mohamed	
4	○			2nd Semester	Wed.	2	M(R0224)	Advanced Biological Chemistry	2	HIROTA Kouji ITO Yutka TAOKA Masato IKEYA Teppei	
5	○	○		2nd Semester	Wed.	1	M(R0163) D(R0164)	Advanced Molecula 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(R0237)	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	
13	○	○		2nd Semester	Fri.	2	M(R0299) D(R0301)	Advanced Lecture in Chemistry Ⅱ (Advanced Materials Chemistry)	2	NOMURA Kotohiro	
14	○			2nd Semester	Wed.	5	M(R0234)	Advanced English in Chemistry	2	＊Julian Koe	
15	○	○		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	
16	○	○		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
	○	○	△				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
17	○	○		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
	○	○	△				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
18	○	○		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
19	○	○		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
20	○	○		2nd Semester II	Mon.	3	M(R0159) D(R0160)	Selected topics in Physics and chemistry Ⅰ(Advanced experimental technique in physics D)	1	＊AZUMA Toshiyuki	This course is offered for Physics and Chemistry majors

Course outline No.	M	D	NA 2025	Semester	Day	Time	Course Number	Course Name	Credit Hours	Instructor(s)	Note (enrollment requirements, subject matter, etc.)
For students enrolling in April											
21	○			1st Semester	Fri.	3・4	Ⅰ:M(R0235)	Seminar on Advanced Chemistry Ⅰ	2	HIROSE Yasushi OKA Daichi	
22	○			2nd Semester	Fri.	3・4	Ⅱ:M(R0236)	Seminar on Advanced Chemistry Ⅱ	2	HIROSE Yasushi OKA Daichi	
21	○			1st Semester	Mon.	1・2	Ⅰ:M(R0239)	Seminar on Advanced Chemistry Ⅰ	2	TAKEGAWA Nobuyuki MOTEKI Nobuhiro	
22	○			2nd Semester	Mon.	1・2	Ⅱ:M(R0240)	Seminar on Advanced Chemistry Ⅱ	2	TAKEGAWA Nobuyuki MOTEKI Nobuhiro	
21	○			1st Semester	Mon.	1・2	Ⅰ:M(R0241)	Seminar on Advanced Chemistry Ⅰ	2	HIROTA Kouji TAOKA Masato	
22	○			2nd Semester	Mon.	1・2	Ⅱ:M(R0242)	Seminar on Advanced Chemistry Ⅱ	2	HIROTA Kouji TAOKA Masato	
21	○			1st Semester	Mon.	3・4	Ⅰ:M(R0243)	Seminar on Advanced Chemistry Ⅰ	2	KANYA Reika OKUMURA Takuma	
22	○			2nd Semester	Mon.	5・6	Ⅱ:M(R0244)	Seminar on Advanced Chemistry Ⅱ	2	KANYA Reika OKUMURA Takuma	
21	○			1st Semester	Tue.	4・5	Ⅰ:M(R0245)	Seminar on Advanced Chemistry Ⅰ	2	NAKATANI Naoki	
22	○			2nd Semester	Mon.	4・5	Ⅱ:M(R0246)	Seminar on Advanced Chemistry Ⅱ	2	NAKATANI Naoki	
21	○			1st Semester	Mon.	3・4	Ⅰ:M(R0247)	Seminar on Advanced Chemistry Ⅰ	2	KUSUMOTO Shuhei DOI Ryohei	
22	○			2nd Semester	Mon.	3・4	Ⅱ:M(R0248)	Seminar on Advanced Chemistry Ⅱ	2	KUSUMOTO Shuhei DOI Ryohei	
21	○			1st Semester	Fri.	3・4	Ⅰ:M(R0249)	Seminar on Advanced Chemistry Ⅰ	2	KUBUKI Siro	
22	○			2nd Semester	Fri.	1・2	Ⅱ:M(R0250)	Seminar on Advanced Chemistry Ⅱ	2	KUBUKI Siro	
21	○			1st Semester	Mon.	1・2	Ⅰ:M(R0251)	Seminar on Advanced Chemistry Ⅰ	2	SUGIURA Ken-ichi ISHIDA Masatoshi	
22	○			2nd Semester	Mon.	1・2	Ⅱ:M(R0252)	Seminar on Advanced Chemistry Ⅱ	2	SUGIURA Ken-ichi ISHIDA Masatoshi	
21	○			1st Semester	Mon.	5・6	Ⅰ:M(R0253)	Seminar on Advanced Chemistry Ⅰ	2	NOMURA Kotohiro SOLIMAN Mehawed Abdellatif Mohamed	
22	○			2nd Semester	Mon.	5・6	Ⅱ:M(R0254)	Seminar on Advanced Chemistry Ⅱ	2	NOMURA Kotohiro SOLIMAN Mehawed Abdellatif Mohamed	
21	○			1st Semester	Fri.	4・5	Ⅰ:M(R0255)	Seminar on Advanced Chemistry Ⅰ	2	YAMAZOE Seizi KAWASOKO Hideyuki OURA Yasuji	
22	○			2nd Semester	Fri.	4・5	Ⅱ:M(R0256)	Seminar on Advanced Chemistry Ⅱ	2	YAMAZOE Seizi KAWASOKO Hideyuki OURA Yasuji	
21	○			1st Semester	Fri.	3・4	Ⅰ:M(R0257)	Seminar on Advanced Chemistry Ⅰ	2	ITO Yutka IKEYA Teppei	
22	○			2nd Semester	Fri.	3・4	Ⅱ:M(R0258)	Seminar on Advanced Chemistry Ⅱ	2	ITO Yutka IKEYA Teppei	
23		○		1st Semester	Fri.	3・4	Ⅲ:D(R0259)	Seminar on Advanced Chemistry Ⅲ	2	HIROSE Yasushi OKA Daichi	
24		○		2nd Semester	Fri.	3・4	Ⅳ:D(R0260)	Seminar on Advanced Chemistry Ⅳ	2	HIROSE Yasushi OKA Daichi	
23		○		1st Semester	Mon.	1・2	Ⅲ:D(R0263)	Seminar on Advanced Chemistry Ⅲ	2	TAKEGAWA Nobuyuki MOTEKI Nobuhiro	
24		○		2nd Semester	Mon.	1・2	Ⅳ:D(R0264)	Seminar on Advanced Chemistry Ⅳ	2	TAKEGAWA Nobuyuki MOTEKI Nobuhiro	
23		○		1st Semester	Mon.	1・2	Ⅲ:D(R0265)	Seminar on Advanced Chemistry Ⅲ	2	HIROTA Kouji TAOKA Masato	
24		○		2nd Semester	Mon.	1・2	Ⅳ:D(R0266)	Seminar on Advanced Chemistry Ⅳ	2	HIROTA Kouji TAOKA Masato	
23		○		1st Semester	Mon.	3・4	Ⅲ:D(R0267)	Seminar on Advanced Chemistry Ⅲ	2	KANYA Reika OKUMURA Takuma	
24		○		2nd Semester	Mon.	5・6	Ⅳ:D(R0268)	Seminar on Advanced Chemistry Ⅳ	2	KANYA Reika OKUMURA Takuma	
23		○		1st Semester	Tue.	4・5	Ⅲ:D(R0269)	Seminar on Advanced Chemistry Ⅲ	2	NAKATANI Naoki	
24		○		2nd Semester	Mon.	4・5	Ⅳ:D(R0270)	Seminar on Advanced Chemistry Ⅳ	2	NAKATANI Naoki	
23		○		1st Semester	Mon.	3・4	Ⅲ:D(R0271)	Seminar on Advanced Chemistry Ⅲ	2	KUSUMOTO Shuhei DOI Ryohei	
24		○		2nd Semester	Mon.	3・4	Ⅳ:D(R0272)	Seminar on Advanced Chemistry Ⅳ	2	KUSUMOTO Shuhei DOI Ryohei	
23		○		1st Semester	Fri.	3・4	Ⅲ:D(R0273)	Seminar on Advanced Chemistry Ⅲ	2	KUBUKI Siro	
24		○		2nd Semester	Fri.	1・2	Ⅳ:D(R0274)	Seminar on Advanced Chemistry Ⅳ	2	KUBUKI Siro	
23		○		1st Semester	Mon.	1・2	Ⅲ:D(R0275)	Seminar on Advanced Chemistry Ⅲ	2	SUGIURA Ken-ichi ISHIDA Masatoshi	
24		○		2nd Semester	Mon.	1・2	Ⅳ:D(R0276)	Seminar on Advanced Chemistry Ⅳ	2	SUGIURA Ken-ichi ISHIDA Masatoshi	
23		○		1st Semester	Mon.	5・6	Ⅲ:D(R0277)	Seminar on Advanced Chemistry Ⅲ	2	NOMURA Kotohiro SOLIMAN Mehawed Abdellatif Mohamed	
24		○		2nd Semester	Mon.	5・6	Ⅳ:D(R0278)	Seminar on Advanced Chemistry Ⅳ	2	NOMURA Kotohiro SOLIMAN Mehawed Abdellatif Mohamed	
23		○		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 2025	Semester	Day	Time	Course Number	Course Name	Credit Hours	Instructor(s)	Note (enrollment requirements, subject matter, etc.)
24		○		2nd Semester	Fri.	4・5	Ⅳ：D(R0280)	Seminar on Advanced Chemistry IV	2	YAMAZOE Seizi KAWASOKO Hideyuki OURA Yasuji	
23		○		1st Semester	Fri.	3・4	Ⅲ：D(R0281)	Seminar on Advanced Chemistry III	2	ITO Yutka IKEYA Teppei	
24		○		2nd Semester	Fri.	3・4	Ⅳ：D(R0282)	Seminar on Advanced Chemistry IV	2	ITO Yutka IKEYA Teppei	
25	○			1st Semester			ⅠA：M(R0284)	Advanced Research of Chemistry IA	2	Multiple instructors	
26	○			2nd Semester			ⅠB：M(R0285)	Advanced Research of Chemistry IB	2	Multiple instructors	
27	○			1st Semester			ⅡA：M(R0287)	Advanced Research of Chemistry IIA	2	Multiple instructors	
28	○			2nd Semester			ⅡB：M(R0288)	Advanced Research of Chemistry IIB	2	Multiple instructors	
29		○		1st Semester			ⅢA：D(R0290)	Advanced Research of Chemistry IIIA	2	Multiple instructors	
30		○		2nd Semester			ⅢB：D(R0291)	Advanced Research of Chemistry IIIB	2	Multiple instructors	
31		○		1st Semester			ⅣA：D(R0293)	Advanced Research of Chemistry ⅣA	2	Multiple instructors	
32		○		2nd Semester			ⅣB：D(R0294)	Advanced Research of Chemistry ⅣB	2	Multiple instructors	

Course outline No.	M	D	NA 2025	Semester	Day	Time	Course Number	Course Name	Credit Hours	Instructor(s)	Note (enrollment requirements, subject matter, etc.)
For students enrolling in October											
21	○			2nd Semester	Fri.	3・4	Ⅰ:M(R0951)	Seminar on Advanced Chemistry Ⅰ	2	HIROSE Yasushi OKA Daichi	
22	○			1st Semester	Fri.	3・4	Ⅱ:M(R0950)	Seminar on Advanced Chemistry Ⅱ	2	HIROSE Yasushi OKA Daichi	
21	○			2nd Semester	Mon.	1・2	Ⅰ:M(R0955)	Seminar on Advanced Chemistry Ⅰ	2	TAKEGAWA Nobuyuki MOTEKI Nobuhiro	
22	○			1st Semester	Mon.	1・2	Ⅱ:M(R0954)	Seminar on Advanced Chemistry Ⅱ	2	TAKEGAWA Nobuyuki MOTEKI Nobuhiro	
21	○			2nd Semester	Mon.	1・2	Ⅰ:M(R0957)	Seminar on Advanced Chemistry Ⅰ	2	HIROTA Kouji TAOKA Masato	
22	○			1st Semester	Mon.	1・2	Ⅱ:M(R0956)	Seminar on Advanced Chemistry Ⅱ	2	HIROTA Kouji TAOKA Masato	
21	○			2nd Semester	Mon.	5・6	Ⅰ:M(R0959)	Seminar on Advanced Chemistry Ⅰ	2	KANYA Reika OKUMURA Takuma	
22	○			1st Semester	Mon.	3・4	Ⅱ: M(R0958)	Seminar on Advanced Chemistry Ⅱ	2	KANYA Reika OKUMURA Takuma	
21	○			2nd Semester	Mon.	4・5	Ⅰ:M(R0961)	Seminar on Advanced Chemistry Ⅰ	2	NAKATANI Naoki	
22	○			1st Semester	Tue.	4・5	Ⅱ:M(R0960)	Seminar on Advanced Chemistry Ⅱ	2	NAKATANI Naoki	
21	○			2nd Semester	Mon.	3・4	Ⅰ: M(R0963)	Seminar on Advanced Chemistry Ⅰ	2	KUSUMOTO Shuhei DOI Ryohei	
22	○			1st Semester	Mon.	3・4	Ⅱ: M(R0962)	Seminar on Advanced Chemistry Ⅱ	2	KUSUMOTO Shuhei DOI Ryohei	
21	○			2nd Semester	Fri.	1・2	Ⅰ:M(R0965)	Seminar on Advanced Chemistry Ⅰ	2	KUBUKI Siro	
22	○			1st Semester	Fri.	3・4	Ⅱ:M(R0964)	Seminar on Advanced Chemistry Ⅱ	2	KUBUKI Siro	
21	○			2nd Semester	Mon.	1・2	Ⅰ: M(R0967)	Seminar on Advanced Chemistry Ⅰ	2	SUGIURA Ken-ichi ISHIDA Masatoshi	
22	○			1st Semester	Mon.	1・2	Ⅱ:M(R0966)	Seminar on Advanced Chemistry Ⅱ	2	SUGIURA Ken-ichi ISHIDA Masatoshi	
21	○			2nd Semester	Mon.	5・6	Ⅰ:M(R0969)	Seminar on Advanced Chemistry Ⅰ	2	NOMURA Kotohiro SOLIMAN Mehawed Abdellatif Mohamed	
22	○			1st Semester	Mon.	5・6	Ⅱ: M(R0968)	Seminar on Advanced Chemistry Ⅱ	2	NOMURA Kotohiro SOLIMAN Mehawed Abdellatif Mohamed	
21	○			2nd Semester	Fri.	4・5	Ⅰ: M(R0971)	Seminar on Advanced Chemistry Ⅰ	2	YAMAZOE Seizi KAWASOKO Hideyuki OURA Yasuji	
22	○			1st Semester	Fri.	4・5	Ⅱ: M(R0970)	Seminar on Advanced Chemistry Ⅱ	2	YAMAZOE Seizi KAWASOKO Hideyuki OURA Yasuji	
21	○			2nd Semester	Fri.	3・4	Ⅰ:M(R0973)	Seminar on Advanced Chemistry Ⅰ	2	ITO Yutka IKEYA Teppei	
22	○			1st Semester	Fri.	3・4	Ⅱ:M(R0972)	Seminar on Advanced Chemistry Ⅱ	2	ITO Yutka IKEYA Teppei	
23		○		2nd Semester	Fri.	3・4	Ⅲ:D(R0975)	Seminar on Advanced Chemistry Ⅲ	2	HIROSE Yasushi OKA Daichi	
24		○		1st Semester	Fri.	3・4	Ⅳ:D(R0974)	Seminar on Advanced Chemistry Ⅳ	2	HIROSE Yasushi OKA Daichi	
23		○		2nd Semester	Mon.	1・2	Ⅲ:D(R0979)	Seminar on Advanced Chemistry Ⅲ	2	TAKEGAWA Nobuyuki MOTEKI Nobuhiro	
24		○		1st Semester	Mon.	1・2	Ⅳ:D(R0978)	Seminar on Advanced Chemistry Ⅳ	2	TAKEGAWA Nobuyuki MOTEKI Nobuhiro	
23		○		2nd Semester	Mon.	1・2	Ⅲ:D(R0981)	Seminar on Advanced Chemistry Ⅲ	2	HIROTA Kouji TAOKA Masato	
24		○		1st Semester	Mon.	1・2	Ⅳ:D(R0980)	Seminar on Advanced Chemistry Ⅳ	2	HIROTA Kouji TAOKA Masato	
23		○		2nd Semester	Mon.	5・6	Ⅲ:D(R0983)	Seminar on Advanced Chemistry Ⅲ	2	KANYA Reika OKUMURA Takuma	
24		○		1st Semester	Mon.	3・4	Ⅳ:D(R0982)	Seminar on Advanced Chemistry Ⅳ	2	KANYA Reika OKUMURA Takuma	
23		○		2nd Semester	Mon.	4・5	Ⅲ:D(R0985)	Seminar on Advanced Chemistry Ⅲ	2	NAKATANI Naoki	
24		○		1st Semester	Tue.	4・5	Ⅳ:D(R0984)	Seminar on Advanced Chemistry Ⅳ	2	NAKATANI Naoki	
23		○		2nd Semester	Mon.	3・4	Ⅲ:D(R0987)	Seminar on Advanced Chemistry Ⅲ	2	KUSUMOTO Shuhei DOI Ryohei	
24		○		1st Semester	Mon.	3・4	Ⅳ:D(R0986)	Seminar on Advanced Chemistry Ⅳ	2	KUSUMOTO Shuhei DOI Ryohei	
23		○		2nd Semester	Fri.	1・2	Ⅲ:D(R0989)	Seminar on Advanced Chemistry Ⅲ	2	KUBUKI Siro	
24		○		1st Semester	Fri.	3・4	Ⅳ:D(R0988)	Seminar on Advanced Chemistry Ⅳ	2	KUBUKI Siro	
23		○		2nd Semester	Mon.	1・2	Ⅲ:D(R0991)	Seminar on Advanced Chemistry Ⅲ	2	SUGIURA Ken-ichi ISHIDA Masatoshi	
24		○		1st Semester	Mon.	1・2	Ⅳ:D(R0990)	Seminar on Advanced Chemistry Ⅳ	2	SUGIURA Ken-ichi ISHIDA Masatoshi	
23		○		2nd Semester	Mon.	5・6	Ⅲ:D(R0993)	Seminar on Advanced Chemistry Ⅲ	2	NOMURA Kotohiro SOLIMAN Mehawed Abdellatif Mohamed	
24		○		1st Semester	Mon.	5・6	Ⅳ:D(R0992)	Seminar on Advanced Chemistry Ⅳ	2	NOMURA Kotohiro SOLIMAN Mehawed Abdellatif Mohamed	
23		○		2nd Semester	Fri.	4・5	Ⅲ:D(R0995)	Seminar on Advanced Chemistry Ⅲ	2	YAMAZOE Seizi KAWASOKO Hideyuki OURA Yasuji	

Course outline No.	M	D	NA 2025	Semester	Day	Time	Course Number	Course Name	Credit Hours	Instructor(s)	Note (enrollment requirements, subject matter, etc.)
24		○		1st Semester	Fri.	4・5	Ⅳ：D(R0994)	Seminar on Advanced Chemistry IV	2	YAMAZOE Seizi KAWASOKO Hideyuki OURA Yasuji	
23		○		2nd Semester	Fri.	3・4	Ⅲ：D(R0997)	Seminar on Advanced Chemistry III	2	ITO Yutka IKEYA Teppei	
24		○		1st Semester	Fri.	3・4	Ⅳ：D(R0996)	Seminar on Advanced Chemistry IV	2	ITO Yutka IKEYA Teppei	
25	○			2nd Semester			ⅠA：M(R0941)	Advanced Research of Chemistry IA	2	Multiple instructors	
26	○			1st Semester			ⅠB：M(R0940)	Advanced Research of Chemistry IB	2	Multiple instructors	
27	○			2nd Semester			ⅡA：M(R0943)	Advanced Research of Chemistry IIA	2	Multiple instructors	
28	○			1st Semester			ⅡB：M(R0942)	Advanced Research of Chemistry IIB	2	Multiple instructors	
29		○		2nd Semester			ⅢA：D(R0945)	Advanced Research of Chemistry IIIA	2	Multiple instructors	
30		○		1st Semester			ⅢB：D(R0944)	Advanced Research of Chemistry IIIB	2	Multiple instructors	
31		○		2nd Semester			ⅣA：D(R0947)	Advanced Research of Chemistry IVA	2	Multiple instructors	
32		○		1st Semester			ⅣB：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	<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. <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.
(3) Course schedule, subject matter, and classroom activities	<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 <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 15. Either Kubuki or Yamazoe provides a more advanced lecture.
(4) Outside-class activities and assignments	<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. <Yamazoe> Review every lecture and prepare for the next lecture in advance.
(5) Textbooks and course materials	<Kubuki> L. Smart and E. Moore "Solid State Chemistry -an introduction" (Chapman and Hall) <Yamazoe> None.
(6) Assessment and grading	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%)
(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	1. Atomic and molecular spectroscopy 2. Photochemical processes in the atmosphere 3. Basics of aerosol thermodynamics 4. Growth of aerosol by condensation 5. Geochemical cycles in the atmosphere and the oceans 6. Overview of atmospheric radiation 7. Longwave radiation and its observation 8. Shortwave radiation and scattering theory 9. Atmospheric thermodynamics and temperature profiles 10. Radiative convective energy transfer and climate change 11. Radiochemistry-1 (Nuclear stability, radioactive decay) 12. Radiochemistry-2 (Nuclear reactions) 13. Natural and environmental radionuclides 14. Natural nuclear reactions 15. Cosmochemical and geochemical applications of natural radionuclides The above schedule may be changed depending on the progress of the course.
(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	Attendance (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, ABDELLATIF Mohamed Mehawed	

(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, IKEYA Teppei	

(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	Recent trends in biochemistry, molecular biology, and structural biology in the context of genomic information of organisms will be explained. 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 exercieses. [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	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. The lecture also introduces recent topics with explanation of basic mechanism, methodology, historical flow.
(2) Knowledge/skills to be acquired and learning objectives/course goals	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	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	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. 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. 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.
(2) Knowledge/skills to be acquired and learning objectives/course goals	1) Learn the design principles of advanced organic molecular materials with various functions, and develop the ability to elucidate photophysical processes and structural relationships. 2) Be able to explain the parameters that characterize the crystal structure of inorganic solids. 3) Be able to explain the atomic arrangement in typical crystal structures of inorganic solids.
(3) Course schedule, subject matter, and classroom activities	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. 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
(4) Outside-class activities and assignments	First half of the lecture: Report assignments given during class must be submitted by the deadline after the lecture. 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.
(5) Textbooks and course materials	First half of the lecture: Lecture handouts will be distributed during the lecture. 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.
(6) Assessment and grading	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. Second half of the lecture: In principle, grades will be evaluated based on each report assignment and final report assignment.
(7) Questions to the instructor (Office hours, etc.)	First half of the lecture: If you contact us in advance by email, we will accept your request at any time. 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.
(8) Special note	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. 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.

Program	Course Name	Course Number	Semester	Day	Time	Credit Hours
Master's program	Advanced Lecture in Chemistry II (Advanced Materials Chemistry)	R0299	2nd	Fri.	2	r
Doctoral program	Advanced Lecture in Chemistry II (Advanced Materials Chemistry)	R0301				

Instructor(s)	Note
NOMURA Kotohiro	

(1) Course policies and topics	Advanced Materials Chemistry: To gain basic sense in advanced materials chemistry using precise synthetic skills [efficient organic transformations and precise (living) polymerization in the presence of catalysis; end/post modification of polymers including grafting (clicking, grafting to/from/through technique etc.); unique materials such as bottle brush, stars, controlled cross links, adaptable networks etc.; preparation of supported molecular catalysts including their characterization etc.]. Better understanding in basic knowledge and trends in design of recent advanced materials through basic introductory lectures, presentations, and discussions through literature reviews.
(2) Knowledge/skills to be acquired and learning objectives/course goals	Basic sense in advanced materials chemistry, and design of functional advanced materials by adopting precise synthetic skills. Basic understanding in trend and outlooks in advanced materials chemistry including basic synthetic techniques. Improve English presentation skills, confidence in speaking/presentation in English.
(3) Course schedule, subject matter, and classroom activities	Lectures consists of basic introductory lectures (10 lectures), presentation of literature reviews concerning advanced materials chemistry and discussion (5 lectures). The person in the presentation (students) should discuss in advance to gain better understanding in the backgrounds as well as knowledge. Lectures will be provided in English.
(4) Outside-class activities and assignments	None.
(5) Textbooks and course materials	Hand out will be distributed.
(6) Assessment and grading	Mini test, presentation and attitude (asking questions and discussion).
(7) Questions to the instructor (Office hours, etc.)	Office Hour: Contact by e-mail: ktnomura@tmu.ac.jp
(8) Special note	On Line, the student should have enough knowledge as graduate student in synthetic chemistry.

Program	Course Name	Course Number	Semester	Day	Time	Credit Hours
Master's program	Advanced English in Chemistry	R0234	2nd	Wed.	5	2
Doctoral program						

Instructor(s)	Note
*Julian Koe	

(1) Course policies and topics	English is a vital communication medium in modern science. This course aims to give chemistry students practice and greater confidence in using English. The course is taught in English and is highly interactive, so that students will develop greater active ability in the language.
(2) Knowledge/skills to be acquired and learning objectives/course goals	1. To gain confidence in using English. 2. To become familiar with technical English grammar and vocabulary used in Chemistry 3. To improve writing, reading, speaking and listening in English 4. To improve communication and presentation skills
(3) Course schedule, subject matter, and classroom activities	1. Introduction. Useful supporting aids; pronunciation 2. The Elements. Tom Lehrer song 3. Chemistry - concepts. Following instructions; passive voice 4. Laboratory Equipment. Extracting information; grammar 5. Periodic Table. Grammar: parts of speech 6. Halogens. Grammar. 7. Inorganic Chemistry I. Chemical crossword 8. Inorganic Chemistry II. 9. Organic Chemistry I 10. Organic Chemistry II, Polymers 11. Polymer presentations. 12. Analytical Chemistry. IR, NMR 13. Environmental chemistry. Presentations; quiz 14. Writing papers 15. Comment Interactive lecture including short presentation and conversation practice.
(4) Outside-class activities and assignments	Weekly work is assigned.
(5) Textbooks and course materials	On-line text: http://www.upjs.sk/public/media/3499/English-for-Chemists.pdf
(6) Assessment and grading	Continual assessment of weekly assignment course work (～70%) and final examination (～30%)
(7) Questions to the instructor (Office hours, etc.)	For questions, call or email. Office: TEL: 0422-33-3249 E-mail: koe@icu.ac.jp
(8) Special note	

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	This subject is intended for graduate students. 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. During the training, please follow the instructions of the implementing agency's employees and staff.
(4) Outside-class activities and assignments	Gather information about the implementing agency using literature, the Internet, etc.
(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) - 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. (Notes) 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	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	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. 1. Review of each laboratory's specialized topics and explanation of future seminar plans 2. Detailed reading of introductory foreign-language literature1 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	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. 1. Review of each laboratory's specialized topics and explanation of future seminar plans 2. Detailed reading of introductory foreign-language literature1 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 IA	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	The specific content of each of the following classes will vary depending on the specialized theme of each laboratory that the student belongs to. 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 IB	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	The specific content of each of the following classes will vary depending on the specialized theme of each laboratory that the student belongs to. 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 IIA	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	The specific content of each of the following classes will vary depending on the specialized theme of each laboratory that the student belongs to. 1. Confirmation of outline of applied experiments to be conducted in Advanced Research of Chemistry IIA. 2. Research planning for applied experiments (Part 1): Literature Review and problem search 3. Research planning for applied experiments (Part 2): Setting subject 4. Research planning for applied experiments (Part 3): Research planning 5. Conducting applied experiments (Part 1): Investigations for conducting applied experiments 6. Conducting applied experiments (Part 2): Conducting Experiment 7. Conducting applied experiments (Part 3): Examining problems 8. Conducting applied experiments (Part 4): Re-experimentation based on the results of the study 9. Conducting applied experiments (Part 5): Summary of applied experiments 10. Interim debriefing of applied experiments 11. Data analysis and organization of applied experiments (Part 1) 12. Data Analysis and organization of applied experiments (Part 2): organizing analysis results 13. Discussion of applied experimental results (Part 1): Comparison with literature, etc. 14. Discussion of applied experimental results (Part 2): Discussion of results 15. 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 IIB	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	The specific content of each of the following classes will vary depending on the specialized theme of each laboratory that the student belongs to. 1. Confirmation of outline of applied experiments to be conducted in Advanced Research of Chemistry IIB. 2. Research planning for advanced experiments (Part 1): Literature Review and problem search 3. Research planning for advanced experiments (Part 2): Setting subject 4. Research planning for advanced experiments (Part 3): Research planning 5. Conducting advanced experiments (Part 1): Investigations for conducting advanced experiments 6. Conducting advanced experiments (Part 2): Conducting Experiment 7. Conducting advanced experiments (Part 3): Examining problems 8. Conducting advanced experiments (Part 4): Re-experimentation based on the results of the study 9. Conducting advanced experiments (Part 5): Summary of advanced experiments 10. Interim debriefing of advanced experiments 11. Data analysis and organization of advanced experiments (Part 1) 12. Data Analysis and organization of advanced experiments (Part 2): organizing analysis results 13. Discussion of advanced experimental results (Part 1): Comparison with literature, etc. 14. Discussion of advanced experimental results (Part 2): Discussion of results 15. 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 IIIA	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 IIIB	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 IVA	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 IVB	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	

2025 Graduate School Course Catalog
Graduate School of Science (Biological Sciences)

＊M = master's courses, D = doctoral courses
＊NA 2025 = Courses not offered in the academic year 2025

Course outline No.	M	D	NA 2025	Semester	Day	Time	Course Number	Course Name	Credit Hours	Instructor(s)	Note (enrollment requirements, subject matter, etc.)
	○	○	△				M(R0359) D(R0360)	Advanced Lecture on Biological Information	2	SAKAI Takaomi WEITEMIER Adam Zachary	Physiological biochemistry of the brain and nervous system, molecular biology
	○	○	△				M(R0363) D(R0364)	Advanced Lecture on Biochemistry	2	KAWAHARA Hiroyuki OKAMOTO Takashi	Biochemistry of protein metabolism
	○	○	△				M(R0369) D(R0370)	Advanced Lecture on Developmental Biology	2	FUKUDA Kimiko TAKATORI Naohito	Modern developmental biology
	○	○	△				M(R0371) D(R0372)	Advanced Lecture on Molecular Biology	2	EHIRA Shigeki HARUTA Shin OHBAYASHI Ryudo	Basics and practice of genomic science
1	○	○		2nd Semester	Thu.	1	M(R0751) D(R0752)	Advanced Lecture on Evolutionary Genetics	2	TAMURA Koichiro TAKAHASHI Aya NOZAWA Masafumi	Evolutionary biology from the perspective of genetics and ecology
2	○	○		1st Semester	Tue.	1	M(R0753) D(R0754)	Advanced Lecture on Ecology	2	SUZUKI Jun-ichiro	Modern ecology with examples of basic research
3	○	○		1st Semester	Thu.	1	M(R0755) D(R0756)	Advanced Lecture on Cell Biology	2	KANEGAE Takeshi NARIKAWA Rei	Light sensing and environmental adaptation of plants
4	○	○		2nd Semester	Fri.	1	M(R0757) D(R0758)	Advanced Lecture on Taxonomy	2	EGUCHI Katsuyuki TAKAYAMA Koji	Phylogenetic evolution and diversity of plants and insects
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
	○	○	△				M(R0391) D(R0392)	Special Lecture on Genetic Information	1	TAMURA Koichiro TAKAHASHI Aya NOZAWA Masafumi	Population genetics and molecular evolution
	○	○	△				M(R0393) D(R0394)	Special Lecture on Ecological Science	1	SUZUKI Jun-ichiro CRONIN Adam	Animal behavior and society, renewal of plant communities
	○	○	△				M(R0397) D(R0398)	Special Lecture on Responses to Environment	1	KANEGAE Takeshi NARIKAWA Rei	Environmental response and speciation of plants
	○	○	△				M(R0373) D(R0374)	Special Lecture on Systematics and Evolution	1	EGUCHI Katsuyuki TAKAYAMA Koji	Phylogenetic evolution of plants and animals
7	○	○		2nd Semester Ⅰ	Tue.	1	M(R0385) D(R0386)	Special Lecture on Cellular communication	1	SAKAI Takaomi WEITEMIER Adam Zachary	Physiology and biochemistry of the brain
8	○	○		1st Semester Ⅱ	Fri.	2	M(R0383) D(R0384)	Special Lecture on Biomolecules	1	KAWAHARA Hiroyuki OKAMOTO Takashi	Cell differentiation and development
9	○	○		1st Semester Ⅰ	Fri.	1	M(R0399) D(R0400)	Special Lecture on Developmental and Regenerative Biology	1	FUKUDA Kimiko TAKATORI Naohito	Modern developmental biology research and presentation methods
10	○	○		2nd Semester Ⅱ	Fri.	2	M(R0389) D(R0390)	Special Lecture on Cell Biology	1	EHIRA Shigeki HARUTA Shin OHBAYASHI Ryudo	The latest of genetics and molecular biology
11	○	○		Summer intensive			M(R0401) D(R0402)	Special Lecture on Biological Sciences	1	Multiple instructors	The continuous education of modern biology
12	○	○		Intensive course (period TBD)			M(R0375) D(R0376)	Special Lecture on Cellular communication	1	＊NARAMOTO Satoshi	
13	○	○		Summer intensive			M(R0761) D(R0762)	Special Lecture on Cell Biology	1	＊KONO Nobuaki	
14	○	○		Summer intensive			M(R0395) D(R0396)	Special Lecture on Systematics and Evolution	1	＊MAKINO Takashi	
	○	○	△				M(R0759) D(R0760)	Special Lecture on Cell Biology	1	＊KODA Hiroki	
15	○	○		Summer intensive			M(R0355) D(R0356)	Special Lecture on Biomolecules	1	＊KURIHARA(OKUBO) Emiko	
16	○	○		Summer intensive			M(R0413) D(R0414)	Special Lecture on Biological Sciences	1	＊MIYADO Kenji ＊UENO Kohei ＊NONAKA Takashi ＊KONDO Yoshitaka	Latest topics in biomedical research 1
	○	○	△				M(R0415) D(R0416)	Special Lecture on Biological Sciences	1	＊INOUE Azusa ＊MARUYAMA Chiaki ＊YOSHITANE Hikari ＊MIURA Yuri	Latest topics in biomedical research 2
	○	○	△				M(R0417) D(R0418)	Special Lecture on Biological Sciences	1	＊TBA	Latest topics in biomedical research 3
17	○	○		Summer intensive			M(R0421) D(R0422)	English for Biology	2	＊IIJIMA Yuka	English for science: listening and speaking
18	○	○		Intensive course (period TBD)			M(R0423) D(R0424)	English for Biology	2	＊MASWANA Sayako	How to write English papers
19	○	○		1st Semester	Mon.	4	M(R0425) D(R0426)	Special Course in Biology Ⅱ	2	＊Elisabeth Zielinska	Nature talk, Science and Culture
20	○	○		2nd Semester	Mon.	3	M(R0427) D(R0428)	Special Course in Biology Ⅱ	2	＊Elisabeth Zielinska	How to create a Persuasive Presentation
21	○	○		2nd Semester	Mon.	4	M(R0429) D(R0430)	Special Course in Biology Ⅱ	2	＊Elisabeth Zielinska	Nature talk Ⅱ
22	○	○		2nd Semester Ⅰ	Fri.	2	M(R0433) D(R0434)	Special Course in Biology Ⅰ	1	ANDO Kanae CRONIN Adam WEITEMIER Adam Zachary	Technique for Research Communication Course in English
23	○	○		Summer intensive			M(R0439) D(R0440)	Special Course in Biology Ⅰ	1	TAMURA Koichiro NOZAWA Masafumi	Computer Practice: Basics
24	○	○		1st Semester Ⅱ	Fri.	1	M(R0441) D(R0442)	Special Course in Biology Ⅰ	1	FUKUDA Kimiko TAKATORI Naohito ASADA Akiko	Computer Practice: Application
	○	○	△				M(R0431) D(R0432)	Special Course in Biological Sciences Ⅰ	1	TBA	Modern Biology Recurrent Practice 1
	○	○	△				M(R0361) D(R0362)	Special Course in Biological Sciences Ⅰ	1	TBA	Modern Biology Recurrent Practice 2
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	○	○		1st Semester	Tue.	2	M(R0445) D(R0446)	Biology course in planning and management 1	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	○	○		1st Semester	Tue.	3	M(R0449) D(R0450)	Biology course in international research experiences 1	1	FUKUDA Kimiko TAKAHASHI Aya Multiple instructors	raining for developing global leadership skills

Course outline No.	M	D	NA 2025	Semester	Day	Time	Course Number	Course Name	Credit Hours	Instructor(s)	Note (enrollment requirements, subject matter, etc.)
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	Tue.	1	M(R0453) D(R0454)	Biology course in research evaluation 2	1	SUZUKI Jun-ichiro Multiple instructors	Evaluation of research presentation
31	○	○		Summer intensive			M(R0455) D(R0456)	Practice in Biological Sciences (Radioisotope Techniques)	1	OKAMOTO Takashi SAITO Taro ASANO Tsunaki	Basic techniques for handling radiolabeled compounds
32	○	○		At all times			M(R0693) D(R0694)	External Experience in Biological Sciences 1	1	Multiple instructors	
33	○	○		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 or 2	Multiple instructors	
34	○	○		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 or 2	Multiple instructors	
35	○	○		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)
36	○	○		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)
37	○	○		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 Affair Committee of the Graduate Program.
38	○	○		2nd Semester I	Tue.	1	M(R0709) D(R0710)	Special Lecture on Biological Sciences	1	FUKUDA Kimiko TAKATORI Naohito	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	Tue.	2	M(R0707) D(R0708)	Special Lecture on Biological Sciences	1	ANDO Kanae	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.
40	○	○		2nd Semester I	Wed.	1	M(R0721) D(R0722)	Special Lecture on Biological Sciences	1	ANDO Kanae OHBAYASHI Ryudo	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.
41	○	○		2nd Semester I	Wed.	2	M(R0717) D(R0718)	Special Lecture on Biological Sciences	1	NOZAWA Masafumi	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.
42	○	○		2nd Semester I	Thu.	1	M(R0711) D(R0712)	Special Lecture on Biological Sciences	1	SUZUKI Jun-ichiro OKAMURA Yu	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.
43	○	○		2nd Semester I	Thu.	2	M(R0669) D(R0670)	Special Lecture on Biological Sciences	1	WEITEMIER Adam Zachary	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.
44	○	○		2nd Semester I	Fri.	1	M(R0733) D(R0734)	Special Lecture on Biological Sciences	1	WEITEMIER Adam Zachary	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.
45	○	○		2nd Semester II	Fri.	1	M(R0749) D(R0750)	Special Lecture on Biological Sciences	1	WEITEMIER Adam Zachary	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.
46	○	○		2nd Semester I	Fri.	2	M(R0713) D(R0714)	Special Lecture on Biological Sciences	1	OKAMOTO Takashi SAKAI Takaomi	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.
47	○	○		Summer intensive			M(R0723) D(R0724)	Special Lecture on Biological Sciences	1	*KODA Hiroki	
48	○	○		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.
49	○	○		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.
50	○	○		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.
	○	○	△				M(R0729) D(R0730)	Special Lecture on Biological Sciences	1	*Ben Warren	This course is also offered in the undergraduate program. Students who took this course previously cannot take this course again.
51	○	○		Summer intensive			M(R0357) D(R0358)	Special Lecture on Biological Sciences	1	*Junryo Watanabe	This course is offered in English and also open to undergraduate students.
52	○	○		Summer intensive			M(R0367) D(R0368)	Special Lecture on Biological Sciences	1	*Junryo Watanabe	This course is offered in English and also open to undergraduate students.
53	○	○		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
54	○	○		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

Course outline No.	M	D	NA 2025	Semester	Day	Time	Course Number	Course Name	Credit Hours	Instructor(s)	Note (enrollment requirements, subject matter, etc.)
53	○	○		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
54	○	○		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
53	○	○		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
54	○	○		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
53	○	○		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
54	○	○		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
53	○	○		1st Semester	Wed.	6	M(R0477) D(R0478)	Seminar in Biological Sciences 1 (Neurobiology 1)	2	WEITEMIER Adam Zachary	Seminar offered in each laboratory
54	○	○		2nd Semester	Wed.	6	M(R0479) D(R0480)	Seminar in Biological Sciences 2 (Neurobiology 1)	2	WEITEMIER Adam Zachary	Seminar offered in each laboratory
53	○	○		1st Semester	Wed.	7	M(R0481) D(R0482)	Seminar in Biological Sciences 1 (Neurobiology 2)	2	WEITEMIER Adam Zachary	Seminar offered in each laboratory
54	○	○		2nd Semester	Wed.	7	M(R0483) D(R0484)	Seminar in Biological Sciences 2 (Neurobiology 2)	2	WEITEMIER Adam Zachary	Seminar offered in each laboratory
53	○	○		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
54	○	○		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
53	○	○		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
54	○	○		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
53	○	○		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
54	○	○		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
53	○	○		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
54	○	○		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
53	○	○		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
54	○	○		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
53	○	○		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
54	○	○		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
53	○	○		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
54	○	○		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
53	○	○		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
54	○	○		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
53	○	○		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
54	○	○		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
53	○	○		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
54	○	○		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
53	○	○		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
54	○	○		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
53	○	○		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
54	○	○		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
53	○	○		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
54	○	○		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
53	○	○		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
54	○	○		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
53	○	○		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
54	○	○		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
53	○	○		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
54	○	○		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

Course outline No.	M	D	NA 2025	Semester	Day	Time	Course Number	Course Name	Credit Hours	Instructor(s)	Note (enrollment requirements, subject matter, etc.)
53	○	○		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
54	○	○		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
53	○	○		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
54	○	○		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
53	○	○		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
54	○	○		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
53	○	○		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
54	○	○		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
53	○	○		1st Semester	Tue.	5	M(R0577) D(R0578)	Seminar in Biological Sciences 1 (Systematic Zoology 1)	2	EGUCHI Katsuyuki	Seminar offered in each laboratory
54	○	○		2nd Semester	Tue.	4	M(R0579) D(R0580)	Seminar in Biological Sciences 2 (Systematic Zoology 1)	2	EGUCHI Katsuyuki	Seminar offered in each laboratory
53	○	○		1st Semester	Tue.	6	M(R0581) D(R0582)	Seminar in Biological Sciences 1 (Systematic Zoology 2)	2	EGUCHI Katsuyuki	Seminar offered in each laboratory
54	○	○		2nd Semester	Tue.	5	M(R0583) D(R0584)	Seminar in Biological Sciences 2 (Systematic Zoology 2)	2	EGUCHI Katsuyuki	Seminar offered in each laboratory
53	○	○		1st Semester	Fri.	3	M(R0585) D(R0586)	Seminar in Biological Sciences 1 (Systematic Botany 1)	2	TAKAYAMA Koji	Seminar offered in each laboratory
54	○	○		2nd Semester	Fri.	3	M(R0587) D(R0588)	Seminar in Biological Sciences 2 (Systematic Botany 1)	2	TAKAYAMA Koji	Seminar offered in each laboratory
53	○	○		1st Semester	Fri.	4	M(R0589) D(R0590)	Seminar in Biological Sciences 1 (Systematic Botany 2)	2	TAKAYAMA Koji	Seminar offered in each laboratory
54	○	○		2nd Semester	Fri.	4	M(R0591) D(R0592)	Seminar in Biological Sciences 2 (Systematic Botany 2)	2	TAKAYAMA Koji	Seminar offered in each laboratory
53	○	○		1st Semester	Mon.	5	M(R0593) D(R0594)	Seminar in Biological Sciences 1 (Environmental Microbiology 1)	2	HARUTA Shin	Seminar offered in each laboratory
54	○	○		2nd Semester	Mon.	5	M(R0595) D(R0596)	Seminar in Biological Sciences 2 (Environmental Microbiology 1)	2	HARUTA Shin	Seminar offered in each laboratory
53	○	○		1st Semester	Mon.	6	M(R0597) D(R0598)	Seminar in Biological Sciences 1 (Environmental Microbiology 2)	2	HARUTA Shin	Seminar offered in each laboratory
54	○	○		2nd Semester	Mon.	6	M(R0599) D(R0600)	Seminar in Biological Sciences 2 (Environmental Microbiology 2)	2	HARUTA Shin	Seminar offered in each laboratory
53	○	○		1st Semester	Fri.	3	M(R0601) D(R0602)	Seminar in Biological Sciences 1 (Cellular Biochemistry 1)	2	KAWAHARA Hiroyuki YOKOTA Naoto	Seminar offered in each laboratory
54	○	○		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
53	○	○		1st Semester	Fri.	4	M(R0605) D(R0606)	Seminar in Biological Sciences 1 (Cellular Biochemistry 2)	2	KAWAHARA Hiroyuki YOKOTA Naoto	Seminar offered in each laboratory
54	○	○		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
53	○	○		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
54	○	○		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
53	○	○		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
54	○	○		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
53	○	○		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
54	○	○		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
53	○	○		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
54	○	○		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
55	○	○		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
55	○	○		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
55	○	○		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
55	○	○		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
55	○	○		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
55	○	○		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
56	○	○		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
56	○	○		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
56	○	○		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
56	○	○		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
56	○	○		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
56	○	○		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

Course outline No.	M	D	NA 2025	Semester	Day	Time	Course Number	Course Name	Credit Hours	Instructor(s)	Note (enrollment requirements, subject matter, etc.)
57	○	○		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
58	○	○		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
57	○	○		1st Semester	Thu.	6・7	M(R0637) D(R0638)	Advanced Experimental Techniques in Biological Sciences 1 (Neurobiology)	2	WEITEMIER Adam Zachary	Advanced research technologies in different branches of biological sciences
58	○	○		2nd Semester	Thu.	6・7	M(R0639) D(R0640)	Advanced Experimental Techniques in Biological Sciences 2 (Neurobiology)	2	WEITEMIER Adam Zachary	Advanced research technologies in different branches of biological sciences
57	○	○		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
58	○	○		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
57	○	○		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
58	○	○		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
57	○	○		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
58	○	○		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
57	○	○		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
58	○	○		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
57	○	○		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
58	○	○		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
57	○	○		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
58	○	○		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
57	○	○		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
58	○	○		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
57	○	○		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
58	○	○		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
57	○	○		1st Semester	Thu.	6・7	M(R0677) D(R0678)	Advanced Experimental Techniques in Biological Sciences 1(Systematic Zoology)	2	EGUCHI Katsuyuki	Advanced research technologies in different branches of biological sciences
58	○	○		2nd Semester	Thu.	6・7	M(R0679) D(R0680)	Advanced Experimental Techniques in Biological Sciences 2(Systematic Zoology)	2	EGUCHI Katsuyuki	Advanced research technologies in different branches of biological sciences
57	○	○		1st Semester	Thu.	6・7	M(R0681) D(R0682)	Advanced Experimental Techniques in Biological Sciences 1 (Systematic Botany)	2	TAKAYAMA Koji	Advanced research technologies in different branches of biological sciences
58	○	○		2nd Semester	Thu.	6・7	M(R0683) D(R0684)	Advanced Experimental Techniques in Biological Sciences 2 (Systematic Botany)	2	TAKAYAMA Koji	Advanced research technologies in different branches of biological sciences
57	○	○		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
58	○	○		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
57	○	○		1st Semester	Thu.	6・7	M(R0689) D(R0690)	Advanced Experimental Techniques in Biological Sciences 1(Cellular Biochemistry)	2	KAWAHARA Hiroyuki YOKOTA Naoto	Advanced research technologies in different branches of biological sciences
58	○	○		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
57	○	○		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
58	○	○		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
57	○	○		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
58	○	○		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	Graduate School of Science		Graduate School of Science and Engineering		Semester	Day	Time	Credit Hours
	Course Name	Course Number	Course Name	Course Number				
Master's program	Advanced Lecture on Evolutionary Genetics	R0751	-	-	2nd	Thu	1	2
Doctoral program	Advanced Lecture on Evolutionary Genetics	R0752	Advanced Lecture on Evolutionary Genetics	R752				

Instructor(s)	Note
Tamura, Takahashi, and Nozawa	-

(1) Course policies and topics	[Evolutionary biology from the view point of genetics]
(2) Knowledge/skills to be acquired and learning objectives/course goals	Concept of population genetics in understanding evolutionary processes. Molecular bases of ecological traits (Takahashi) Concept of genome evolution and bioinformatics (Nozawa) Concept of molecular evolution and molecular phylogeny (Tamura)
(3) Course schedule, subject matter, and classroom activities	1. Molecular ecology and population genetics (Takahashi, 5 classes) Learn about genetic mechanisms underlying ecological traits and stochastic processes of allele frequency changes in a population that are essential for understanding evolutionary processes. In particular, theoretical background in population genetics are discussed by introducing previously conducted studies. 2. Genome evolution and bioinformatics (Nozawa, 5 classes) Genome evolution has been able to connect organismal evolution by rapid advancement in sequencing technology. Using this advancement, discuss about factors in genome evolution by using old and recent studies. Students are also expected to utilize the bioinformatics skill learned from this course in their own research topics. 3. Molecular evolution and molecular phylogeny (Tamura, 5 classes) Understanding how DNA and genomes evolve is crucial to understand organismal evolution. Students are expected to understand the methods in molecular evolution and molecular phylogenetics to analyze empirical molecular sequence data and learn principle underlying the evolution of genes and genomes.
(4) Outside-class activities and assignments	Further reading the related subjects and prepare for presentation.
(5) Textbooks and course materials	Handouts will be distributed.
(6) Assessment and grading	Evaluation is based on presentations, short assignments, and final assignments.
(7) Questions to the instructor (Office hours, etc.)	If you have any questions, send an email to Tamura (ktamura@tmu.ac.jp), Takahashi (ayat@tmu.ac.jp), or Nozawa (manozawa@tmu.ac.jp) in advance to make an appointment.
(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	Advanced Lecture on Ecology	R0753	1st	Tue.	1	2
Doctoral program	Advanced Lecture on Ecology	R0754				

Instructor(s)	Note
SUZUKI Jun-ichiro	Available in English. Please inquire in advance.

(1) Course policies and topics	Learn advanced topics in current ecology and related fields.
(2) Knowledge/skills to be acquired and learning objectives/course goals	1st to 8th lectures are focused on interdisciplinary area of population ecology, evolution, genetics and development. In lectures 9th to 15th, graduate students learn about applied ecology.
(3) Course schedule, subject matter, and classroom activities	1-3: Population ecology and evolution 4-6: Eco-evolutionary feedbacks 7-8: How to read and write scientific papers 9-10: Theoretical backgrounds of conservation ecology 11-12: Research examples of conservation ecology 13-14: Urban ecology: its theory and examples 15: Biodiversity in cities
(4) Outside-class activities and assignments	The review and preparation for the lecture is required. Report assignment will be given in some topics.
(5) Textbooks and course materials	Handouts or PDF. References will be announced in lecture (for the course by YO). Handouts will be provided through kibaco. (for the course by JS).
(6) Assessment and grading	Students will be assessed based on the average score of the first half by YO and the second half by JS. Active involvement in lecture and argument, reports(for the course by YO). The course by JS will be assessed based on in-class contribution (15%), homework (35%) and an exam or essay (50%).
(7) Questions to the instructor (Office hours, etc.)	How to reach out to the instructors; students can make an appointment by email 1st-8th yasu_okada@tmu.ac.jp 9th-15th jsuzuki@tmu.ac.jp
(8) Special note	Students attending this course must have some knowledge in very basic math, basic ecology, basic genetics and/or evolutionary biology.

Program	Course Name	Course Number	Semester	Day	Time	Credit Hours
Master's program	Advanced Lecture on Cell Biology	R0755	1	Thu	1	2
Doctoral program	Advanced Lecture on Cell Biology	R0756				

Instructor(s)	Note
KANEGAE Takeshi NARIKAWA Rei	

(1) Course policies and topics	The purpose of this course is to provide students with an understanding of the techniques used in cell biology research and the results obtained from such research. Example studies and the techniques used will be discussed and the literature will be reviewed. Students will consider what techniques can be used to study their chosen topic and present their ideas.
(2) Knowledge/skills to be acquired and learning objectives/course goals	First half: To understand the various regulatory mechanisms of light-responsive responses in plants and knowledge of research methods for such responses. Second half: To understand the properties and functions of cyanobacterial photoreceptors and to acquire knowledge of their biochemical and spectroscopic methods. Students will also gain an understanding of examples of applied research on photoreceptors.
(3) Course schedule, subject matter, and classroom activities	First half (8 classes): Kanegae 1: Overview of light sensing in plants 2: Studies on red light-dependent response 3: Studies on blue light-dependent response 4: Light-dependent regulatory mechanisms 5: Transcriptional and post-transcriptional regulation 6: Plant light signaling research and related papers 7: General discussion 8: Summary of the first half Second half (7 classes): Narikawa 9th: Overview of studies on light acclimation processes in cyanobacteria 10th: Diversity of photoreceptors in cyanobacteria 11th: Light perception mechanism of cyanobacteriochromes 12th: Light acclimation processes regulated by cyanobacteriochromes 13th: Application of cyanobacteriochromes to optogenetics 14th: Application of cyanobacteriochromes to fluorescent bioimaging 15th: Summary of the second half
(4) Outside-class activities and assignments	First half: Students should understand the lecture materials and papers, and actively contribute questions and comments. Second half: Students should prepare for the next lecture and understand the meaning of technical terms.
(5) Textbooks and course materials	First half: Handouts and materials related to the major papers will be distributed. Second half: Handouts and materials related to the major papers will be distributed.
(6) Assessment and grading	First half: Evaluation will be based on the report and class discussion. Second half: Evaluation will be based on class participation and presentation content.
(7) Questions to the instructor (Office hours, etc.)	No specific office hours will be set, but if you wish to ask questions in person, please make an appointment in advance by e-mail.
(8) Special note	In principle, the class will be held in a face-to-face format. However, online lectures may be used in some cases due to Covid-19 infection or other reasons. In such a case, the ID of the ZOOM conference room will be provided via kibaco or e-mail. Available in English. Please inquire in advance.

Program	Course Name	Course Number	Semester	Day	Time	Credit Hours
Master's program	Advanced Lecture on Taxonomy	M(R0757)	2nd Semester	Fri.	1	2
Doctoral program	Advanced Lecture on Taxonomy	D(R0758)				

Instructor(s)	Note
EGUCHI Katsuyuki TAKAYAMA Koji	

(1) Course policies and topics	Understand current research on plant and animal diversity and phylogenetic evolution through literature readings and presentations.
(2) Knowledge/skills to be acquired and learning objectives/course goals	The goal of this course is to understand the perspectives, thoughts and approaches that researchers use to elucidate the phylogeny and the factors, processes and mechanisms of phylogenetic evolution.
(3) Course schedule, subject matter, and classroom activities	Day 1 to 7 (Koji Takayama, Plant Systematics and Evolution) This course involves reading and discussing research papers and literature focused on land plants, covering topics such as systematics, phylogeography, and speciation. Through these readings, students will deepen their understanding of the diversity of land plants and the methodologies used to investigate it. Day 8 to 15 (Katsuyuki Eguchi, Animal Systematics) Students will deepen their understanding of the perspectives, thoughts and approaches that have been used to elucidate diversity and evolutionary processes of animals, by reading and introducing articles and literature on systematics and phylogeography of mainly terrestrial arthropods by themselves.
(4) Outside-class activities and assignments	When reading an article together with other participants, it is necessary to read the parts that you will not be presenting in advance and organise any issues or points that you do not understand. Furthermore, it is necessary to review the materials again after the lecture and supplement your knowledge by utilising reference materials.
(5) Textbooks and course materials	The lecture will be based on the handouts distributed, and references (articles, books, etc.) will be introduced.
(6) Assessment and grading	Evaluation will be based on students' performance in the class and the contents of their presentation(s).
(7) Questions to the instructor (Office hours, etc.)	Office hours are not set, but if you wish to ask a question directly, please make an appointment in advance by e-mail (Takayama: takayamak[at]tmu.ac.jp, Eguchi: antist[at]tmu.ac.jp).
(8) Special note	Students are not required particularly to take other classes in advance.

7Program	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, Adam Weitemier	

(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	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. Non-associative learning 1 (A. Weitemier) 10. Non-associative learning 2 (A. Weitemier) 11. Classical Conditioning 1 (A. Weitemier) 12. Classical Conditioning 2 (A. Weitemier) 13. Instrumental Conditioning 1 (A. Weitemier) 14. Instrumental Conditioning 2 (A. Weitemier) 15. Brain reward system and Addiction (A. Weitemier) 16. Psychiatric Disorders (A. Weitemier)
(4) Outside-class activities and assignments	Students are expected to prepare for and review the class and work on reports and other assignments.
(5) Textbooks and course materials	Handouts and other materials will be distributed as appropriate. 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	Evaluation will be made comprehensively based on class attitude, reports, etc.
(7) Questions to the instructor (Office hours, etc.)	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.
(8) Special note	Students can take this course in English. Those who wish to take the course in English should contact the lecturers. Lectures by Weitemier will be conducted in English only, A note on the lecture by Sakai will be given in the first lecture.

Program	Course Name	Course Number	Semester	Day	Time	Credit Hours
Master's program	Special Lecture on Biomolecules		1st - II	Fri.	2	1
Doctoral program	Special Lecture on Biomolecules					

Instructor(s)	Note
KAWAHARA Hiroyuki OKAMOTO Takashi	

(1) Course policies and topics	Mechanisms in protein metabolism and reproduction
(2) Knowledge/skills to be acquired and learning objectives/course goals	The first half focuses on the ubiquitin system, which is at the heart of intracellular protein metabolism, from its historical discovery to its biological functions (Kawahara). The second half focuses on the sexual reproduction (Okamoto).
(3) Course schedule, subject matter, and classroom activities	1st-4th classes: From the historical discovery of the ubiquitin system to its biological functions. 5th -8th classes: The mechanism of sexual reproduction in organisms
(4) Outside-class activities and assignments	As an out-of-class study, it is recommended to review the content of each lecture and exercise after the lecture and to ask questions at the next lecture.
(5) Textbooks and course materials	Handouts and other materials will be distributed as appropriate.
(6) Assessment and grading	Evaluation is based on class participation and report or presentation content.
(7) Questions to the instructor (Office hours, etc.)	Questions will be addressed as needed by e-mail with scheduling. Room 8-320, okamoto-takashi@tmu.ac.jp (Okamoto); Room 9-481b, hkawa@tmu.ac.jp (Kawahara)
(8) Special note	

Program	Course Name	Course Number	Semester	Day	Time	Credit Hours
Master's program	Special Lecture on Developmental and Regenerative Biology	R0399	1st I	Fri.	1	1
Doctoral program	Special Lecture on Developmental and Regenerative Biology	R0340				

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	Special Lecture on Cell Biology	R0389	2nd Semester II	Fri	2	1
Doctoral program	Special Lecture on Cell Biology	R0390				

Instructor(s)	Note
EHIRA Shigeki HARUTA Shin OHBAYASHI Ryudo	

(1) Course policies and topics	This course will introduce the latest research on bacterial cell growth, metabolic regulation, and diversity.
(2) Knowledge/skills to be acquired and learning objectives/course goals	(Haruta) You will learn environmental responses, interspecies interactions, and population dynamics of bacteria and archaea. (Ehira) You will learn research on genetic regulation and metabolic regulation of bacteria. (Ohbayashi) You will learn the mechanisms of bacterial growth.
(3) Course schedule, subject matter, and classroom activities	1st-3rd: Shin HARUTA 1. Environmental responses 2. Interspecies interactions 3. Population dynamics 4th-6th: Shigeki EHIRA 4. Signaling molecules 5. Cellular differentiation and pattern formation 6. Biological clock 7th-8th: Ryudo OHBAYASHI 7. Genome replication 8. Cell division
(4) Outside-class activities and assignments	Students are expected to prepare each lecture by reading research articles.
(5) Textbooks and course materials	Hand-outs will be provided in the class.
(6) Assessment and grading	Evaluation will be based on reports. Presentation and discussion in the class are also considered.
(7) Questions to the instructor (Office hours, etc.)	by appointment through e-mail
(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	English for Biology	R0421	Summer intensive			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	This course is a listening/speaking course in English for science students. Students will practise situations in which they may need to speak English in the future, such as when giving oral presentations at conferences, discussing their research with other scientists, visiting or working in laboratories overseas, or explaining their research to a general audience. Students will be shown how they can become more independent and autonomous learners of English.
(3) Course schedule, subject matter, and classroom activities	Basic scientific terms and expressions not usually covered in general English classes will be studied and practised. The class will be conducted in English using an interactive workshop style for active listening and speaking practice. 1. Introduction to English for Specific Purposes 2. Professional self-introduction 3. Numbers, Mathematical expressions 4. Laboratory equipment, Tables and graphs 5. Dictation 6. Listening and summarizing science news podcast 7. Listening and speaking practice: Prosody 8. Recitation and self-analysis 9. Genre analysis: Science news 10. Your science news podcast 11. Presentation skills and pronunciation 12. Useful expressions for presentations and Q&A sessions 13. How to chair an academic session 14. Slides and script writing 15. Oral presentations
(4) Outside-class activities and assignments	The homework will include preparing slides for oral presentations and preparing transcripts of spoken texts.
(5) Textbooks and course materials	Reference books: 理系英語のライティング　（野口ジュディー、アルク） Judy先生の成功する理系英語プレゼンテーション（野口ジュディー・照井雅子・藤田清士著，講談社）
(6) Assessment and grading	Discussion: 25% Listening dictation: 20% Presentations: 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. Students are required to use computers (which can access the Internet via WiFi) and earphones in class for reading, listening, writing, speaking, and video- and audio-recording tasks. Students should also have a Gmail account.

Program	Course Name	Course Number	Semester	Day	Time	Credit Hours
Master's program	English for Biology	R0423	Winter intensive			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	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. Note: For the RA analysis, students will collect and submit electronic copies of five RAs that meet all the requirements below: a. Original RAs **Reviews are not acceptable. b. Full-length RAs **NOT letters or short communications c. RAs on or related to the students' own research d. RAs published in well-respected journals e. 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.) 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
(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 野口ジュディ―、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. Students are expected to have their own Gmail accounts for file sharing purposes.

Program	Graduate School of Science		Graduate School of Science and Engineering		Semester	Day	Time	Credit Hours
	Course Name	Course Number	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	Special Course in Biology II (Communication in English)	R426				

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. 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.
(3) Course schedule, subject matter, and classroom activities	**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	

Program	Graduate School of Science		Graduate School of Science and Engineering		Semester	Day	Time	Credit Hours
	Course Name	Course Number	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	Special Course in Biology II (Communication in English)	R428				

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	Outline: 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.
(3) Course schedule, subject matter, and classroom activities	Content: 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	Assessment: eekly presentations (50%), final presentation (50%).
(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	

Program	Graduate School of Science		Graduate School of Science and Engineering		Semester	Day	Time	Credit Hours
	Course Name	Course Number	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	Special Course in Biology II (Communication in English)	R430				

Instructor(s)	Note
Elizabeth Zielinska*	

(1) Course policies and topics	Nature Talk II
(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. 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.
(3) Course schedule, subject matter, and classroom activities	**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	

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 WEITEMIER Adam Zachary	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	Format: Didactic lecture & student presentation Tentative schedule: I. Conference style 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) II. 3-min talk 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	Text book and Required Supplies: Science Research Writing: For Native And Non-native Speakers Of English (second Edition) ISBN: 978-1786347848 Handout will be distributed in the class.
(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), Adam Cronin (adam-l@tmu.ac.jp) and Adam Weitemier (aweitem@tmu.ac.jp).
(8) Special note	This course includes COIL (collaborative online international learning) with classes from partner universities.

Program	Course Name	Course Number	Semester	Day	Time	Credit Hours
Master's program	Special Course in Biology I (Computer Practice: Basic)	R0439	1st intensive	-·	-	1
Doctoral program	Special Course in Biology I (Computer Practice: Basic)	R0440				

Instructor(s)	Note
Tamura and 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	The students taking this course can learn the network system to get information for study and research in Department of Biological Sciences. They will also 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. Day 1: Wednesday, April 9 2-5 periods (4 classes) Day 2: Wednesday, April 16 2-5 periods (4 classes) 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.
(2) Knowledge/skills to be acquired and learning objectives/course goals	・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	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. ・Utilization of computers and networks (BioForum) for study and research in the Department of Biological Sciences ・Utilization of the campus network (TMUNER) and the Library Information Center ・Proper use of software, copyright, security management, etc. ・Utilization of the literature database ・Fundamentals of next-generation sequence data analysis *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.
(4) Outside-class activities and assignments	・Log on to TMUNER and verify your user ID and password in advance. ・Review the content of the exercise and address the issues.
(5) Textbooks and course materials	[Reference URLs] Tokyo Metropolitan University Information Processing System (TMUNER) http://www.comp.tmu.ac.jp/tmuner/ Biological Sciences Forum (BioForum) https://forum.biol.se.tmu.ac.jp/ Tokyo Metropolitan University Library http://www.lib.tmu.ac.jp/
(6) Assessment and grading	Attitude (50%) and report (50%)
(7) Questions to the instructor (Office hours, etc.)	If you have any questions, please email Tamura (ktamura [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 Course in Biology Ⅰ(Computer practice : advance)	R0441	1st II	Fri.	1	1
Doctoral program	Special Course in Biology Ⅰ(Computer practice : advance)	R0442				

Instructor(s)	Note
FUKUDA Kimiko TAKATORI Naohito ASADA Akiko	

(1) Course policies and topics	Computer practice: advance This class will be offered in the second half of the first semester. Students are required to have already completed " Computer practice: Basic" (first half of the first semester). Students are expected to be familiar with basic computer operations and software such as Word and Excel, and to have a basic knowledge of statistics at the undergraduate level.
(2) Knowledge/skills to be acquired and learning objectives/course goals	Computer applications in biology research Basic programming and practical examples Understanding of the basic structure of image data and its analysis Understanding the necessity of bioinformatics
(3) Course schedule, subject matter, and classroom activities	In this exercise, students will be introduced to software commonly used in biological and life science research, and will practice advanced data analysis and statistical processing. The contents are as follows. Class 1 to 3 (Takatori) Image analysis using ImageJ: microscopy Class 4 to 5 (Asada) Image analysis using ImageJ: electrophoresis gel Class 6 to 8 (Fukuda) Practical techniques for presenting research using PowerPoint
(4) Outside-class activities and assignments	For image analysis using ImageJ, review the scope of the previous class and understand the meaning of technical terms, etc. For practical techniques of research presentation using PowerPoint, students are to prepare and submit a PowerPoint presentation of their own research.
(5) Textbooks and course materials	Handouts and other materials will be distributed as necessary.
(6) Assessment and grading	Evaluation will be based on class participation (50%) and reports and other submissions (50%).
(7) Questions to the instructor (Office hours, etc.)	takatori-naohito1@tmu.ac.jp (Takatori) a7203ki@tmu.ac.jp (Asada) kokko@tmu.ac.jp (Fukuda)
(8) Special note	Computer practice: advance This class will be offered in the second half of the first semester. Students are required to have already completed " Computer practice: Basic" (first half of the first semester). Students are expected to be familiar with basic computer operations and software such as Word and Excel, and to have a basic knowledge of statistics at the undergraduate level.

Program	Course Name	Course Number	Semester	Day	Time	Credit Hours
Master's program	Planning and Management Practicum	R0443	1st	Tue	2	1
Doctoral program	Planning and Management Practicum	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	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. ・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 Students are expected to work in groups, with assistance from the lecturers as needed. Financial support for project implementation may be available.
(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.

Program	Course Name	Course Number	Semester	Day	Time	Credit Hours
Master's program	Planning and Management Practicum	R0445	2nd	Wed	1	1
Doctoral program	Planning and Management Practicum	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	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. ・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 Students are expected to work in groups, with assistance from the lecturers as needed. Financial support for project implementation may be available.
(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.

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	

Program	Graduate School of Science		Graduate School of Science and Engineering		Semester	Day	Time	Credit Hours
	Course Name	Course Number	Course Name	Course Number				
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	Biology Course in International Research Experiences 2	R450				

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	

Program	Graduate School of Science		Graduate School of Science and Engineering		Semester	Day	Time	Credit Hours
	Course Name	Course Number	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. Kanae Ando (k_ando@tmu.ac.jp), a member of the Graduate School Academic Affairs Committee.
(8) Special note	Students will need to find their own internship hosts.

Program	Graduate School of Science		Graduate School of Science and Engineering		Semester	Day	Time	Credit Hours
	Course Name	Course Number	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)—		—R412 (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.
(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. Kanae Ando (k_ando@tmu.ac.jp), a member of the Graduate School Academic Affairs Committee.
(8) Special note	Students will need to find their own internship hosts.

Program	Graduate School of Science		Graduate School of Science and Engineering		Semester	Day	Time	Credit Hours
	Course Name	Course Number	Course Name	Course Number				
Master's program	Internship (2unit)	R0931	Internship (1units)	R0929	As Needed	—	—	1 or 2
Doctoral program	Internship (2unit)	R0932—	Internship (1units)	R0930				

Instructor(s)	Note
Kanae Ando 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 spends 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	1unit: 5 days（40h） or more, less than 8 days（60h), one credit 2 units: 8 days (60 h) or more, two credits, Students should submit a detailed internship plan more than six weeks before the start date.

Program	Graduate School of Science		Graduate School of Science and Engineering		Semester	Day	Time	Credit Hours
	Course Name	Course Number	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	Special Seminar in Biological Sciences 1	R458				

Instructor(s)	Instructor(s)
All faculty member of Department of Biological Sciences	

(1) Course policies and topics	Latest Topics in Biological Sciences As a seminar in the Department of Biological Sciences, faculty member and guest researchers will introduce their research.
(2) Knowledge/skills to be acquired and learning objectives/course goals	In graduate studies, it is necessary to learn from many examples of cutting-edge research how the research was carried out. In addition, they need to learn about the cutting-edge knowledge, methods, and techniques contained in life science research in a variety of fields that cannot be obtained from 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 in various fields through direct contact with and questioning of studies in order to master the expertise of the life sciences.
(3) Course schedule, subject matter, and classroom activities	Omnibus format will be used to teach the latest research in metabolic biology, microbiology, cell biology, plant ecology, plant environmental response, plant embryology, plant phylogenetics, and molecular neurobiology.
(4) Outside-class activities and assignments	Read the abstract of the research introduction in advance.
(5) Textbooks and course materials	No textbook will be provided. Necessary materials will be handed out in each class.
(6) Assessment and grading	Evaluation will be based on class participation and questions.
(7) Questions to the instructor (Office hours, etc.)	If you have any questions for the instructor, please contact Fukuda (kokko@tmu.ac.jp).
(8) Special note	This course is offered in Japanese. Courses are offered in the first semester. It is expected that graduate students in both the master's and doctoral programs will take this course each year.

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	Latest Topics in Biological Sciences As a seminar in the Department of Biological Sciences, faculty member and guest researchers will introduce their research.
(2) Knowledge/skills to be acquired and learning objectives/course goals	In graduate studies, it is necessary to learn from many examples of cutting-edge research how the research was carried out. In addition, they need to learn about the cutting-edge knowledge, methods, and techniques contained in life science research in a variety of fields that cannot be obtained from 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 in various fields through direct contact with and questioning of studies in order to master the expertise of the life sciences.
(3) Course schedule, subject matter, and classroom activities	Omnibus format will be used to teach current research in behavioral neurology, microbial ecology, population genetics, animal ecology, environmental response of microorganisms, developmental biology, animal phylogenetics, and neurophysiology.
(4) Outside-class activities and assignments	Read the abstract of the research introduction in advance.
(5) Textbooks and course materials	No textbook will be provided. Necessary materials will be handed out in each class.
(6) Assessment and grading	Evaluation will be based on class participation and questions.
(7) Questions to the instructor (Office hours, etc.)	If you have any questions for the instructor, please contact Fukuda (kokko@tmu.ac.jp).
(8) Special note	This course is offered in Japanese. Courses are offered in the second semester. It is expected that graduate students in both the master's and doctoral programs will take this course each year.

Program	Course Name	Course Number	Semester	Day	Time	Credit Hours
Master's program	Special Lecture on Biological Sciences	R0715	2	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	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. Presentations will employ TMU's COIL (Collaborative Online International Learning) platform where possible.
(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	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. This class is for graduates of other universities. The permission of curriculum coordinator (Dr. Fukuda) is required for the registration. Discuss with your supervisor and class teachers in advance.

Program	Course Name	Course Number	Semester	Day	Time	Credit Hours
Master's program	Special Lecture on Biological Sciences	R0709	2-I	Tue	1	1
Doctoral program	Special Lecture on Biological Sciences	R0710				

Instructor(s)	Note
Fukuda, Takatori	

(1) Course policies and topics	Course description: We will discuss cellular mechanisms of germ layer fate separation during early embryogenesis. Recent discoveries related to asymmetric cell division and cell polarization will be discussed.
(2) Knowledge/skills to be acquired and learning objectives/course goals	Course objectives: Students will learn how to read, understand and interpret resent research results related to embryogenesis. Students will also learn how to formulate research ideas and crystalize original questions through dialectical methods. By the end of the course, students will also acquire basic knowledge on germ layer fate separation, asymmetric cell division and polarization of cells.
(3) Course schedule, subject matter, and classroom activities	1. A brief history of Developmental Biology and its essential goals 2. Fate specification during embryonic development 3. Cell differentiation and asymmetric cell division 4. Cell differentiation and gene expression 5. Microscopy in developmental biology 6. Cell polarization in embryogenesis 7. Summary 8.Final review
(4) Outside-class activities and assignments	Reading materials may be assigned every week.
(5) Textbooks and course materials	Texts and handouts be provided by the instructor.
(6) Assessment and grading	Assessment: Students will be assessed by their contribution to discussions during class and final test.
(7) Questions to the instructor (Office hours, etc.)	Questions can be posted via KIBACO. Office hours; by appointment through e-mail
(8) Special note	A basic understanding of cell biology is required. Students will be required to participate in discussions during class. Students who do not yet possess sufficient command of the English language may need to improve their English language skills. For questions regarding class and English proficiency, contact the instructor before registration.

Program	Course Name	Course Number	Semester	Day	Time	Credit Hours
Master's program	Special Lecture on Biological Sciences	R0707	2nd semester-I	Tue	2	1
Doctoral program	Special Lecture on Biological Sciences	R0708				

Instructor(s)	Note
Kanae Ando	

(1) Course policies and topics	COURSE TITLE: Molecular mechanisms of aging COURSE DESCRIPTION: Our society is aging, and the number of patients with age-associated diseases is growing. Studies revealed that diet and metabolism are key regulators of a healthy lifespan. This course will discuss the current understanding of molecular mechanisms that regulate aging and age-related diseases.
(2) Knowledge/skills to be acquired and learning objectives/course goals	COURSE OBJECTIVES: This course introduces current knowledge of age-related changes at molecular levels and their roles in diseases. The format of this course is a combination of didactic lectures and student presentations. Lectures will introduce concepts, and student presentations followed by discussions will promote an understanding of analytical approaches to questions in neuroscience and critical scientific thinking.
(3) Course schedule, subject matter, and classroom activities	TENTATIVE COURSE SCHEDULE: 1. Introduction 2. Mitochondria and aging (lecture) 3. Mitochondria and aging (student presentation) 4. Diet and aging (lecture) 5. Diet and aging (student presentation) 6. Proteostasis and aging (lecture) 7. Proteostasis and aging (student presentation) 8. Review & discussion
(4) Outside-class activities and assignments	Students will be asked to read recent articles from scientific journals and prepare for presentation.
(5) Textbooks and course materials	Reading materials including primary literature will be distributed in the class.
(6) Assessment and grading	EVALUATION: Class participation 40%, Presentation 40%, Final report 20%
(7) Questions to the instructor (Office hours, etc.)	Please email Dr. Kanae Ando (k_ando@tmu.ac.jp)
(8) Special note	This course is open to students who have completed an undergraduate program in universities other than TMU and are not fluent in Japanese. Talk to your supervisors about whether this course is appropriate for you. To register, submit a course registration request form to the program organizer.

Program	Course Name	Course Number	Semester	Day	Time	Credit Hours
Master's program	Special Lecture on Biological Sciences	R0721	2nd semester-I	Wed	1	1
Doctoral program	Special Lecture on Biological Sciences	R0722				

Instructor(s)	Note
Kanae Ando, Ryudo Ohbayashi	

(1) Course policies and topics	COURSE DESCRIPTION: 1st: Ryudo Ohbayashi In the past few years, the academic trend has been shifting from molecular biology to synthetic biology and systems biology. In this class, synthetic biology will be discussed using the example of research in bacteria. 2nd half: Kanae Ando 'age-related neurodegenerative diseases' Brain aging increases the risks of neurodegenerative diseases such as Alzheimer's disease. Many of these diseases are accompanied by an accumulation of aggregated proteins. However, what causes protein accumulation and how it leads to neurodegeneration is not clear. This course will discuss the current understanding of molecular mechanisms underlying the pathogenesis of age-related diseases.
(2) Knowledge/skills to be acquired and learning objectives/course goals	COURSE OBJECTIVES: 1st: Ryudo Ohbayashi Understanding of synthetic biology and presentation skills 2nd half: Kanae Ando Discuss current understanding of molecular pathogenesis of neurodegenerative diseases through lectures and discussion.
(3) Course schedule, subject matter, and classroom activities	TENTATIVE COURSE OUTLINE: Ohbayashi 1. Introduction, Molecular biology to synthetic biology 2. synthetic biology 3. Summary and student presentation 4. Student presentation Ando: 1. Introduction, Alzheimer's disease 2. Alzheimer's disease, cont. 3. Parkinson's disease 4. Summary and student presentation
(4) Outside-class activities and assignments	OUT OF CLASS ACTIVITY REQUIREMENT: Ando: Students will be asked to read journal articles and prepare for presentations.
(5) Textbooks and course materials	TEXTBOOKS: Ohbayashi: Textbooks will be distributed in the class. Ando: Reading materials including primary literature will be distributed in the class.
(6) Assessment and grading	EVALUATION: Ohbayashi: Class participation 50%, Assignment and Presentation 50% Ando; Class participation 50%, Assignment and Presentation 50%
(7) Questions to the instructor (Office hours, etc.)	[HOW TO REACH OUT TO THE INSTRUCTOR] Ohbayashi: ryudohbys@tmu.ac.jp Ando: E-mail to k_ando@tmu.ac.jp for an appointment.
(8) Special note	This course is open to students who have completed an undergraduate program in universities other than TMU and are not fluent in Japanese. Talk to your supervisors about whether this course is appropriate for you. To register, submit a course registration request form to the program organizer.

Program	Graduate School of Science		Graduate School of Science and Engineering		Semester	Day	Time	Credit Hours
	Course Name	Course Number	Course Name	Course Number				
Master's program	Special Lecture on Biological Sciences	R0717	-	-	2nd A	Wed.	2	1
Doctoral program	Special Lecture on Biological Sciences	R0718	Special Lecture on Biological Sciences	R718				

Instructor(s)	Note
Nozawa	Common lecture for undergrads

(1) Course policies and topics	Various topics on evolutionary biology with special focus on sex-chromosome evolution.
(2) Knowledge/skills to be acquired and learning objectives/course goals	Mutation is an ultimate source of organismal evolution. Therefore, understanding of molecular and genetic bases of evolution is crucial. In this lecture, the topics on evolution of sex and sex chromosomes will be extensively introduced. Students are expected to understand how evolution has occurred at the molecular level in the long run and to feel enthusiasm how researchers have set questions to be solved and how they have overcome the difficulties during their researches.
(3) Course schedule, subject matter, and classroom activities	1. Degeneration of Y chromosome and dosage compensation 2. Histone modifications on sex chromosomes and loss of Y chromosome 3. Toxicity of Y chromosome and B chromosome 4. Sex-chromosome turnover and sex-ratio distortion 5. Current topics on evolutionary biology 1 6. Current topics on evolutionary biology 2 7. Current topics on evolutionary biology 3 8. Current topics on evolutionary biology 4
(4) Outside-class activities and assignments	Homework assignments will be given several times.
(5) Textbooks and course materials	Handouts will be distributed via kibaco.
(6) Assessment and grading	Response to questions and discussions 30%, Report quality 70%
(7) Questions to the instructor (Office hours, etc.)	There is no particular office hour. If you have any questions, send an email to Masafumi Nozawa (manozawa[at]tmu.ac.jp).
(8) Special note	[Note for graduate students] This course is open to students who have completed an undergraduate program in universities other than TMU and are not fluent in Japanese. Talk to your supervisors about whether this course is appropriate for you. To register, submit a course registration request form to the program organizer (Prof. Nozawa).

Program	Course Name	Course Number	Semester	Day	Time	Credit Hours
Master's program	Special Lecture in Ecology（生態学特別講義）	R0711	2-I	Thu	1	1
Doctoral program	Special Lecture in Ecology（生態学特別講義）	R0712				

Instructor(s)	Note
SUZUKI Jun-ichiro OKAMURA Yu	

(1) Course policies and topics	Course Description This course is an advanced and specific introduction to ecology. Students will be introduced to the concepts and theories that lead good research questions, and the methods that are used to answer ecological questions. This course explores topics such as population ecology, evolutionary ecology, experimental ecology, behaviour ecology and reproductive ecology. Both animal and plant systems will be considered. Instructor; Dr. Yu Okamura (**@**) for the first half and Dr. Jun-Ichirou Suzuki (jsuzuki@tmu.ac.jp) for the second half.
(2) Knowledge/skills to be acquired and learning objectives/course goals	Objectives Students completing this course will be able to; approach natural phenomena with ecological methods, and ask effective questions on ecological aspects.
(3) Course schedule, subject matter, and classroom activities	Course Schedule 1. Molecular and Chemical approaches in Ecology (YO) 2. Plant and Herbivore Interactions (YO) 3. Ecological Interactions in Insects (YO) 4. Ecological Genomics (YO) 5. Physiological integration in clonal plants (by JS) 6. Self-thinning in clonal plants (by JS) 7. Performance of clonal plants under heterogeneous environments (by JS) 8. Sexual reproduction and genetic structure in populations of clonal plants (by JS)
(4) Outside-class activities and assignments	Out-of-class activities 1st half: Students will be given a short homework assignment after each class. 2nd half: Students will be given homework (ca. A4, 1page) after each class.
(5) Textbooks and course materials	Textbook and required supplies 1st half: Students will receive handouts through kibaco. Additional reading materials or references will be provided during the course. 2nd half: Students will receive handouts through kibaco.
(6) Assessment and grading	Assessment Students will be assessed based on the average score of the first half by YO and the second half by JS. The course by YO will be assessed based on in-class activity and contributions (40%), homework (20%) and reports (40%). The course by JS will be assessed based on in-class contributions (25%), homework (25%) and reports (50%).
(7) Questions to the instructor (Office hours, etc.)	How to reach out to the instructors Students can make an appointment by email (jsuzuki@tmu.ac.jp). You can contact YO at any time by email (**@**).
(8) Special note	Notes and prerequisites Students attending this course must have some knowledge in very basic math, basic ecology, basic genetics and/or evolutionary biology. The prerequisite for the course is General Biology IB, General Biology IIB, General Ecology and Ecology at TMU. If you are an exchange student staying for this semester, contact the instructor in advance.

Program	Course Name	Course Number	Semester	Day	Time	Credit Hours
Master's program	Special Lecture in Scientific Writing	R0669	2nd Semester I	Th	2nd	1
Doctoral program	Special Lecture in Scientific Writing	R0670				

Instructor(s)	Note
Adam Weitemier	

(1) Course policies and topics	A majority of scientific communication is done through writing, much of which is in the form of scientific publications. Since English is the language used by most scientific journals, it is essential to be able to effectively read and navigate through English scientific publications. It is also essential to be able to write about scientific information in a style that is understandable and acceptable for English language scientific journals. Active participation in the class is essential.
(2) Knowledge/skills to be acquired and learning objectives/course goals	The aims of this course are to 1) improve students' ability and confidence in effectively navigating among the sections of an English language scientific report and 2) to familiarize students with English scientific writing styles from the perspectives of reading and writing.
(3) Course schedule, subject matter, and classroom activities	TENTATIVE COURSE OUTLINE: 1. Experimental Design and Paper Structure; References 2. Introduction Section 3. Methods Section 4. Results Section 5. Discussion Section 6. Peer Review I 7. Peer Review II 8. Class Review and Discussion Online activities will be frequent. Some activities will require access to Google Docs. Holding a Google account is not necessary.
(4) Outside-class activities and assignments	The class assignment is a writing sample on a student-chosen topic.
(5) Textbooks and course materials	Sample publications will be distributed throughout the course. For further independent reference, students may refer to the books: 理系英語のライティングVer2. （理系たまごシリーズ） or Science Research Writing: For Native And Non-native Speakers Of English (second Edition) ISBN: 978-1786347848 available in the English Mini-Library
(6) Assessment and grading	Participation 50%, Effort 35%, Assignment 15%
(7) Questions to the instructor (Office hours, etc.)	The instructor can be reached at aweitem[at]tmu.ac.jp or through the kibaco class page messages.
(8) Special note	This course will be taught in English. This course is open to students who have completed an undergraduate program in universities other than TMU and are not fluent in Japanese. A retake is not allowed for students who took this course in the undergraduate program. Talk to your supervisors about whether this course is appropriate for you. To register, submit a course registration request form to the program organizer.

Program	Course Name	Course Number	Semester	Day	Time	Credit Hours
Master's program	Special Lecture in Physiology1: Neurobiology of the Norepinephrine System	R0733	2nd Semester I	Fri	1	1
Doctoral program	Special Lecture in Physiology1: Neurobiology of the Norepinephrine System	R0734				

Instructor(s)	Note
Adam Weitemier	

(1) Course policies and topics	The locus coeruleus (the “blue spot”) is a small nucleus on either side of the vertebrate hindbrain. Its primary neurotransmitter is norepinephrine (NE). Through extensive neuronal projections, NE output from the locus coeruleus influences fundamental bodily functions, emotional responses, and cognition. Although the locus coeruleus NE system is the longest and most well-studied neuronal system, current research continues to make new discoveries about its role in brain function and behavior. This course will take a student-interactive approach to explore fundamental and current knowledge about the locus coeruleus NE system. We will consider current topics and future questions through the lens of recent studies that are conducted from different biological perspectives. Active participation in the class is essential.
(2) Knowledge/skills to be acquired and learning objectives/course goals	Students taking this course will gain an understanding and perspective on the importance of NE (and related systems) in physiology and behavior. They will be able to use the knowledge that they gain in this course to guide future learning about the diversity of brain function.
(3) Course schedule, subject matter, and classroom activities	[Tentative Course Schedule] 1. Introduction – Neuroanatomy basics 2. NE System Physiology and Measurement 3. Pharmacology – In-class Activity; Reading Homework 4. Behavioral Modulation 5. NE in Memory and Cognition; quiz 6. Human applications; Theories on NE Function 7. Student Presentation preparation 8. Student Presentation
(4) Outside-class activities and assignments	Presentation preparation.
(5) Textbooks and course materials	Research articles and supplementary readings will be distributed throughout the course. General background on these topics may be found in the textbook 'Bear, Mark F., Barry W. Connors, and Michael A. Paradiso. Neuroscience: Exploring the Brain, 3rd ed. Lippincott Williams & Wilkins, 2006. ISBN: 9780781760034' - This book may be checked out from the English Mini Library.
(6) Assessment and grading	Class participation 50%, Assigned Work 20%, Presentation 30%
(7) Questions to the instructor (Office hours, etc.)	Available for questions/comments via KIBACO online system E-mail to aweitem@tmu.ac.jp for questions or an appointment.
(8) Special note	Previous knowledge in basic neuroscience or physiology will be helpful. This course is open to students who have completed an undergraduate program in universities other than TMU and are not fluent in Japanese. A retake is not allowed for students who took this course in the undergraduate program. Talk to your supervisors about whether this course is appropriate for you. To register, submit a course registration request form to the program organizer.

Program	Course Name	Course Number	Semester	Day	Time	Credit Hours
Master's program	Special Lecture in Physiology2: Neurobiology and the Environment	R0749	2nd Semester II	Fri	1	1
Doctoral program	Special Lecture in Physiology2: Neurobiology and the Environment	R0750				

Instructor(s)	Note
Adam Weitemier	

(1) Course policies and topics	The brain and supporting systems are dependent on environmental conditions for maintaining normal function. As we review fundamental knowledge about the brain, we will consider the various ways in which it is vulnerable to changes made to the environment by human activity, including emissions of toxins and pollutants, and changes in our surroundings. The class will consist of informative lecture and communicative activities. Research on the impacts of environmental pollutants on nervous system function is ongoing. Therefore, in this class we will hold discussions that consider the history, latest findings and preventative measures considered in the current research literature. Students will do their own research on mechanistic, health and preventative viewpoints of an environmental issue that impacts nervous system function. Active participation in the class is essential.
(2) Knowledge/skills to be acquired and learning objectives/course goals	Students will gain an informed perspective on the interaction of nervous system physiology and the environment. They will strengthen inquiry and critical thinking skills through discussion and research activities.
(3) Course schedule, subject matter, and classroom activities	[Tentative] 1. Introduction 2. Study Perspectives; Course task 3. Brain Defenses; Discussion 4. Mechanisms of Damage; Discussion 5. Homeostasis; Discussion 6. Stress; Discussion 7. Management; Student presentations 8. Solutions; Student presentations
(4) Outside-class activities and assignments	Students will be asked to search for articles and scientific papers to prepare for in-class discussion and presentation.
(5) Textbooks and course materials	Research articles to be distributed throughout the course. General background on the nervous system may be found textbooks such as: 'Bear, Mark F., Barry W. Connors, and Michael A. Paradiso. Neuroscience: Exploring the Brain, 3rd ed. Lippincott Williams & Wilkins, 2006. ISBN: 9780781760034'.
(6) Assessment and grading	Class participation 50%, Quizzes 20%, Research Motivation 30%
(7) Questions to the instructor (Office hours, etc.)	Available for questions/comments via KIBAKO online system E-mail to aweitem@tmu.ac.jp for questions or an appointment.
(8) Special note	Previous knowledge of general neuroscience or physiology will be helpful. This course will be taught in English. This course is independent from the 2nd Semester I (後期 I) course taught by Dr. Weitemier. If you wish to take both courses, please register for them separately. This course is open to students who have completed an undergraduate program in universities other than TMU and are not fluent in Japanese. A retake is not allowed for students who took this course in the undergraduate program. Talk to your supervisors about whether this course is appropriate for you. To register, submit a course registration request form to the program organizer.

Program	Course Name	Course Number	Semester	Day	Time	Credit Hours
Master's program	Special Lecture in Cell Biology（細胞生物学特別講義）	R0713	2-I	Fri	2	1
Doctoral program	Special Lecture in Cell Biology（細胞生物学特別講義）	R0714				

Instructor(s)	Note
OKAMOTO Takashi SAKAI Takaomi	

(1) Course policies and topics	Molecular and cellular mechanisms of biological processes. This lecture will be taught by Prof. Takaomi Sakai (Part1), Prof. Takashi Okamoto (Part 2)
(2) Knowledge/skills to be acquired and learning objectives/course goals	【Part 1】 This lecture will provide opportunities to learn how to use genetics to understand mechanisms of complex biological processes, such as development, aging, cancer, learning and memory. 【Part 2】 In the later half, students will understand the reproductive and developmental aspects in plants. In addition to these basic aspects in plant sciences, applied usage the plant reproductive/developmental mechanisms will be also learned.
(3) Course schedule, subject matter, and classroom activities	【Part 1】 1. Associative learning and behavioral plasticity 2. Learning and memory in Drosophila 3. Molecullar and cellular mechanisms of Long-term memory 1 4. Molecullar and cellular mechanisms of Long-term memory 2 【Part 2】 ５：Fertilization in plants I (Self-incompatibility and pollen tube elongation) ６：Fertilization in plants II (Pollen tube guidance and gamete fusion) ７：Embryogenesis in plants (Zygotic activation and development) ８：Plant reproduction and breeding
(4) Outside-class activities and assignments	You should review the last lecture every week.
(5) Textbooks and course materials	Handouts will be distributed to students in classes.
(6) Assessment and grading	Presentation and discussion 30%, Quiz or Report submission 30%, Midterm and final examinations 40%.
(7) Questions to the instructor (Office hours, etc.)	Particular office hour is not allocated, but students can make appointments by e-mail.
(8) Special note	1. It is advisable to take “Cell Biology” at TMU before you take this course. 2. This lecture is for exchange students with some knowledge in cell biology and genetics. 3. If the lecture is conducted online, we will tell you the necessary information, such as the Zoom URL, via kibaco "Announcements".

Program	Course Name	Course Number	Semester	Day	Time	Credit Hours
Master's program	Special Lecture on Biological Sciences	R0725	1	Aug 18, 19	1-4	1
Doctoral program	Special Lecture on Biological Sciences	R0726				

Instructor(s)	Note
Florian Barton Reyda	

(1) Course policies and topics	Course title: Parasitology Lecturer: Florian Reyda Class Location: TBA Aug 18, 19, 21, & 22 (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, [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.
(2) Knowledge/skills to be acquired and learning objectives/course goals	[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: 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	<Tentative schedule> Monday Aug 18, 2025 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) Tuesday Aug 19, 2025 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 Wednesday Aug 20, 2025: (Optional) Optional field trip to Megro Parasitology museum Thursday Aug 21, 2025 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 Friday Aug 22, 2025 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 9pm Aug 22nd Japan time Wednesday Sep 10, 2025 The species writing assignment should be submitted to me via email, no later than 9pm, Sep 10th, 2025, Japan time.
(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, please contact Dr. Kanae Ando (k_ando@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. NOTE: This syllabus is subject to change at any time.

Program	Course Name	Course Number	Semester	Day	Time	Credit Hours
Master's program	Special Lecture on Biological Sciences	R0727	1	Aug 21, 22	1-4	1
Doctoral program	Special Lecture on Biological Sciences	R0728				

Instructor(s)	Note
Florian Barton Reyda	

(1) Course policies and topics	Course title: Parasitology Lecturer: Florian Reyda Class Location: TBA Aug 18, 19, 21, & 22 (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, [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.
(2) Knowledge/skills to be acquired and learning objectives/course goals	[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: 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	<Tentative schedule> Monday Aug 18, 2025 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) Tuesday Aug 19, 2025 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 Wednesday Aug 20, 2025: (Optional) Optional field trip to Megro Parasitology museum Thursday Aug 21, 2025 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 Friday Aug 22, 2025 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 9pm Aug 22nd Japan time Wednesday Sep 10, 2025 The species writing assignment should be submitted to me via email, no later than 9pm, Sep 10th, 2025, Japan time.
(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, please contact Dr. Kanae Ando (k_ando@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. NOTE: This syllabus is subject to change at any time.

Program	Course Name	Course Number	Semester	Day	Time	Credit Hours
Master's program	Special Lecture on Biological Sciences	R0719	1	Aug 28, 29	2-5	1
Doctoral program	Special Lecture on Biological Sciences	R0720				

Instructor(s)	Note
Diego Tavares Vasques	

(1) Course policies and topics	Course Title: Introduction to Plants Systematics and Taxonomy Instructor: Diego Tavares Vasques Dates: Aug 28 & Aug 29, 2, 3, 4 &5 periods 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. 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
(2) Knowledge/skills to be acquired and learning objectives/course goals	
(3) Course schedule, subject matter, and classroom activities	Schedule Day 1 Unit 1: Introductions, and Plants Systematics (2nd, 3rd period) - Course explanation - Concept of evolution in Biology - Introduction to plants' diversity - Evidences of Evolution - History and definition of Taxonomy and Systematics Unit 2: Herbaria (4th, 5th period) Practice 1: Herbaria construction (5th period) Groups division and projects decision/ planning 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 (2nd, 3rd period) - Introduction to some research on the field of plant systematics - Phylogenetic tree reconstruction Practice 2: Reading and Drawing Phylogenies (4th period) Groups presentation (5th period) 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. 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".
(4) Outside-class activities and assignments	Further instructions will be uploaded to https://dtvasques.wordpress.com/
(5) Textbooks and course materials	Required Textbook None - required reading will be provided by the professor. 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 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 more information, please contact Dr. Kanae Ando (k_ando@tmu.ac.jp).
(8) Special note	

Program	Course Name	Course Number	Semester	Day	Time	Credit Hours
Master's program	Special Lecture on Biological Sciences	R0357	1st semester-I	Wed	2	1
Doctoral program	Special Lecture on Biological Sciences	R0358				

Instructor(s)	Note
Junryo Watanabe	

(1) Course policies and topics	[Course Title] Neuroimmunology - Molecular and Cellular Interactions Between the Nervous and Immune Systems [Instructor] Junryo Watanabe [Class Period] Wed and Thu in April and May, 2nd period. *Please register both R0357 and R0367 to earn credits.
(2) Knowledge/skills to be acquired and learning objectives/course goals	[Course Objectives/Overview] The course explores the role of immune molecules in neural development, and the bi-directional mechanisms by which the brain and immune system communicate with each other in health and during injury or infection. Topics include: innate immunity in brain development, inflammation in neurodegenerative diseases, central nervous system infections, autoimmune diseases, and the immune system in psychiatric disorders. Emphasis will be placed on critically reading and evaluating primary literature, experimental design, and scientific writing. Keywords Neuroscience, immunology, neuroimmunology, autoimmune diseases 神経科学、免疫学、神経免疫学、自己免疫疾患 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. 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
(3) Course schedule, subject matter, and classroom activities	[Tentative Course Schedule] 04/09 (W) Welcome, syllabus, introduction to immunology, (lectures) Sompayrac Ch 1 04/10 (Th) Innate immune system, B cells and antibodies (lectures) Sompayrac Ch 2, 3 04/16 (W) antigen presentation, T cells and cytokines (lectures) Sompayrac Ch 4, 5 04/17 (Th) Lymphoid organs, tolerance induction (lectures) Sompayrac Ch 6, 8 04/23 (W) Immunopathology, blood-brain barrier (lectures) Sompayrac Ch 10 04/24 (Th) Immune molecules in the nervous system: MHC, complement Journal club papers 04/30 (W) Immune molecules in the nervous system: DSCAM, DSCAM II Journal club papers 05/01 (Th) Immune molecules in the nervous system: acetylcholine, TNF□ Journal club papers 05/07 (W) Immune system and injury to the nervous system: inflammation and neurogenesis, spinal cord injury Journal club papers 05/08 (Th) HIV – disease of the immune system, HIV and stem cell therapy Lecture & paper 05/14 (W) Diseases with neurological symptoms: HIV-associated dementia, malaria Journal club papers 05/15 (Th) Autoimmune diseases: Multiple Sclerosis and Epstein-Barr virus, Guillain-Barré syndrome Journal club papers 05/21 (W) Autoimmune diseases?: Narcolepsy, Autism Journal club papers 05/22 (Th) Autoimmune diseases?: Schizophrenia, Epilepsy Journal club papers 05/28 (W) Autoimmune diseases?: Sydenham's chorea, Parkinson's disease Journal club papers 05/29 (Th) Autoimmune diseases?: Alzheimer's disease, end of class Journal club papers On 04/16 you will choose a presentation partner as well as an article to present as a group and another to present by yourself.
(4) Outside-class activities and assignments	In order for all of us to have a meaningful discussion-based learning on neuroimmunology, we all must learn the fundamentals of immunology. The first part of class are going to be lecture-based. In order for you to get the most out of these lectures, you need to read the relevant chapters in the textbook before class.

(5) Textbooks and course materials	Textbooks • (Required) How the Immune System Works. L. Sompayrac. Blackwell Publishing. 4th Edition (2013) • (Optional) The Immune System. P. Parham. Gardland Science. 3rd Edition (2009). May come in handy in Med School, if that is your path. Chock full o' details should you want to delve deeper. Additional Materials Selections from other texts, reviews, and primary literature will be provided. Background research materials for group and individual presentations will be selected by you. (see below for details)
(6) Assessment and grading	[Assessment] Class participation – 40% Journal club presentations – 60%
(7) Questions to the instructor (Office hours, etc.)	[Office hour] Please email Dr. Kanae Ando (k_ando@tmu.ac.jp) or Dr. Watanabe (junryo.watanabe@oneonta.edu) for more questions.
(8) Special note	This course MUST be taken in conjunction with R0367. For more information, please contact Dr. Kanae Ando : k_ando@tmu.ac.jp

Program	Course Name	Course Number	Semester	Day	Time	Credit Hours
Master's program	Special Lecture on Biological Sciences	R0367	1st semester-I	Thu	2	1
Doctoral program	Special Lecture on Biological Sciences	R0368				

Instructor(s)	Note
Junryo Watanabe	

(1) Course policies and topics	[Course Title] Neuroimmunology - Molecular and Cellular Interactions Between the Nervous and Immune Systems [Instructor] Junryo Watanabe [Class Period] Wed and Thu in April and May, 2nd period. *Please register both R0357 and R0367 to earn credits.
(2) Knowledge/skills to be acquired and learning objectives/course goals	[Course Objectives/Overview] The course explores the role of immune molecules in neural development, and the bi-directional mechanisms by which the brain and immune system communicate with each other in health and during injury or infection. Topics include: innate immunity in brain development, inflammation in neurodegenerative diseases, central nervous system infections, autoimmune diseases, and the immune system in psychiatric disorders. Emphasis will be placed on critically reading and evaluating primary literature, experimental design, and scientific writing. Keywords Neuroscience, immunology, neuroimmunology, autoimmune diseases 神経科学、免疫学、神経免疫学、自己免疫疾患 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. 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
(3) Course schedule, subject matter, and classroom activities	[Tentative Course Schedule] 04/09 (W) Welcome, syllabus, introduction to immunology, (lectures) Sompayrac Ch 1 04/10 (Th) Innate immune system, B cells and antibodies (lectures) Sompayrac Ch 2, 3 04/16 (W) antigen presentation, T cells and cytokines (lectures) Sompayrac Ch 4, 5 04/17 (Th) Lymphoid organs, tolerance induction (lectures) Sompayrac Ch 6, 8 04/23 (W) Immunopathology, blood-brain barrier (lectures) Sompayrac Ch 10 04/24 (Th) Immune molecules in the nervous system: MHC, complement Journal club papers 04/30 (W) Immune molecules in the nervous system: DSCAM, DSCAM II Journal club papers 05/01 (Th) Immune molecules in the nervous system: acetylcholine, TNF□ Journal club papers 05/07 (W) Immune system and injury to the nervous system: inflammation and neurogenesis, spinal cord injury Journal club papers 05/08 (Th) HIV – disease of the immune system, HIV and stem cell therapy Lecture & paper 05/14 (W) Diseases with neurological symptoms: HIV-associated dementia, malaria Journal club papers 05/15 (Th) Autoimmune diseases: Multiple Sclerosis and Epstein-Barr virus, Guillain-Barré syndrome Journal club papers 05/21 (W) Autoimmune diseases?: Narcolepsy, Autism Journal club papers 05/22 (Th) Autoimmune diseases?: Schizophrenia, Epilepsy Journal club papers 05/28 (W) Autoimmune diseases?: Sydenham's chorea, Parkinson's disease Journal club papers 05/29 (Th) Autoimmune diseases?: Alzheimer's disease, end of class Journal club papers On 04/16 you will choose a presentation partner as well as an article to present as a group and another to present by yourself.
(4) Outside-class activities and assignments	In order for all of us to have a meaningful discussion-based learning on neuroimmunology, we all must learn the fundamentals of immunology. The first part of class are going to be lecture-based. In order for you to get the most out of these lectures, you need to read the relevant chapters in the textbook before class.

(5) Textbooks and course materials	Textbooks • (Required) How the Immune System Works. L. Sompayrac. Blackwell Publishing. 4th Edition (2013) • (Optional) The Immune System. P. Parham. Gardland Science. 3rd Edition (2009). May come in handy in Med School, if that is your path. Chock full o' details should you want to delve deeper. Additional Materials Selections from other texts, reviews, and primary literature will be provided. Background research materials for group and individual presentations will be selected by you. (see below for details)
(6) Assessment and grading	[Assessment] Class participation – 40% Journal club presentations – 60%
(7) Questions to the instructor (Office hours, etc.)	[Office hour] Please email Dr. Kanae Ando (k_ando@tmu.ac.jp) or Dr. Watanabe (junryo.watanabe@oneonta.edu) for more questions.
(8) Special note	This course MUST be taken in conjunction with R0367. For more information, please contact Dr. Kanae Ando : k_ando@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, so please contact your supervisor. Students should take the courses offered by their own laboratories.

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.

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. Ando (k_ando@tmu.ac.jp).
(8) Special note	Students must obtain permission from their academic advisors and the Educational Affairs Committee.

Program	Graduate School of Science Course Name	Course Number	Semester	Day	Time	Credit
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. Ando (k_ando@tmu.ac.jp).
(8) Special note	Students must obtain permission from their academic advisors and the Educational Affairs Committee.

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	Thr	6・7	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, so please contact your supervisor. It is expected that students will take the courses offered by their own laboratories.

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	Thr	6・7	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 how to read scientific papers in the biology and life sciences field. Students will learn how scientific papers are organized and determine what papers are worth reading. In addition, students present the paper they read, and ask questions and criticize the paper. Since the latest results and technology are included in the paper, the required knowledge in the life science field is acquired by repeating this process. Choose a paper suitable for each area of study.
(2) Knowledge/skills to be acquired and learning objectives/course goals	In graduate school, the latest knowledge is obtained from scientific papers. To obtain novel and advanced knowledge, it is necessary to select quality papers. It is essential to judge it since the description of the paper is not always correct. Therefore, the training which reads the paper critically and presents logically is accumulated. It is also imperative to ask questions about other students' presentations. The ability to read the paper is also crucial for advancing the research.
(3) Course schedule, subject matter, and classroom activities	Read scientific papers, learn scientific English words, the structure of scientific papers, and what kind of papers to read. Learn how to ask questions and criticize scientific papers. Obtain necessary knowledge from the latest articles.
(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.