Academic Year 2022

Graduate Program and Course Outlines

Graduate School of Science | Tokyo
Metropolitan University
Graduate School of Science and Engineering | Tokyo
Metropolitan University

2022 Academic Calendar

First Semester	Graduate School of Science orientation	Tue., April 5, 2022
	First day of the first semester and first I semester	Thu., April 7, 2022
	Orientation ceremony	Sun., April 10, 2022
	First-semester course registration (online) period	Thu., April 14–Thu., April 21, 2022
	Last day of the first-semester course registration (online) confirmation	5 p.m. Fri., April 25, 2022
	The final exam of the first I semester	Mon, May 30, 2022, Thu., June 2-Fri., June 3, 2022 Tue., June 7-Wed., June 8, 2022 (The first semester has regular classes in this period.)
	Start of the first II semester	Mon., June 6, 2022
	Deadline for doctoral degree application (for students who graduate in September)	Fri., June 10, 2022 (scheduled)
	Annual contest with Osaka Prefecture University	Sat., July 2–Sun., July 3, 2022
	Deadline for master's degree application (for students who graduate in September)	Fri., July 8, 2022 (scheduled)
	Annual physical exam	Mon., July 25, 2022-Fri., July 29, 2022
	The final exam of the first semester and the first I semester	Thu., July 28–Wed., August 3, 2022
	Summer recess	Wed., August 4–Fri., September 30, 2022
Second Semester	First day of the second semester	Mon., October 3, 2022
	Second-semester courses registration (online) period	To be announced on CAMPUSSQUARE and the bulletin board on the first floor of Building 8.
	College festival	Wed., November 2–Sun., November 6, 2022 (including preparation and cleanup)
	The final exam of the second I semester	Tue., November 22, 2022, Mon., November 28, 2022, Thu., December 1-Fri, December 2, 2022, Wed., December 7, 2022 (The second semester has regular classes in this period.)
	Start of the second II semester	Tue. November 29, 2022
	Deadline for doctoral degree application	Fri., December 9, 2022 (scheduled)
	Winter recess	Thu., December 29, 2022–Tue., January 3, 2023
	The first day after the winter recess	Wed., January 4, 2023
	Deadline for master's degree application	Fri., January 10, 2023 (scheduled)
	The national college entrance test	Fri., January 13–Sun., January 15, 2023 (incl. preparation)
	The final exam of the second semester	Mon., January 30–Fri., February 3, 2023 (The second II semester has regular classes in this period.)
	The final exam of the second and second II semesters	Mon., February 6-Fri., February 10, 2023
	Last day of the in-class lecture	Fri., February 10, 2023
	First day of the spring recess	Mon., February 13, 2023–
	Graduation ceremony	To be announced on CAMPUSSQUARE and the bulletin board on the first floor of Building 8.

* Please be sure to check the student portal CAMPUSSQUARE and the graduate program bulletin board on the first floor of Building 8 for updated

information on course registration and degree applications, as well as notifications and applications on intensive courses.

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Organization of the graduate school and basic rules of the courses
(Graduate School of Science & Graduate School of Science and Engineering | Tokyo Metropolitan University)

1. Objectives and Program Structure of the Graduate School

The Graduate School of Tokyo Metropolitan University aims to teach and research specialized academic theories and applications in technical fields of study from a broad perspective in order for students to gain deep knowledge and outstanding abilities to engage in professions that require a high level of expertise. It also aims to improve the lives of Tokyo citizens and develop the culture of Tokyo.

The graduate program is divided into two sections: the first two years (hereinafter referred to as the "master's program") and the next three years (hereinafter the "doctoral program"). The first part of the graduate program is considered to be a master's program.

The master's program aims to enable students to gain deep knowledge and advanced skills to engage in professions that require research skills or a high level of expertise in the field of study from a broad perspective.

The doctoral program aims to enable students to acquire advanced research skills and profound academic knowledge that are the foundations for conducting independent research activities as researchers or engaging in other highly specialized work in their field of study.

2. Educational and research objectives of the graduate program

Educational and research objectives of the Graduate School of Science

The master's program of Graduate School of Science aims to enable students to gain a wide range of knowledge, concepts, and methods in natural science as well as developing research skills and flexible problem-solving and presentation skills. It also aims to train students to become researchers, educators, and engineers with an international perspective, creativity, and applicable skills.

The doctoral program of the Graduate School of Science aims to enable students to gain advanced knowledge, concepts, and methods in natural science as well as developing independent research skills and the ability to explore and discover mid- to long-term projects and issues. It also aims to train students to become researchers, educators, and engineers with international leadership, outstanding creativity, and applicable skills.

Educational and research objectives of the Graduate School of Science and Engineering

The master's program of Graduate School of Science and Engineering aims to enable students to gain a wide range of knowledge, concepts, and methods in natural science and science and technology as well as developing research skills and flexible problem-solving and presentation skills. It also aims to train students to become researchers, educators, and engineers with an international perspective, creativity, and applicable skills.

The doctoral program of the Graduate School of Science and Engineering aims to enable students to gain advanced knowledge, concepts, and methods in natural science and science and technology as well as developing independent research skills and the ability to explore and discover mid- to long-term projects and issues. It also aims to train students to become researchers, educators, and engineers with international leadership, outstanding creativity, and applicable skills.

3. Structure of the Graduate School

The Graduate School of Science consists of the following majors: (Enrolled in school in 2018 or later)

Master's program	Mathematical Sciences	Doctoral program	Mathematical Sciences
	Physics		Physics
	Chemistry		Chemistry
	Biological Sciences		Biological Sciences

The Graduate School of Science and Engineering consists of the following majors: (Enrolled in school in 2017 or earlier)

Master's program	Mathematics and Information Sciences	Doctoral program	Mathematics and Information Sciences
	Physics		Physics
	Molecular Materials Chemistry		Molecular Materials Chemistry
	Biological Sciences		Biological Sciences
	Electrical and Electronic Engineering		Electrical and Electronic Engineering
	Mechanical Engineering		Mechanical Engineering

4. Educational and research objectives of the Graduate School of Science

Mathematical Sciences

The Department of Mathematical Sciences aims to develop competent individuals with advanced knowledge of mathematics and applied mathematics as well as flexible and original mathematical and scientific thinking skills. It also aims to develop those who can solve various issues in natural science and modern information society while being aware of the importance of mathematical science as a foundation of science.

Upon completing the master's program, students will acquire:

(1) Advanced technical knowledge in mathematical sciences and flexible mathematical thinking skills
(2) The ability to initiate projects and conduct research in a systematic manner independently or under the guidance of the graduate advisor
(3) The ability to clearly express the research findings and the ability to discuss with other researchers Upon completing the doctoral program, students will acquire:
(1) Advanced technical knowledge in mathematical sciences and flexible and original mathematical thinking skills
(2) The ability to conduct original research activities as independent researchers with an international perspective
(3) The ability to objectively evaluate the significance of their own research and its position in society

Physics

The Department of Physics aims to develop individuals with advanced knowledge and research skills in physics covering the natural world extensively, including elementary particles, substances with various structures, and the universe. It also aims to develop competent individuals who can lead the next generation of advanced science and solve various social and environmental issues based on science.

The master's program aims to develop researchers, professional engineers, and educators specializing in physics as a basis for science and technology, who have basic knowledge in physics and a global perspective and interact with other natural science fields. In order to achieve these objectives, students will acquire:

(1) The basic knowledge necessary for conducting research in physics as well as logical thinking and practical research methods.
(2) The ability to initiate research projects in each field of physics, solve problems, and conduct research individually or under the graduate advisor's guidance, as well as the ability to write logically organized papers and present the research findings.
(3) The ability to discuss with other researchers and the ability to present research findings from a broad perspective.

The doctoral program aims to develop individuals to beindependent researchers and research supervisors who can conduct leading research activities in the global arena. The students will develop broad insights into fundamental and applied physics while having the social responsibilities associated with research in mind. The students will acquire:

(1) The extensive knowledge, logical thinking, and practical research methods necessary to identify advanced and important research projects in physics.

(2) The ability to initiate unique research projects in each field of physics, plan and conduct research, and develop the ability to deliver adequate research findings, write the original papers, and publish them in international journals.
(3) The ability to conduct research projects as an independent researcher, engage in international research discussions, and widely present the findings and significance of the research, and associate the research projects with society.

Chemistry

Chemistry is the essential study of natural science that we explore to understand nature at the atomic and molecular levels and the properties and changes of matter. In recent years, chemistry has been significantly integrated with other fields of natural science, ranging from the development of materials such as electronic devices to space, life, and environmental issues. The Department of Chemistry aims to develop chemical researchers, engineers, and educators with extensive knowledge and understanding of chemistry, and a high level of expertise and the ability to make judgments in a broad and comprehensive manner beyond their specialties.

The master's program aims to develop a wide range of basic academic skills in chemistry and the ability to independently initiate research projects, organize the findings in papers, and present them at academic conferences, etc. Students will also develop the ability to perceive issues from a broad perspective and acquire the basic skills for research and providing guidance on technological and educational issues in their specialized fields. Through this program, students will acquire:

(1) The basic knowledge necessary for conducting research in chemistry as well as logical thinking and practical research methods.
(2) The ability to initiate research projects in each field of chemistry, solve problems, and conduct research individually or under the graduate advisor's guidance, as well as the ability to write logically organized papers and present the research findings.
(3) The ability to discuss with other researchers and the ability to present research findings from a broad perspective.

The doctoral program aims to develop individuals who can independently identify and develop research projects from a broad perspective and organize the findings in papers at the international level. The program is also designed to develop individuals who can play active roles in international settings, presenting the research findings at international conferences and providing technical and educational guidance from a broad perspective. The students will acquire:

(1) The extensive knowledge, logical thinking, and practical research methods necessary to identify advanced and important research projects in chemistry.
(2) The ability to initiate unique research projects in each field of chemistry, plan and conduct research, and develop the ability to deliver adequate research findings, write the original papers, and publish them in international journals.
(3) The ability to conduct research projects as an independent researcher, engage in international research discussions, and widely present the findings and significance of the research, and associate the research projects with society.

Biological Sciences

The Department of Biological Sciences aims to develop graduate students with creative research skills, actively engaging in new projects through biological sciences.

The master's program aims to develop the basic skills to set objectives and methods and identify problems independently to understand the basic mechanisms of the growth of organisms, higher-order structures, behavior, and ecology. The program also aims to train students to become researchers, educators, and developers with global perspectives and communication skills to play active roles in Japan and in the international arena.

The doctoral program aims to develop the basic and applicable skills to set objectives and methods and identify problems independently to understand the basic mechanisms of the growth of organisms, higher-order structures, behavior, and ecology. The program also aims to train students to become researchers, educators, and developers with global perspectives and communication skills to play active roles as leaders in Japan and in the international arena.

5. Educational and research objectives of the Graduate School of Science and Engineering

Mathematics and Information Sciences

The Department of Mathematical and Information Sciences aims to develop researchers with outstanding creativity that are highly skilled in fundamental mathematics and information sciences, who are keen to challenge other fields and disciplines, and who can respond to the needs of society. The program is designed to develop individuals who can master the core curriculum of advanced topics in algebra, geometry, and information sciences and conduct integrated research on these topics. The program also aims to develop individuals who can take on the immediate needs of modern society, according to the nature of mathematics as the foundation of various disciplines such as natural sciences.

The master's program provides a curriculum that is in line with the vision of the department, and the students will acquire:

(1) A broad understanding and expertise in mathematics and information sciences.
(2) The ability to gain knowledge from a global perspective.
(3) The ability to systematically develop learning strategies and integrate related issues to solve an issue.

The doctoral program provides a curriculum based on the knowledge gained in the master's program to help students achieve goals. The students will acquire:

(1) A deep and broad understanding and expertise in mathematics and information sciences research.
(2) The ability to conduct innovative and advanced research and to carry out international research activities as an independent researcher in mathematical and information science.
(3) The ability to objectively evaluate the significance of their research and its position in society.

Physics

The Department of Physics aims to develop individuals with advanced knowledge and research skills in physics covering the natural world extensively, including elementary particles, substances with various structures, and the universe. It also aims to develop competent individuals who can lead the next generation of advanced science and solve various social and environmental issues based on science.

The master's program aims to develop researchers, professional engineers, and educators specializing in physics as a basis for science and technology, who have basic knowledge in physics and a global perspective and interact with other natural science fields. In order to achieve these objectives, students will acquire:

(1) The basic knowledge necessary for conducting research in physics as well as logical thinking and practical research methods.
(2) The ability to initiate research projects in each field of physics, solve problems, and conduct research individually or under the graduate advisor's guidance, as well as the ability to write logically organized papers and present the research findings.
(3) The ability to discuss with other researchers and the ability to present research findings from a broad perspective.

The doctoral program aims to develop individuals to beindependent researchers and research supervisors who can conduct leading research activities in the global arena. The students will develop broad insights into fundamental and applied physics while having the social responsibilities associated with research in mind. The students will acquire:

(1) The extensive knowledge, logical thinking, and practical research methods necessary to identify advanced and important research projects in physics.
(2) The ability to initiate unique research projects in each field of physics, plan and conduct research, and develop the ability to deliver adequate research findings, write the original papers, and publish them in international journals.
(3) The ability to conduct research projects as an independent researcher, engage in international research discussions, and widely present the findings and significance of the research, and associate the research projects with society.

Molecular Materials Chemistry

Chemistry is the essential study of natural science that we explore to understand nature at the atomic and molecular levels and the properties and changes of matter. In recent years, chemistry has been significantly integrated with other fields of natural science, ranging from conventional organic, inorganic, and biological materials to materials related to the ocean, atmospheric environment, and space. The Department of Molecular Materials Chemistry aims to train students to become professionals with extensive knowledge and understanding of chemistry as well as enabling them to have deep expertise and become successful in the international community.

The master's program aims to develop a wide range of basic academic skills in chemistry and the ability to independently initiate research projects, organize the findings in papers, and present them at academic conferences, etc. Students will also develop the ability to perceive issues from a broad perspective and acquire the basic skills for research and providing guidance on technological and educational issues in their specialized fields.

The doctoral program aims to develop individuals who can uniquely identify and develop research projects from a broad perspective, organize the findings in papers at the international level, and present them at international conferences. The program is also designed to develop leaders who can conduct research and provide technical and educational guidance on various issues in their specialized fields from a global perspective based on their research experience while continuing to develop their skills.

Biological Sciences

The Department of Biological Sciences aims to develop creative researchers who can plan and evaluate in various biological sciences and biology fields. The goals are set for students for each course, and the education and research organizations will provide support for students to achieve their goals. The program covers various fields from micro to macro, microorganisms to higher plants and animals.

The master's program is designed to develop researchers, educators, planners and developers, and business managers in the fields of biological science and biology with a global perspective, creativity, and applicable skills. In order to achieve these objectives, students will acquire:

(1) Extensive knowledge, ways of thinking, and practical methods necessary to conduct research in basic biological sciences and biology, as well as more specialized knowledge, ways of thinking, and practical research methods related to their chosen research topics.

(2) Basic research skills in each field of biological science and biology through initiating new research projects or applied or educational research projects independently or under the graduate advisor's guidance as well as writing papers and presenting the research findings.

(3) Writing and communication skills in English necessary to conduct research and work on the international stage, and the ability to present the research findings to a wide range of audiences.

The doctoral program is designed to develop researchers, educators, planners and developers, and business managers in the fields of biological science and biology with global leadership, exceptional creativity, and applicable skills. In order to achieve these objectives, students will acquire:

(1) Extensive knowledge, ways of thinking, and practical research methods necessary to develop the skills to explore and discover advanced and important topics in basic biological science and biological research.

(2) Independent research skills in each field of basic biological science and biology through initiating new research projects or applied or educational research projects independently, as well as delivering satisfactory research findings and publishing them as original papers in English.

(3) Advanced communication skills in English, which are essential for leading research in the international arena, and the presentation skills to convey the results and significance of research to a broad audience.

Electrical and Electronic Engineering

The Department of Electrical and Electronic Engineering has a unique curriculum and instruction method for students to acquire advanced specialized knowledge in the field and develop the ability to discover and solve problems.

In the master's program, the students will acquire:

(1) A deep understanding of the fundamentals and latest studies, know-how, and techniques in the field of electrical and electronic engineering.
(2) Engineering knowledge, applicable skills, and creativity that can help contribute to the new development of the industry and society.
(3) A sense of value and mission to make engineering contributions considering the impact of technological development on the sustainable society and the environment, rather than focusing solely on producing results.
(4) Skills to continuously fulfill their various responsibilities with a high level of scientific and technological ethics.

In the master's program, the students will acquire:

(1) A deep understanding of the fundamentals and latest studies, know-how, and techniques in the field of electrical and electronic engineering and related fields.
(2) Engineering knowledge, applicable skills, creativity, and a comprehensive perspective to explore unknown technologies and engineering fields that can lead to new developments and technological innovations in the industry and society.
(3) A sense of value and mission to make comprehensive engineering contributions considering the impact of technological development on the sustainable society and the environment,rather than focusing solely on producing results.
(4) Leadership skills with a high level of scientific and technological ethics to fulfill various responsibilities.

Mechanical Engineering

The field of mechanical engineering has a demand for high-level engineers and creative researchers with flexible thinking who can provide foreknowledge in various manufacturing and advanced technology fields, considering all artificial objects are mechanical. With the social demands, the Department of Mechanical Engineering aims to develop mechanical engineers and researchers specializing in research and development who can materialize their ideas and have skills in manufacturing gained through practical academic training.

The master's program provides a curriculum that helps students achieve academic goals. The students will acquire:

(1) The ability to gain a wide range of interdisciplinary knowledge and information and think and develop independently and organically to solve given problems based on the solid fundamental understanding of mechanical engineering.
(2) Basic research skills by initiating research projects independently or under the graduate advisor's guidance, writing papers, and presenting the research findings regarding "basic research to form the basis of mechanical engineering" or "applied research to contribute to advancing the mechanical industry."
(3) A broad range of communication skills with a global perspective by taking part in joint and collaborative research and development with various private companies and public research institutions and through research activities at overseas universities and international conferences.

The doctoral program provides a curriculum to help students achieve academic goals. The students will acquire:

(1) The ability to gain a wide range of interdisciplinary knowledge and information and think and develop independently and organically to identify and solve the latest problems based on the solid fundamental understanding of mechanical engineering.
(2) Research skills by initiating research projects independently on "basic research to form the basis of mechanical engineering" or "applied research to contribute to advancing the mechanical industry." Students are also expected to deliver satisfactory research results and publish them as original papers in English.
(3) International leadership and a broad range of communication skills necessary for leaders in research and development organizations. The students acquire the skills by actively initiating joint and collaborative research and development with private companies and public research institutions and through research activities at overseas universities and international conferences and publishing original academic papers in English.

6. Certification of the program completion

Master's program

In order to complete the master's program, students must complete the two-year enrollment period by attending regular classes, acquiring 30 or more credits of required courses in the master's program, submitting a thesis, and taking the final examination. In this case, if the graduate advisor considers it academically beneficial, up to 10 credits out of the 30 credits may be used as required credits by taking the following courses as prescribed by the graduate school:

- Non-major courses in the graduate program,
- Major courses in other graduate programs, or
- Undergraduate courses

(Collectively referred to as "non-major courses that can fulfill the major's requirements.")

As for the enrollment period for those who are recognized as delivering excellent research results, enrollment in the master's program for one year or more satisfies the requirement. (referred to as "completion with a shortened period of enrollment").

Doctoral program

In order to complete the doctoral program, the students must complete the three-year enrollment period by attending regular classes, acquiring 20 or more credits in the required courses in the doctoral program, submitting a dissertation, and taking the final examination.

As for the enrollment period for those who are recognized as delivering exceptional research results, enrollment in the doctoral program for one year or more shall satisfy the requirement. However, for those who have completed the master's program with one-year enrollment, two-year enrollment satisfies the completion requirement of the doctoral program. (referred to as "completion with a shortened period of enrollment").

7. Years of the enrollment period

The regular enrollment period for the master's program shall be two years, and the regular enrollment period for the doctoral program shall be three years.

The enrollment period in the master's program shall not exceed four years, and the enrollment period in the doctoral program shall not exceed six years. However, when exceptionally approved by the Graduate Faculty Committee under particular circumstances, the student may stay enrolled beyond the regular enrollment period.

8. The long-term enrollment system

Students who need to plan the enrollment for a certain period beyond the regular enrollment period stated in section 7 above under certain circumstances (employment, childbirth, childcare, nursing care, etc.) may apply for long-term enrollment to be reviewed by the Graduate Faculty Committee. The period for long-term enrollment is either 3 or 4 years for the master's program and 4, 5, or 6 years for the doctoral program from the first day of the enrollment. In this case, tuition fees will be calculated by dividing the total tuition fees for the regular enrollment period by the number of admitted years for the long-term enrollment, which will be due from the following term. The application for current students will be accepted during the first year of the master's program and during the first and second year of the doctoral program. The details of the application period, qualifications, and application form will be announced separately.

9. Degrees

In order to complete the master's programs or doctoral program and obtain respective degrees, students must earn the required credits for accredited courses as described in section 6 above and pass the thesis examination and the final examination.

10. Courses and credits in the Graduate School of Science and Graduate School of Science and Engineering

Refer to the list of general courses and courses for each department

11. Credit acceptance and grades on academic achievement

Credit for courses shall be granted based on written or oral examinations or research reports and shall be awarded at the end of each semester or academic year. As a general rule, grading of academic achievement is based on a five-point grade scale, with the top four grades passing.

Grade	Transcript	Credit	Description
5	Outstanding	○	Outstanding
4	Excellent	○	Excellent
3	Good	○	Average
2	Satisfactory	○	Below average
1	(Hidden)	×	Unsatisfactory
0	(Hidden)	×	Incomplete (Not graded)

12. Course enrollment

(1) After admission to the graduate school, each student shall be assigned a professor (hereinafter referred to as a "graduate/doctoral advisor") who will provide guidance to the student.
(2) At the beginning of each academic year, students shall apply to attend courses for the academic year according to the instruction and need to be admitted for the course enrollment.
(3) Students shall receive guidance from their respective graduate/doctoral advisors on selecting courses, writing theses, and conducting research.
(4) When the graduate/doctoral advisor deems it necessary, the student may take specified courses. (However, non-major courses within the graduate program, major courses of other graduate programs, or undergraduate courses (collectively referred to as "non-major courses that can fulfill the major's requirements (will not be counted toward the credits required for course completion. Only "non-major courses that can fulfill the major's requirements" will be counted toward the credits required for course completion)

The approval of the Graduate Faculty Committee or Graduate Academic Affairs Committee is required for one of the following two cases:

(1) When the student takes "non-major courses that can fulfill the major's requirements."
(2) When a student becomes a non-degree student to take undergraduate courses required for teacher certification or curator qualification.

The procedures and schedule for course registration for the 2022 academic year are as follows:

- In general, students apply for courses through the student portal site by logging in. (https://jjh.tmu.ac.jp/)
- Students of **the Graduate School of Science**: Select courses with **5-digit** course numbers starting with "R"
- Students of **the Graduate School of Science and Engineering**: Select courses with **4-digit** course numbers starting with "R"
- For non-major courses that can fulfill the major's requirements, students can apply only the courses approved by the Graduate Faculty Committee or Graduate Academic Affairs Committee.

The course registration schedules are as follows:

- Courses offered throughout the year and regular and intensive courses in the first semester
  Registration period : April 14, 2022–April 21, 2022
  Course confirmation/change deadline : 5 p.m., April 25, 2022

- The registration schedule for regular and intensive courses offered in the second semester will be posted on the student portal CAMPUSSQUARE and the bulletin board on the first floor of Building 8 when available.
- Intensive courses that start in the middle of the year will be posted on the student portal CAMPUSSQUARE and the bulletin board on the first floor of Building 8. Students can register for courses at the Academic Affairs Division of the Faculty of Science by one week before the first day of the class in principle.

13. Questions about grades

Students may contact the Academic Affairs Division of the Faculty of Science for any questions about the course grades in the Graduate School of Science or the Graduate School of Science and Engineering within one week after the grades become available.

14. Academic leave of absence, return to school, withdrawal, and removal

Leave of absence

(1) When the student cannot attend courses for six months or more due to illness or other reasons, the student may apply for a leave of absence to the provost.
(2) A medical leave of absence application must be accompanied by the medical record from the doctor.
(3) A leave of absence cannot exceed one year. However, in the case of special circumstances, an extension of leave of absence may be granted up to one year.
(4) The leave of absence cannot exceed the three years in total for each program.
(5) The period of absence is not counted toward the required years of enrollment.
(6) The period of absence is not counted toward the period of enrollment.
(7) The student needs to repeat the grade in principal after the leave of absence. However, the student will move up to the next grade if the following requirements are met.

Academic year	1st year	2nd year*
Enrollment period	12 months or more	24 months or more

* Applicable to the doctoral program only

Return to school

When the leave of absence period ends or the student no longer needs to take a leave of absence, the student may apply for permission to return to school to the provost.

Withdrawal

(1) In order to withdraw from the school, the student must submit the form with a guarantor's signature to the provost to obtain permission.
(2) If a student has exceeded the allowed enrollment period or is unable to return to school after a leave of absence, the provost shall advise the student to withdraw from school based on the Faculty Committee's decision.

Expulsion

If a student fails to pay tuition even after the reminder, the provost shall expel the student from school based on the Faculty Committee's decision.

Payment of tuition

(1) Tuition during the leave of absence will be waived. However, if the leave of absence or return of school starts in the middle of the first or second semester, the student is obliged to pay the tuition for the entire semester.
(2) If a student is allowed to leave school or advised to withdraw or be expelled from school, the student is obliged to pay the tuition for the entire semester.

Others

In general, the request for a leave of absence, return to school, or withdrawal from school must be submitted to the Academic Affairs no later than one month before the date of the leave, return, or withdrawal.

15. Research guidance at other graduate schools or research institutes, etc.

If the provost finds that it is academically beneficial for the student, the student may be allowed to receive research guidance at another graduate school or research institute, etc., after having the Graduate Faculty Committee's approval and an agreement or discussion with the other graduate school or institution. (For more information, consult with your graduate/doctoral advisor or the Academic Affairs Division of the Faculty of Science)

16. Courses for teacher certification

In principle, each student must complete at least 24 credits of the major-specific courses (excluding general courses for all majors) Each major has different requirements of courses that can be counted for 24 credits. Therefore, each student shall consult with the Academic Affairs Division of the Faculty of Science for confirmation. Note that non-major courses that can fulfill the major's requirements and related courses cannot be counted toward the credits for this purpose.

17. General Courses for All Graduate Programs (Graduate School Career Courses)

These courses are offered by the University Education Center for the purpose of career development of graduate students and is available for all graduate students (master's and doctoral programs).

However, credits from these courses cannot be counted as required credits for program completion.

For course descriptions, see this document and the course syllabi.

18. Approval of previously earned credits

Students who have completed or dropped out of other graduate schools, or who have earned credits as a non-degree student, and who are newly admitted to the first year after passing the entrance examination for the Graduate School of Science of TMU, may be granted up to 10 credits in total if the credits they have earned are educationally beneficial and their academic ability is deemed adequate.

Students who wish to receive credits from TMU for the credits that they already earned elsewhere must apply to the Academic Affairs Division of the Faculty of Science and submit the necessary documents within one month of enrollment.

Graduate School of Science & Graduate School of Science and Engineering | Tokyo Metropolitan University
Course Catalog

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 student portal CAMPUSSQUARE and the bulletin board on the first floor of Building 8 when available.

△: The course is not offered in 2022.

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

[Graduate School of Science and Engineering]

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 Molecular Materials 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 the respective courses provide different subject matter.

- Special Lecture on Science and Engineering I
- Special Lecture on Science and Engineering II
- Selected Topics in Physics and Chemistry I
- Selected Topics in Physics and Chemistry II

2022 Graduate School Course Catalog
(General courses of the Graduate School of Science) (General courses of the Graduate School of Science and Engineering)

* M = master's courses, D = doctoral courses
* NA 2022 = Courses not offered in the academic year 2022

Course outline	M	D	NA 2022	Semester	Day of the week	Time	Course Number		Course Name	Units	Instructor(s)	Note (enrollment requirements, subject matter, etc.)
							Graduate School of Science	Graduate School of Science and Engineering				
1	○	○		Summer intensive course			M(R0005) D (R0006)	M(R005) D (R006)	Radiation Experiment Ⅰ	2	(Chemistry) Shiro Kubuki * Part-time	For all majors. Not allowed to retake this course for both as a general course and a major course
2	○	○		Summer intensive course			M(R0007) D (R0008)	M(R007) D (R008)	Radiation Experiment ⅠⅠ	1	(Chemistry) Shiro Kubuki	For all majors. Not allowed to retake this course for both as a general course and a major course

1

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	Radiation Experiment I	R005	Radiation Experiment I	R005	Summer intensive course	—	—	2
Doctoral program	Radiation Experiment I	R006	Radiation Experiment I	R006				

Instructor(s)	Note
Shiro Kubuki	For all majors. Not allowed to retake this course as a general course and a major course

(1) Course policies and topics	This subject fosters 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.

2

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	Radiation Experiment II	R007	Radiation Experiment II	R007	Summer intensive course	—	—	1
Doctoral program	Radiation Experiment II	R008	Radiation Experiment II	R008				

Instructor(s)	Note
Shiro Kubuki	For all majors. Not allowed to retake this course as a general course and a major course

(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 again.

Mathematical Sciences / Mathematics and Information Sciences
(Graduate School of Science & Graduate School of Science and Engineering)

Notes on course enrollment

[Mathematical Sciences]

(Master's program)

1. Exercises in Mathematical Sciences is a required course for the master's program in the Graduate School of Science.
2. Seminar in Mathematical Sciences is a required course for the master's program in the Graduate School of Science.
   The first-year students should take the course first.
3. As for the courses marked with an asterisk (*) in the graduate school course catalog (for Mathematical Sciences of the Graduate School of Science), students may retake the same course if the respective courses provide different subject matter.

(Doctoral program)

1. Advanced Seminar in Mathematical Sciences is a required course for the doctoral program in the Graduate School of Science.
   The first-year students should take the course first.
2. As for the courses marked with an asterisk (*) in the graduate school course catalog (for Mathematical Sciences of the Graduate School of Science), students may retake the same course if the respective courses provide different subject matter.

[Mathematics and Information Sciences]

(Doctoral program)

1. Advanced Seminar in Mathematical and Information Sciences is a required course for the doctoral program in the Graduate School of Science and Engineering.
   The first-year students should take the course first.
2. As for the courses marked with an asterisk (*) in the graduate school course catalog (for Mathematical and Information Sciences of the Graduate School of Science and Engineering), students may retake the same course if respective courses provide different subject matter.

Course outline	M	D	NA 2022	Semester	Day	Time	[Graduate School of Science]		[Graduate School of Science and Engineering]		Credit Hours	Instructor(s)	Note (enrollment requirements, subject matter, etc.)
							Course Number	Course Name	Course Number	Course Name			
1	○			First Semester	Fri.	2	M(R0011)	* Special Lectures in Algebra (1)			2	Hokuto Uehara	
2	○			First Semester	Tue.	2	M(R0012)	* Special Lectures in Algebra (2)			2	Shigeru Kuroda	
3	○			Second Semester	Fri.	5	M(R0013)	* Special Lectures in Algebra (3)			2	Hiroo Tokunaga	
4	○			First Semester	Tue.	3	M(R0014)	* Special Lectures in Geometry (1)			2	Masanori Kobayashi	Manabu Akaho
5	○			Second Semester	Wed.	3	M(R0015)	* Special Lectures in Geometry (2)			2	Asuka Takasu	
6	○			Second Semester	Tue.	2	M(R0016)	* Special Lectures in Geometry (3)			2	Tomohiro Fukaya	
7	○			First Semester	Mon.	2	M(R0017)	* Special Lectures in Analysis (1)			2	Kazushi Yoshitomi	Kazuhiro Kurata
8	○			First Semester	Mon.	4	M(R0018)	* Special Lectures in Analysis (2)			2	Kensuke Ishitani	
9	○			Second Semester	Mon.	2	M(R0019)	* Special Lectures in Analysis (3)			2	Kazuhiro Kurata	
10	○			First Semester	Tue.	5	M(R0020)	* Special Lectures in Applied Mathematics (1)			2	Toshio Suzuki	
11	○			Second Semester	Tue.	3	M(R0021)	* Special Lectures in Applied Mathematics (2)			2	Yukihiro Uchida	
12	○			Second Semester	Thu.	2	M(R0022)	* Special Lectures in Applied Mathematics (3)			2	Shun'ichi Yokoyama	
13	○	(○)		First Semester	Fri.	5	M(R0023)	* Advanced Topics in Algebra 1			1	Hiroo Tokunaga	
14	○	(○)		First Semester	Tue.	4	M(R0095)	* Advanced Topics in Algebra 2			2	Hokuto Uehara	Takeshi Kawasaki
15	○	(○)		Second Semester	Mon.	5	M(R0025)	* Advanced Topics in Geometry 1			1	Manabu Akaho	
16	○	(○)		First Semester	Thu.	3	M(R0027)	* Advanced Topics in Geometry 2			2	Tomoyuki Hisamoto	
	○	(○)	△		.		M(R0029)	* Advanced Topics in Analysis 1			1		
17	○	(○)		Second Semester	Wed.	4	M(R0031)	* Advanced Topics in Analysis 2			2	Masahiko Simojo	
18	○	(○)		Second Semester	Fri.	4	M(R0049)	* Advanced Topics in Applied Mathematics 1			1	Toshio Suzuki	
19	○	(○)		Second Semester	Fri.	2	M(R0051)	* Advanced Topics in Applied Mathematics 2			2	Shigenori Uchiyama	
	○	(○)		Intensive course				* Intensive Lectures in Algebra 1			1		
	○	(○)		Intensive course				* Intensive Lectures in Algebra 2			2		
	○	(○)		Intensive course				* Intensive Lectures in Geometry 1			1		
	○	(○)		Intensive course				* Intensive Lectures in Geometry 2			2		
	○	(○)		Intensive course				* Intensive Lectures in Analysis 1			1		
	○	(○)		Intensive course				* Intensive Lectures in Analysis 2			2		
	○	(○)		Intensive course				* Intensive Lectures in Applied Mathematics 1			1		
	○	(○)		Intensive course				* Intensive Lectures in Applied Mathematics 2			2		
	○	(○)		Intensive course				* Intensive Lectures in Mathematical Sciences 1			1		
	○	(○)		Intensive course				* Intensive Lectures in Mathematical Sciences 2			2		
20	○	(○)		First Semester	Wed.	3	M(R0033)	- Exercises in Mathematical Sciences			1	Takashi Sakai	Searching and collecting information on mathematics
21	○			First Semester	Intensive course		M(R0034)	- Seminar in Mathematical Sciences 1			3	Multiple instructors	
21	○			Second Semester	Intensive course		M(R0035)	- Seminar in Mathematical Sciences 2			3	Multiple instructors	
21	○			First Semester	Intensive course		M(R0036)	- Seminar in Mathematical Sciences 3			3	Multiple instructors	
21	○			Second Semester	Intensive course		M(R0037)	- Seminar in Mathematical Sciences 4			3	Multiple instructors	
23	○			Intensive course			M (R0045) 1 unit M (R0047) 2 units	* Internship in Mathematical Sciences			1 or 2	Multiple instructors	
13	(○)	○		First Semester	Fri.	5	D (R0024)	* Advanced Topics in Algebra 1	D (R028)	* Advanced Topics in Geometry 1	1	Hiroo Tokunaga	
14	(○)	○		First Semester	Tue.	4	D (R0096)	* Advanced Topics in Algebra 2	D (R096)	* Advanced Topics in Geometry 2	2	Takeshi Kawasaki	
15	(○)	○		Second Semester	Mon.	5	D (R0026)	* Advanced Topics in Geometry 1	D (R056)	* Advanced Topics in Geometry 1	1	Manabu Akaho	
16	(○)	○		First Semester	Thu.	3	D (R0028)	* Advanced Topics in Geometry 2	D (R026)	* Advanced Topics in Geometry 2	2	Tomoyuki Hisamoto	
	(○)	○	△				D (R0030)	* Advanced Topics in Analysis 1	D (R024)	* Advanced Topics in Algebra 1	1		
17	(○)	○		Second Semester	Wed.	4	D (R0032)	* Advanced Topics in Analysis 2	D (R030)	* Advanced Topics in Algebra 2	2	Masahiko Simojo	
18	(○)	○		Second Semester	Fri.	4	D (R0050)	* Advanced Topics in Applied Mathematics 1	D (R060)	* Advanced Topics in Information Sciences 1	1	Toshio Suzuki	
19	(○)	○		Second Semester	Mon.	3	D (R0052)	* Advanced Topics in Applied Mathematics 2	D (R032)	* Advanced Topics in Information Sciences 2	2	Shigenori Uchiyama	
	(○)	○		Intensive course				* Intensive Lectures in Algebra 1		* Advanced Topics in Geometry 1	1		

Course outline	M	D	NA 2022	Semester	Day	Time	[Graduate School of Science]		[Graduate School of Science and Engineering]		Credit Hours	Instructor(s)	Note (enrollment requirements, subject matter, etc.)
							Course Number	Course Name	Course Number	Course Name			
	(○)	○		Intensive course				* Intensive Lectures in Algebra 2		* Advanced Topics in Algebra 2	2		
	(○)	○		Intensive course				* Intensive Lectures in Geometry 1		* Advanced Topics in Geometry 1	1		
	(○)	○		Intensive course				* Intensive Lectures in Geometry 2		* Advanced Topics in Geometry 2	2		
	(○)	○		Intensive course				* Intensive Lectures in Analysis 1		* Advanced Topics in Algebra 1	1		
	(○)	○		Intensive course				* Intensive Lectures in Analysis 2		* Advanced Topics in Algebra 2	2		
	(○)	○		Intensive course				* Intensive Lectures in Applied Mathematics 1		* Advanced Topics in Information Sciences 1	1		
	(○)	○		Intensive course				* Intensive Lectures in Applied Mathematics 2		* Advanced Topics in Information Sciences 2	2		
20		○		First Semester	Wed.	3	D (R0038)	Special Exercises in Mathematical Sciences	D (R038)	Special Exercises in Mathematics and Information Sciences	1	Takashi Sakai	Searching and collecting information on mathematics
22		○		First Semester	Intensive course		D (R0039)	- Advanced Seminar in Mathematical Sciences 1	D (R039)	◎Advanced Seminar in Mathematics and Information Sciences 1	4	Multiple instructors	
22		○		Second Semester	Intensive course		D (R0040)	- Advanced Seminar in Mathematical Sciences 2	D (R040)	◎Advanced Seminar in Mathematics and Information Sciences 2	4	Multiple instructors	
22		○		First Semester	Intensive course		D (R0041)	- Advanced Seminar in Mathematical Sciences 3	D (R041)	◎Advanced Seminar in Mathematics and Information Sciences 3	3	Multiple instructors	
22		○		Second Semester	Intensive course		D (R0042)	- Advanced Seminar in Mathematical Sciences 4	D (R042)	◎Advanced Seminar in Mathematics and Information Sciences 4	3	Multiple instructors	
22		○		First Semester	Intensive course		D (R0043)	- Advanced Seminar in Mathematical Sciences 5	D (R043)	◎Advanced Seminar in Mathematics and Information Sciences 5	2	Multiple instructors	
22		○		Second Semester	Intensive course		D (R0044)	- Advanced Seminar in Mathematical Sciences 6	D (R044)	◎Advanced Seminar in Mathematics and Information Sciences 6	2	Multiple instructors	
23		○		Intensive course			D (R0046) 1 unit D (R0048) 2 units	* Internship in Mathematical Sciences	D (R046) 1 unit D (R048) 2 units	* Internship in Mathematics and Information Sciences	1 or 2	Multiple instructors	

*Students may retake the same course if respective courses provide different subject matter.
◎ Required course for the major

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 Lectures in Algebra (1)	R0011	—	—	First Semester	Fri.	2	2
Doctoral program	—	—	—	—				

Instructor(s)	Note
Hokuto Uehara	

(1) Course policies and topics	Galois theory, solvability of polynomial equations
(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 6-8 Proof of Galois fundamental theorem 9-15 Applications
(4) Outside-class activities and assignments	Sometimes homeworks will be given.
(5) Textbooks and course materials	None
(6) Assessment and grading	Reports (app. 50%), exams (app/ 50%)
(7) Questions to the instructor (Office hours, etc.)	Send an e-mail to hokuto[at]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	Special Lectures in Algebra (2)	R0012	—	—	First Semester	Tue.	2	2
Doctoral program	—	—	—	—				

Instructor(s)	Note
Shigeru Kuroda	

(1) Course policies and topics	I will give lectures on some interesting topics in commutative algebra and related fields, with introducing some basic concepts. No much prior knowledge is assumed. The necessary concepts in algebra are reviewed when they are used.
(2) Knowledge/skills to be acquired and learning objectives/course goals	Learn about the following items and know the deep world of commutative algebra and related fields: symmetric polynomial, monomial order, invariant ring, monoid, monoid algebra, finite generation of a ring, isomorphism of rings, integral extension, Noetherian ring, Hilbert's basis theorem, convex polyhedral cone, Gordan's lemma
(3) Course schedule, subject matter, and classroom activities	1. Extensions and generations of rings 2. Modules over a ring and integral extensions 3. Noetherian rings and Hilbert's basis theorem 4. Invariant theory for finite groups 5. Cancellation Problem 6. Convex polyhedral cones 7. Gordan's lemma 8. Monoid algebras 9. Fundamental theorem of symmetric polynomials and degree monoids 10. A criterion for non-finite generation 11. Hilbert's 14th Problem 12. Normal rings 13. Transcendental extension and algebraic extension 14. Luroth's theorem and its application 15. Summary and supplement
(4) Outside-class activities and assignments	The explanation will be given based on the lecture materials. Homework is assigned to confirm comprehension. Homework, Review of the previous lecture
(5) Textbooks and course materials	Distribute lecture materials
(6) Assessment and grading	participation and activity, homework, and the term paper (100%)
(7) Questions to the instructor (Office hours, etc.)	Contact by email etc.
(8) Special note	Prior knowledge is not required, but a basic knowledge of ring and module theory is helpful.

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 Lectures in Algebra (3)	R0013	—	—	Second Semester	Fri.	5	2
Doctoral program	—	—	—	—				

Instructor(s)	Note
Hiroo Tokunaga	

(1) Course policies and topics	The theory of Groebner bases have many applications not only in algebra but also in various fields in mathematics. In this course, students first learn some basic results on the theory of Groenber bases. Afterward, various application are explained.
(2) Knowledge/skills to be acquired and learning objectives/course goals	Student learn basic knowledge on Groenber bases and their applications. The course goal is to acquire ability to make use of such knowledge to solve various problems
(3) Course schedule, subject matter, and classroom activities	1. Overview. Ideals. 2. Monomial orderings. 3. A division algorithms and monomial oderings 4. Dickson's Lemma and Groebner bases. 5. Properties of Groebner bases and the Hilbert Basis Theorem. 6, 7, 8. Buchberger's criterion and Buchberger's algorithm. 9.10. Elimination Theory and Groebner bases. 11, 12, 13, 14. Applications. 15. Review. For 1 -10, lectures are given based on [CLO] below. For 11-14, suitable references are given
(4) Outside-class activities and assignments	Those who attend at the class are expected to work with some assignments.
(5) Textbooks and course materials	[CLO] D. Cox, J. Little and D. O'Shea: Ideals, Varieties and Algorithms, 4th edition. Springer. (The 4th edition is strongly recommended)
(6) Assessment and grading	Attendance and assignments
(7) Questions to the instructor (Office hours, etc.)	Those who have questions are supposed to make appointments via email. The instructor's email address will be given In the 1st lecture.
(8) Special note	Those who are interested in this course are supposed to have some knowledge on commutative algebra. As, applications are involved with various field, students are strongly encouraged to learn various fields (including computer 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	Special Lectures in Geometry (1)	R0014	—	—	First Semester	Tue.	3	2
Doctoral program	—	—	—	—				

Instructor(s)	Note
Masanori Kobayashi	

(1) Course policies and topics	**Introduction to topology** 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	Course schedule: 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 gourp and covering spaces (1) definition of covering space and examples 9. The fundamental gourp and covering spaces (2) relation between covering projections and group actions 10. The fundamental gourp and covering spaces (3) lifting of maps 11. The fundamental gourp 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 The class is a combination of lectures and exercises. The order and the contents of this lecture would be modified if necessary.
(4) Outside-class activities and assignments	Occasionally homework will be given. Students are encouraged to review the last lecture and prepare for the next 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).
(6) Assessment and grading	Report (60%), participation and activity (40%). No exam. Evaluated mainly by the understanding of the fundamental group.
(7) Questions to the instructor (Office hours, etc.)	The office hour will be announced in the first lecture.
(8) Special note	It is preferable to have some basic knowledge of groups and manifolds. 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	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 Lectures in Geometry (2)	R0015	—	—	Second Semester	Wed.	3	2
Doctoral program	—	—	—	—				

Instructor(s)	Note
Asuka Takatsu	

(1) Course policies and topics	Lecture on Riemannian geometry; we study on how to measure the length and area in a smoothly curved space.
(2) Knowledge/skills to be acquired and learning objectives/course goals	The purpose of this course is to learn Riemannian geometry and to deepen understanding of properties of curvatures. Students also learn about comparison geometry.
(3) Course schedule, subject matter, and classroom activities	This is a lecture-centered course. The contents and schedule are as shown below, but subject to change as needed. no.1: Review 1 (surface) no.2: Review 2 (manifold) no.3: Review 3 (tensor) no.4: Riemannian metric and connection no.5: geodesic no.6: curvature no.7: differential operator no.8: Riemannian distance function no.9: application of Riemannian distance function no.10: Riemannian volume measure no.11: application of Riemannian volume measure no.12: comparison geometry no.13: space form no.14: warped product no.15: summary
(4) Outside-class activities and assignments	Students are required not only to submit class assignments but also to review each class using handouts.
(5) Textbooks and course materials	References are handed out at every class. No textbooks will be used but the following book is a reference. Takashi Sakai, *Riemannian Geometry* (Translations of Mathematical Monographs), ISBN-13 : 978-0821802847.
(6) Assessment and grading	class participation + report = 100%
(7) Questions to the instructor (Office hours, etc.)	Office hours will be given at the beginning of course.
(8) Special note	Manifold theory (Geometry And Differential form (Geometry B) are used in the course, but it is not required to master them.

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 Lectures in Geometry (3)	R0016	—	—	Second Semester	Tue.	2	2
Doctoral program	—	—	—	—				

Instructor(s)	Note
Tomohiro Fukaya	

(1) Course policies and topics	The Hodge theory is a tool for analysing the cohomology of a smooth manifold using partial differential equations. One of the most important consequences of the Hodge theory is that there exists a unique harmonic form in each de Rham cohomology class. This course provides an overview of the theory including a proof of the Hodge decomposition theorem.
(2) Knowledge/skills to be acquired and learning objectives/course goals	The basis of the analysis on smooth Riemannian manifolds.
(3) Course schedule, subject matter, and classroom activities	The plan of this course is the following: 1 -- 2 A quick review of the theory of manifolds and the de Rham cohomology 3 Hodge star operation and Laplace operator 4 An overview of the Hodge decomposition theorem 5 the machinery necessary for the proofs of the main theorem 6 Sobolev space 7 Rellich theorem 8 Sobolev embedding 9 Elliptic operators 10 Poincaré inequality 11 A reduction to the case of bounded domains in the Euclidean space 12 A proof of the main theorem 13 Levi-Civita connection 14 Bochner's technique 15 A vanishing of the cohomology
(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	Frank W. Warner `Foundations of Differential Manifolds and Lie Groups' GTM 94 John Roe `Elliptic Operators, Topology, and Asymptotic Methods' 今野宏　「微分幾何学」　東京大学出版
(6) Assessment and grading	Attendance (40 per cent)　Report (60 per cent)
(7) Questions to the instructor (Office hours, etc.)	For office hours and contact informations, see the following: https://www.comp.tmu.ac.jp/tomohirofukaya/
(8) Special note	It is desirable that students have basic knowledge on the theory of smooth manifolds and differential forms.

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 Lectures in Analysis (1)	R0017	—	—	First Semester	Mon.	2	2
Doctoral program	—	—	—	—				

Instructor(s)	Note
Kazushi Yoshitomi	

(1) Course policies and topics	Several fundamental topics in functional analysis are discussed.
(2) Knowledge/skills to be acquired and learning objectives/course goals	One can learn basics of functional analysis.
(3) Course schedule, subject matter, and classroom activities	1. Normed linear spaces, Banach spaces, Examples 2. L^p space, Bounded linear operators 3. Dual space 4. Second dual space, Completion of normed spaces 5. Hahn-Banach theorem 6. Direct sum of Banach spaces, Quotient spaces 7. Baire's category theorem, Banach-Steinhaus theorem 8. Open mapping theorem, Inverse mapping theorem 9. Closed graph theorem 10. Hilbert spaces 11. Orthogonal projection, Riesz representation theorem 12. Compact operators 13. Fredholm operators 14. Stability of indices 15. Summary of lectures
(4) Outside-class activities and assignments	One is required to submit reports three times. One needs to study about four hours per a week.
(5) Textbooks and course materials	・S. Kuroda, Functional analysis, Kyoritsu Shuppan (in Japanese). ・M. Fabian, P. Habala, P. Hajek, V. Montesinos and Z. Zizler, Banach space theory, CMS Books in Mathematics, Springer, 2011. ・F. Riesz and B. Sz.-Nazy, Functional analysis, Dover, 1990. ・T. Kato, Perturbation theory for linear operators, Springer, 1980.
(6) Assessment and grading	Report (three times).
(7) Questions to the instructor (Office hours, etc.)	One can ask a question via e-mail: yositomi@tmu.ac.jp.
(8) Special note	A familiarity with the theory of Lebesgue integration is assumed.

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 Lectures in Analysis (2)	R0018	—	—	First Semester	Mon.	4	2
Doctoral program	—	—	—	—				

Instructor(s)	Note
Kensuke Ishitani	

(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 have questions, make an appointment via email. (k-ishitani@tmu.ac.jp)
(8) Special note	Check the information of this class on kibaco.

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 Lectures in Analysis(3)	R0019	—	—	Second Semester	Mon.	2	2
Doctoral program	—	—	—	—				

Instructor(s)	Note
Kazuhiro Kurata	

(1) Course policies and topics	Study the basic materials on the distribution theory, Sobolev spaces and their applications to partial 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 aimes 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. The distribution theory, derivatives of the distribution 3. The rapidly decreasing functions, the inversion formula of the Fourier transform 4. The tempered distributions and their Fourier transform 5. Sobolev spaces and their fundamental properties 6. Sobolev's embedding theorem, the extension theorem 7. Sobolev's inequality, the compactness theorem 8. Elliptic boundary value problems 9. Elliptic regularity theorems for weak solutions 10. Eigenvalue problems 11. Fredholm theory 12. Introduction to variational methods 13. Fixed point theorems 14. Subsolution-supersolution method 15. Summary
(4) Outside-class activities and assignments	This is a lecture-centered course. 1. The lecture time is limited and therefore self-directed learning is important. Students are required to prepare an review for each lecture. 2. In each lecture, homework will be given. Keep in mind the deadline of the report at kibaco.
(5) Textbooks and course materials	1. Partial Diferential Equations, by L.C. Evans, Amer. Math. Soc. 2. Functional Analysis and Partial Differential equations, by H.Brezis, Springer(e-Book is available at the Mathematics Library) Moreover, the lecture notes will be provided via kibaco.
(6) Assessment and grading	Evaluation is performed comprehensively based on homeworks(60%) and the final report(40%).
(7) Questions to the instructor (Office hours, etc.)	Office hours and the contact information for the lecturer will be given at the beginning of the course. Questions are welcome in the class, kibaco and e-mail. E-mail: kurata@tmu.ac.jp Office:8-632
(8) Special note	Basic materials in the Lebesgue integration theory and the functional analysis are required.

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 Lectures in Applied Mathematics (1)	R0020	—	—	First Semester	Tue.	5	2
Doctoral program	—	—	—	—				

Instructor(s)	Note
Toshio Suzuki	

(1) Course policies and topics	This is an introduction to logic in 20th century and its application. Logical formulas defines various interresting structures across mathematics, computer science, and philosopy. Logic is a mathematical science of such structures. This year we read a famous textbook of incompleteness theorem written by Shoji Maehara.
(2) Knowledge/skills to be acquired and learning objectives/course goals	The result shown by K. Gödel in 1931 is currently knwon as incompleteness theorem. We acquire prerequisite for this result by Chapters 1--6 of Maehara's textbook. In Chapters 7--8, the author explains the proof faithfully to the original paper. The purpose of this lecture is to acquire ability to understand Chapter 8.
(3) Course schedule, subject matter, and classroom activities	1. Formalization of mathematical theory 2-3. A formal system of propositional logic 4-6. A formal system of predicate logic with equality symbol 7. Type theory 8-9. A formal system of arithmetic 10-11. Rerpresentation of relations and functions 13. Gödel numbering and the provability predicate 14. The first incompleteness theorem 15. Summary and advanced topics
(4) Outside-class activities and assignments	Students are expected to prepare and review each time by reading the textbook.
(5) Textbooks and course materials	Shoji Maehara: Sugaku Kisoron Nyumon (An introduction to foundation of mathematics), Asakura (2006) (written in Japanese). This is a reprint of a book published in 1977. Our mathematics library has an access to an e-book. (For an English transllation of Gödel's original paper, see (8) below.)
(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	- You may find Gödel's original paper and its English translation in pp.144--205 of the following. S. Feferman et al. (eds.) Kurt Gödel Collected Works Volume I, Oxford University Press, New York, 1986. - Check the information of this course on kibaco.

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 Lectures in Applied Mathematics (2)	R0021	—	—	Second Semester	Tue.	3	2
Doctoral program	—	—	—	—				

Instructor(s)	Note
Yukihiro Uchida	

(1) Course policies and topics	Elliptic curves defined as plane cubic curves are one of important research subjects in modern number theory. Elliptic curves are also used in various number theoretic algorithms and have broad applications. Moreover, there are various studies on hyperelliptic curves which are generalizations of elliptic curves since we can apply to them techniques similar to ones for elliptic curves. In this course, the instructor will give lectures on elliptic curves and hyperelliptic curves as generalizations of elliptic curves with applications of these curves.
(2) Knowledge/skills to be acquired and learning objectives/course goals	The purpose of this course is to acquire the theory of elliptic and hyperelliptic curves and to understand their applications.
(3) Course schedule, subject matter, and classroom activities	The schedule of this course is below. The following schedule may be changed according to circumstances. 1. Introduction and guidance 2. The definition of elliptic curves 3. Points of finite order and endomorphisms 4. Division polynomials 5. Pairings and Hasse's theorem 6. Point counting on elliptic curves 7. Applications of elliptic curves 8. The definition of hyperelliptic curves and rational functions 9. Divisors on hyperelliptic curves 10. Semi-reduced and reduced divisors 11. The Jacobians of hyperelliptic curves 12. Addition algorithm of divisors 13. Jacobians over finite fields 14. Applications of hyperelliptic curves 15. Summary and report
(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. S. Tsujii and M. Kasahara eds., Cryptography and Elliptic Curves, Morikita Publishing, 2008. (Japanese). N. Koblitz, Algebraic Aspects of Cryptography, Springer, 1998. L. C. Washington, Elliptic Curves: Number Theory and Cryptography, Chapman & Hall/CRC, 2nd ed., 2008.
(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 a basic knowledge of groups, rings, and fields. - Students are recommended to attend the first lecture in which a detailed guidance about the overview, assessment, and grading will be given. - For information of this course and the instructor's contact details, please see kibaco and the instructor's web page: https://www.comp.tmu.ac.jp/y-uchida/

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 Lectures in Applied Mathematics (3)	R0022	—	—	Second Semester	Thu.	2	2
Doctoral program	—	—	—	—				

Instructor(s)	Note
Shun'ichi Yokoyama	

(1) Course policies and topics	Introduction to elliptic curve cryptography
(2) Knowledge/skills to be acquired and learning objectives/course goals	Elliptic curve is one of the most important object in modern number theory. The purpose of this course is to learn the theory of elliptic curve from a viewpoint of computation and applications to the theory of public-key cryptography. If time permits, the instructor introduces recent topics of elliptic curve cryptography and digital signature.
(3) Course schedule, subject matter, and classroom activities	1. Diophantine problem and elliptic curve 2. Elliptic curve over the rationals I 3. Elliptic curve over the rationals II 4. Elliptic curve over the rationals III 5. Fast addition algorithm using binary expansion 6. ECDH key-exchange protocol 7. EC-DSA digital signature algorithm 8. Elliptic curve over finite fields 9. Hasse-Weil theorem and Frobenius map 10. Division points and Weil pairing 11. Schoof algorithm 12. Index calculus 13. Attack strategy (MOV, FR, Weil descent) 14. Recent/Advanced topics I 15. Recent/Advanced topics II
(4) Outside-class activities and assignments	Strongly recommended activities: 1. Reading recent papers/proceedings and articles in number theory public-key cryptography 2. Trying to experience computer algebra systems
(5) Textbooks and course materials	No textbook. Additional information and references will be given.
(6) Assessment and grading	Final report (100%)
(7) Questions to the instructor (Office hours, etc.)	Whenever it is necessary. Please contant the instructor. If you use email, remember to sign your full name and the title of this course underneath.
(8) Special note	Basic knowledge of algebra (groups, rings, and fields) are required. Support webpage is available: https://sites.google.com/view/s-yokoyama/teaching/

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 Topics in Algebra 1	R0023	—	—	First Semester	Fri.	5	1
Doctoral program	Advanced Topics in Algebra 1	R0024	Advanced Topics in Geometry 1	R028				

Instructor(s)	Note
Hiroo Tokunaga	

(1) Course policies and topics	Among algebraic curves, hyperelliptic and elliptic curves are in special positions. In this lecture, representations for divisors on hyperelliptic (elliptic) curves are explaind from the scratch and then their applications are given.
(2) Knowledge/skills to be acquired and learning objectives/course goals	Student learn basic knowledge to deal with the divisor class group of hyperelliptic curves through two representations: Mumford representation and Leitenberger representation. Our goals are to understand that it has various applications
(3) Course schedule, subject matter, and classroom activities	1. Hyperelliptic curves and elliptic curves. 2. Coordinate rings and the field of rational functions. 3. Divisors. 4., 5, 6. Representations of divisors, Groebner bases and the addition on the divisor class group. 7, 8. Applications: Plane curves with quasi-toric relations, multisections on elliptic surfaces and so on. The above plan can be changed based on attending students. Detail will be found in the kibaco
(4) Outside-class activities and assignments	Those who attend at the class are expected to work with some assignments.
(5) Textbooks and course materials	1. A.J. Menezes, Y.-H. Wu and R.J.Zuccherato: An elementary introduction to hyperelliptic curves, in 'N.Koblitz:Algebraic Aspects of Cryptography' 2. Some other references will be given.
(6) Assessment and grading	Attendance and assignments
(7) Questions to the instructor (Office hours, etc.)	Those who have questions are supposed to make appointments via email. The instructor's address will be given In the 1st lecture.
(8) Special note	Those who take this course are supposed to have some knowledge on plane algebraic curves and surfaces, in particular, elliptic curves and their group structure. Also some knowledge on the theory of Groebner bases will be assumed.

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 Topics in Algebra 2	R0095	—	—	First Semester	Tue.	4	2
Doctoral program	Advanced Topics in Algebra 2	R0096	Advanced Topics in Geometry 2	R096				

Instructor(s)	Note
Hokuto Uehara	

(1) Course policies and topics	Vector bundles on algebraic varieties
(2) Knowledge/skills to be acquired and learning objectives/course goals	We learn elemental properties of vector bundles on algebrai varieties.
(3) Course schedule, subject matter, and classroom activities	1-3 Sheaf theory, algebraic varieties 4-5 Chern classes, Riemann—Roch theorem 6-8 Grothendieck theorem of vector bundles on projective lines 9-12 Uniform bundles 13-15 Moduli spave of vector bundles
(4) Outside-class activities and assignments	Sometimes homeworks will be given.
(5) Textbooks and course materials	"[OSS] C. Okonek, M. Schneider, H. Spindler, Vector bundles on complex projective spaces"
(6) Assessment and grading	Reports (app. 50%), exams (app/ 50%)
(7) Questions to the instructor (Office hours, etc.)	Send an e-mail to hokuto[at]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	Advanced Topics in Geometry 1	R0025	—	—	Second Semester	Mon.	5	1
Doctoral program	Advanced Topics in Geometry 1	R0026	Advanced Topics in Geometry 1	R056				

Instructor(s)	Note
Manabu Akaho	

(1) Course policies and topics	Introduction to symplectic manifolds
(2) Knowledge/skills to be acquired and learning objectives/course goals	The goal is to become familiar with many examples of symplectic manifolds.
(3) Course schedule, subject matter, and classroom activities	1. Symplectic manifolds 2. The basics of symplectic manifolds 3. Kahler manifolds 4. Lie groups and Lie algebras 5. Lie group actions and quotient spaces 6. Coadjoint orbits 7. Moment maps 8 Symplectic quotients
(4) Outside-class activities and assignments	Homework
(5) Textbooks and course materials	Chapter 3 and 5 of "Introduction to Symplectic Topology" by McDuff and Salamon
(6) Assessment and grading	Report (100%)
(7) Questions to the instructor (Office hours, etc.)	Get in touch by email.
(8) Special note	It is desirable to know manifolds, vector fields and differential forms.

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 Topics in Geometry 2	R0027	—	—	First Semester	Thur.	3	1
Doctoral program	Advanced Topics in Geometry 2	R0028	Advanced Topics in Geometry 2	R026				

Instructor(s)	Note
Tomoyuki Hisamoto	

(1) Course policies and topics	Foundations of Several Complex Variables. We in particular focus on the holomorphic functions defined over a Euclidean domain and on the L2 estimate method. We neither address in depth the local theory of analytic sets, theory of complex manifolds, nor coherent analytic sheaves.
(2) Knowledge/skills to be acquired and learning objectives/course goals	The students would be able to understand the basic properties of holomorphic functions of several complex variables and their difference from one variable functions.
(3) Course schedule, subject matter, and classroom activities	1. Existence theorem in one complex variables (1) 2. Ecistenxe theorem in one complex variables (2) 3. Consequence of Caucy's integral theorem 4. Difference from one complex variable functions 5. Dolbealt's lemma 6. Supplementaly materials 7. Plurisubharmonic functions (1) subharmonic functions and their properties 8. Plurisubharmonic functions (2) plurisubharmonic functions 9. Pseudoconvex and holomorphic domain (1) 10. Pseudoconvex and holomorphic domain (2) 11. L2 estimate (0) one variable case 12. L2 estimate (1) preparation from functional analysis 13. L2 estimate (2) Kodaira-Nakano identity 14. L2 estimate (3) Existence of holomorphic functions 15. Supplementaly materials
(4) Outside-class activities and assignments	You should try to bring back by yourself the whole detail of the lectures. It is strongly recommended one can digest the statements of definitions and theorems without help of any notes. Consider in each times examples or counterexamples.
(5) Textbooks and course materials	References will be suggested in the lectures.
(6) Assessment and grading	Report and participateon.
(7) Questions to the instructor (Office hours, etc.)	I would explain about the office hours in the first lecture. If necessary, please contat hisamoto@tmu.ac.jp
(8) Special note	It's better if you get familiar with one variable complex analysis and the Hilbert space theory.

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 Topics in Analysis 2	R0031	—	—	Second Semester	Wed.	4	2
Doctoral program	Advanced Topics in Analysis 2	R0032	Advanced Topics in Algebra 2	R030				

Instructor(s)	Note
Masahiko Shimojo	

(1) Course policies and topics	This lecture offers an opportunity to learn the fundamental theory of infinite dimensional dynamical systems and its applications to reaction-diffusion equations.
(2) Knowledge/skills to be acquired and learning objectives/course goals	Students will master the fundamental theory of dynamical system for nonlinear parabolic equations. This course is designed to help students understand advanced lectures and deepen their interest in research of this field.
(3) Course schedule, subject matter, and classroom activities	1.Initial value problem of ordinary differential equation 2.Phase portrait 3.Dynamical system on metric space 4.Stability 5.Comparison principles for reaction-diffusion systems 6.Application of comparison principle to stability 7.Limit set 8.Lyapunov functional 9.Linear stability principle 10.Linear stability principle 11.Stable manifold, unstable manifold Center manifold 12.Turing instability of Reaction-diffusion system 13.Applications to nonlinear parabolic equations 14.Inertial manifold 15.Bifurcation problem
(4) Outside-class activities and assignments	Students are required to review the lecture notes for each class.
(5) Textbooks and course materials	References (lecture notes) are handed out at every class. Infinite-Dimensional Dynamical Systems: An Introduction to Dissipative Parabolic PDEs and the Theory of Global Attractors (Cambridge Texts in Applied Mathematics, Series Number 28)
(6) Assessment and grading	By reports.
(7) Questions to the instructor (Office hours, etc.)	Students can email their questions.
(8) Special note	Materials are provided via kibaco.

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 Topics in Applied Mathematics 1	R0049	---	---	Second Semester	Fri.	4	1
Doctoral program	Advanced Topics in Applied Mathematics 1	R0050	Advanced Topics in Information Sciences 1	R060				

Instructor(s)	Note
Toshio Suzuki	

(1) Course policies and topics	This is a 1 credit lecture on applied mathematics. This year's topics are ultraproduct and infinitesimal real numbers.
(2) Knowledge/skills to be acquired and learning objectives/course goals	Model theory is a branch of logic in which they study sets of logical formulas by algebraic methods. Around 1960, A. Robinson succeeded in theorizing inifinitesimal real numbers by means of model theory. The theory is known as nonstandard analysis. In the former half of this lecture we learn basic concepts of model theory, in particular ultraproducts. In the latter half we introduce infinitesimal real numbers based on ultraproducts.
(3) Course schedule, subject matter, and classroom activities	1. Structures and isomorphisms in model theory 2. Elementary maps and definable sets 3-4. Ultrafilters and ultraproducts 5. Infinitesimal real numbers 6. Continuous functions 7. Differentiation
(4) Outside-class activities and assignments	Students are expected to prepare and review each time by reading the textbook.
(5) Textbooks and course materials	The textbook in the former half is A. Tsuboi "Model theory and compactness" section 1.1--2.3, in: K. Tanaka (eds.) " Gödel and logic in 20th century, volume 2", pp.111--139 (written in Japanese). A textbook in the latter half will be announced in kibaco.
(6) Assessment and grading	It is 50 percent the term paper, and 50 percent the others (including the midterm report assignment).
(7) Questions to the instructor (Office hours, etc.)	My office our is 5th period of Monday.
(8) Special note	- Check the information of this course on kibaco.

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 Topics in Applied Mathematics 2	R0051	---	---	Second Semester	Fri.	2	2
Doctoral program	Advanced Topics in Applied Mathematics 2	R0052	Advanced Topics in Information Sciences 2	R032				

Instructor(s)	Note
Shigenori Uchiyama	

(1) Course policies and topics	Lecture on the basic mathematics of quantum computers.
(2) Knowledge/skills to be acquired and learning objectives/course goals	Although a large-scale practical quantum computer has not been realized yet, here we will learn the basic mathematics of a mathematical model called a quantum Turing machine and some quantum algorithms that will be used as examples. The purpose of this lecture is to learn the basic mathematics of a mathematical model called a quantum Turing machine and some quantum algorithms that can be used as concrete examples.
(3) Course schedule, subject matter, and classroom activities	The class schedule is as follows. However, it may be changed depending on the situation. 1 Introduction and guidance 2.New computer models 3 Realization of quantum computers 4 Introduction to Computational Theory 5 Tensor Product Vector Space (Part 1) 6.Tensor product vector space (Part 2) 7 Mathematical models of quantum computers 8. Mid-term summary and report 9. Simple quantum computers 10. Discrete integral transformation 11. Deutsch-Jozsa's decision algorithm 12. Grover's search algorithm 13. Shor's prime factorization algorithm 14. Applications to cryptography 15. Summary and report
(4) Outside-class activities and assignments	Some practical problems will be given in a class, so be sure to solve them before the next class.
(5) Textbooks and course materials	The textbook will not be specified, but some useful references will be introduced as necessary.
(6) Assessment and grading	Evaluation will be based on 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	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	Exercises in Mathematical Sciences	R0033	—	—	First Semester	Wed.	3	1
Doctoral program	Special Exercises in Mathematical Sciences	R0038	Special Exercises in Mathematics and Information Sciences	R038				

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 (50%), presentation (30%), participation and activity (20%)
(7) Questions to the instructor (Office hours, etc.)	See the following web page: http://www.comp.tmu.ac.jp/tsakai/
(8) Special note	- This course is a required subject in the master's program. - Check the information of this course on kibaco.

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	Seminar in Mathematical Sciences 1,2,3,4	—	—	—	First Semester / Second Semester	Intensive course	—	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.
(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	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	—	—	—	—	First Semester / Second Semester	Intensive course	—	See Graduate School Course Catalog
Doctoral program	Advanced Seminar in Mathematical Sciences 1,2,3,4,5,6	—	Advanced Seminar in Mathematics and Information Sciences 1,2,3,4,5,6	—				

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.
(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	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 in Mathematical Sciences	—	—	—	Intensive course	—	—	1 or 2
Doctoral program	Internship in Mathematical Sciences	—	Internship in Mathematics and Information Sciences	—				

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) 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 (4), 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 (5) to the academic instructor of Tokyo Metropolitan University. A Credit will be accredited based on the suitability with the above purpose of the course (totally 30 hours or more of learning including a report writing work), 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 make contact with 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.

Physics
(General courses for Graduate School of Science and Graduate School of Science and Engineering)

Notes on course enrollment

[School of Science]
(Master's program)

1. The following courses are required for the master's degree.
For theoretical physics:
- Advanced Seminar in Physics I–IV and
- Advanced Practice in Physics I–IV
For experimental physics:
- Advanced Seminar in Physics I–IV and
- Advanced Experiment in Physics I–IV Courses I to IV should be taken in order. These courses cannot be taken at the same time.
2. For the following courses, students may retake the same course if respective courses provide different subject matter.
- Special Lecture in Physics I
- Special Lecture in Physics II
- Selected Topics in Physics I
- Selected Topics in Physics II
3. For courses offered both in the undergraduate and graduate program, students are not allowed to take the same course already taken in our undergraduate program if the course provides the same subject matter.
4. For students who are admitted for early completion due to their outstanding research achievements, some of the requirements in Section 1 above may be waived.

(Doctoral program)

1. The following courses are required for the doctorate.
For theoretical physics:
- Advanced Practice in Physics V–VIII
For experimental physics:
- Advanced Experiment in Physics V–VIII
Courses V to VIII should be taken in order. These courses cannot be taken at the same time. Students for theoretical physics can take Advanced Practice in Physics IX after taking the Adcanced Practice in Physics VIII, and students for experimental physics can take Adcanced Experiment in Physics IX after taking the Advanced Experiment in Physics VIII.
2. For the following courses, students may retake the same course if respective courses provide different subject matter.
- Special Lecture in Physics I
- Special Lecture in Physics II
- Selected Topics in Physics I
- Selected Topics in Physics II
3. For courses offered both in the master's and doctoral programs, students are not allowed to take the same courses already taken in our master's program if the course provides the same subject matter.
4. For students who are admitted for early completion due to their outstanding research achievements, some of the requirements in Section 1 above may be waived.

[School of Science and Engineering]
(Doctoral program)

1. The following courses are required for the doctorate.
For theoretical physics:
- Advanced Practice in Physics V–VIII

For experimental physics:
- Advanced Experiment in Physics V–VIII

Courses V to VIII should be taken in order. These courses cannot be taken at the same time.

2. For the following courses, students may retake the same course if respective courses provide different subject matter.
   - Special Lecture in Physics I
   - Special Lecture in Physics II
   - Selected Topics in Physics I
   - Selected Topics in Physics II
3. For courses offered both in the master's and doctoral programs, students are not allowed to take the same courses already taken in our master's program if the course provides the same subject matter.
4. For students who are admitted for early completion due to their outstanding research achievements, some of the requirements in Section 1 above may be waived.

* M = master's courses, D = doctoral courses
* NA 2022: Courses not offered in the academic year 2022

Course outline	M	D	NA 2022	Semester	Day	Time	[Graduate School of Science]		[Graduate School of Science and Engineering]		Credit Hours	Instructor(s)	Note (enrollment requirements, subject matter, etc.)
							Course Number	Course Name	Course Number	Course Name			
1	○			1st	Thu.	2	M(R0101)	General Relativity			2	S. Ketov	This course is also offered in the undergraduate program
2	○			1st	Fri.	4	M(R0102)	Statistical physics			2	Kazumasa Hattori	
3	○			1st	Fri.	2	M(R0103)	Field theory			2	S. Ketov	
4	○			2nd	Mon.	2	M(R0104)	Fluid Mechanics			2	Rei Kurita	This course is also offered in the undergraduate program
5	○			1st	Thu.	3	M(R0105)	Nuclear physics			2	Tetsuo Hyodo	This course is also offered in the undergraduate program
6	○			1st	Mon.	2	M(R0106)	Particle physics			2	Osamu Yasuda	This course is also offered in the undergraduate program
7	○			2nd	Fri.	2	M(R0107)	Astrophysics			2	Yoshitaka Ishisaki	This course is also offered in the undergraduate program
8	○			1st	Tue.	2	M(R0108)	Selected Topics in Physics and Chemistry II (Atomic physics)			2	Hajime Tanuma	This course is offered for Physics and Chemistry majors and also in the undergraduate program
9	○			1st	Wed.	2	M(R0109)	Selected Topics in Physics and Chemistry II (Solid State Physics I)			2	Emiko Arahata	This course is offered for Physics and Chemistry majors and also in the undergraduate program
10	○			2nd	Wed.	2	M(R0111)	Solid State Physics II			2	Tatsuma Matsuda	This course is also offered in the undergraduate program
11	○			1st	Mon.	3	M(R0112)	Solid State Physics with Particle Beam			2	Hiroaki Kadowaki	This course is also offered in the undergraduate program
12	○			2nd	Wed.	5	M(R0114)	Computational Physics			2	Akira Shudo	This course is also offered in the undergraduate program
13	○	○		2nd A	Tue.	3	M(R0171) D (R0172)	Advanced Experimental Technique in Physics A	D (R0172)	Advanced Experimental Technique in Physics A	1	Yuji Aoki	
14	○	○		2nd A	Tue.	3	M(R0937) D (R0938)	Advanced Experimental Technique in Physics B	D (R938)	Advanced Experimental Technique in Physics B	1	Hiroaki Kadowaki	
15	○	○		2nd A	Wed.	3	M(R0161) D (R0162)	Selected Topics in Physics and Chemistry I (Advanced Experimental Technique in Physics C)	D (R162)	Selected Topics in Physics and Chemistry I (Advanced Experimental Technique in Physics C)	1	Hajime Tanuma	This course is offered for Physics and Chemistry majors
16	○	○		2nd B	Mon.	3	MCR0159) D (R0160)	Selected Topics in Physics and Chemistry I (Advanced Experimental Technique in Physics D)	D (R160)	Selected Topics in Physics and Chemistry I (Advanced Experimental Technique in Physics D)	1	* Toshiyuki Azuma	This course is offered for Physics and Chemistry majors
17	○	○		1st Intensive			M(R0097) D (R0098)	Advanced particle physics	D (R098)	Advanced particle physics	1	Osamu Yasuda	Register during the first semester registration period
18	○	○		2nd A	Tue.	2	M(R0099) D (R0100)	Advanced high energy theoretical physics	D (R100)	Advanced high energy theoretical physics	1	S. Ketov	
19	○	○		2nd A	Thu.	3	M(R0125) D (R0126)	Advanced subatomic physics	D (R126)	Advanced subatomic physics	1	Tetsuo Hyodo	
20	○	○		2nd A	Fri.	3	M(R0131) D (R0132)	Advanced High Energy Astrophysics I	D (R132)	Advanced High Energy Astrophysics I	1	Yutaka Fujita	
-	○	○	△	2nd A	Fri.	3	M(R0133) D (R0134)	Advanced High Energy Astrophysics II	D (R134)	Advanced High Energy Astrophysics II	1	Yutaka Fujita	
21	○	○		1st A	Mon.	3	M(R0141) D (R0142)	Advanced nonlinear physics	D (R142)	Advanced nonlinear physics	1	Akira Shudo	
22	○	○		1st B	Tue.	3	M(R0117) D (R0118)	Advanced statistical mechanics	D (R118)	Advanced statistical mechanics	1	Emiko Arahata	
23	○	○		1st Intensive			M(R0115) D (R0116)	Advanced Quantum Many Body System	D (R116)	Advanced Quantum Many Body System	1	Kazumasa Hattori	Register during the first semester registration period
-	○	○	△	2nd A	Mon.	3	M(R0145) D (R0146)	Advanced physics of superconductivity	D (R146)	Advanced physics of superconductivity	1	Takashi Hotta	
24	○	○		2nd B	Mon.	3	M(R0123) D (R0124)	Advanced Physics of Magnetism	D (R124)	Advanced Physics of Magnetism	1	Takashi Hotta	
25	○	○		1st B	Fri.	3	M(R0119) D (R0120)	Advanced High Energy Physics I	D (R120)	Advanced High Energy Physics I	1	Hidekazu Kakuno	
-	○	○	△	1st B	Fri.	3	M(R0121) D (R0122)	Advanced High Energy Physics II	D (R122)	Advanced High Energy Physics II	1	Hidekazu Kakuno	
26	○	○		2nd B	Mon.	4	M(R0153) D (R0154)	Advanced Atomic Physics I	D (R154)	Advanced Atomic Physics I	1	* Toshiyuki Azuma	
-	○	○	△	2nd A	Wed.	4	M(R0155) D (R0156)	Advanced Atomic Physics II	D (R156)	Advanced Atomic Physics II	1	Hajime Tanuma	
27	○	○		1st A	Wed.	3	M(R0127) D (R0128)	Advanced Astrophysics I	D (R128)	Advanced Astrophysics I	1	Yuichiro Ezoe	
-	○	○	△	1st A	Fri.	3	M(R0129) D (R0130)	Advanced Astrophysics II	D (R130)	Advanced Astrophysics II	1	Yoshitaka Ishisaki	
28	○	○		2nd A	Thu.	3	M(R0149) D (R0150)	Advanced Correlated Electron Physics I	D (R150)	Advanced Correlated Electron Physics I	1	Tatsuma Matsuda	
-	○	○	△	2nd A	Wed.	4	M(R0135) D (R0136)	Advanced Correlated Electron Physics II	D (R136)	Advanced Correlated Electron Physics II	1	Yoshikazu Mizuguchi	
29	○	○		2nd A	Tue.	2	M(R0147) D (R0148)	Selected Topics in Physics and Chemistry I (Advanced Nanoscience, Surface, and Interface Physics I)	D (R148)	Selected Topics in Physics and Chemistry I (Advanced Nanoscience, Surface, and Interface physics I)	1	Yasumitsu Miyata	This course is offered for Physics and Chemistry majors
-	○	○	△	1st B	Tue.	1	M(R0137) D (R0138)	Selected Topics in Physics and Chemistry I (Advanced Nanoscience, Surface, and Interface Physics II)	D (R138)	Selected Topics in Physics and Chemistry I (Advanced Nanoscience, Surface, and Interface Physics II)	1	Kazuhiro Yanagi	
30	○	○		2nd B	Tue.	4	M(R0157) D (R0158)	Advanced Neutron Scattering and Magnetism I	D (R158)	Advanced Neutron Scattering and Magnetism I	1	Hiroaki Kadowaki	
31	○	○		1st B	Thu.	3	M(R0151) D (R0152)	Selected Topics in Physics and Chemistry I (Advanced Soft Matter Physics I)	D (R152)	Selected Topics in Physics and Chemistry I (Advanced Soft Matter Physics I)	1	Rei Kurita	This course is offered for Physics and Chemistry majors
-	○	○	△	1st B	Thu.	3	M(R0143) D (R0144)	Selected Topics in Physics and Chemistry I (Advanced Soft Matter Physics II)	D (R144)	Selected Topics in Physics and Chemistry I (Advanced Soft Matter Physics II)	1	Rei Kurita	This course is offered for Physics and Chemistry majors
32	○	○		2nd A	Fri.	2	M(R0110) D (R0113)	Selected Topics in Physics and Chemistry I (Advanced Minimum Material Science)	D (R113)	Selected Topics in Physics and Chemistry I (Advanced Minimum Material Science)	1	Yuji Aoki	This course is offered for Physics and Chemistry majors
33	○	○		2nd A	Thu.	2	M(R0139) D (R0140)	Advanced English for science	D (R140)	Advanced English for science	1	Hiroyuki Mori	
34	○	○		2nd	Wed.	1	M(R0163) D (R0164)	Selected Topics in Physics and Chemistry II Advanced Molecular Spectroscopy	D (R164)	Selected Topics in Physics and Chemistry II Advanced Molecular Spectroscopy	2	Reika Kanya	(See syllabus in Chemistry)
35	○	○		1st	Wed.	1	M(R0165) D (R0166)	Selected Topics in Physics and Chemistry II (Advanced Physical Chemistry of Condensed Matter)	D (R166)	Selected Topics in Physics and Chemistry II (Advanced Physical Chemistry of Condensed Matter)	2	Yasushi Hirose	This course is offered for Physics and Chemistry majors (See syllabus in Chemistry)
36	○	○		1st	Tue.	2	M(R0167) D (R0168)	Selected Topics in Physics and Chemistry II (Advanced Theoretical Chemistry)	D (R168)	Selected Topics in Physics and Chemistry II (Advanced Theoretical Chemistry)	2	Masahiko Hada, Naoki Nakatani	This course is offered for Physics and Chemistry majors (See syllabus in Chemistry)
38	○			1st/2nd	*	*	M (R0173) 1st M (R0330) 2nd	Advanced Seminar Physics I			2	All instructors	For first-year master's students
38	○			1st/2nd	*	*	M (R0174) 2nd M (R0331) 1st	Advanced Seminar in Physics II			2	All instructors	For first-year master's students

Course outline	M	D	NA 2022	Semester	Day	Time	[Graduate School of Science]		[Graduate School of Science and Engineering]		Credit Hours	Instructor(s)	Note (enrollment requirements, subject matter, etc.)
							Course Number	Course Name	Course Number	Course Name			
38	○			1st/2nd	*	*	M (R0175) 1st M (R0332) 2nd	Advanced Seminar in Physics III			2	All instructors	For second-year master's students
38	○			1st/2nd	*	*	M (R0176) 2nd M (R0333) 1st	Advanced Seminar in Physics IV			2	All instructors	For second-year master's students
39	○			1st/2nd	*	*	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
39	○			1st/2nd	*	*	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
39	○			1st/2nd	*	*	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
39	○			1st/2nd	*	*	M (R0180) 2nd M (R0337) 1st	Advanced Experiment in Physics IV			2	All instructors of experimental physics	For second-year master's students of experimental physics
40	○			1st/2nd	*	*	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
40	○			1st/2nd	*	*	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
40	○			1st/2nd	*	*	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
40	○			1st/2nd	*	*	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
-	○	○		Intensive course	TBA	TBA	M(R0197) D (R0198)	Advanced Physics I	D (R198)	Advanced Physics I	1	TBA	The credit hours will be added if the course provides a different subject matter.
-	○	○		Intensive course	TBA	TBA	M(R0199) D (R0200)	Advanced Physics II	D (R200)	Advanced Physics II	2	TBA	The credit hours will be added if the course provides a different subject matter.
-	○	○		Intensive course	TBA	TBA		Selected Topics in Physics I		Selected Topics in Physics I	1	TBA	The credit hours will be added if the course provides a different subject matter.
-	○	○		Intensive course	TBA	TBA		Selected Topics in Physics Ⅱ		Selected Topics in Physics Ⅱ	2	TBA	The credit hours will be added if the course provides a different subject matter.
-	○	○		Intensive course	TBA	TBA		Selected Topics in Physics and Chemistry I		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
37	○	○		Intensive course	TBA	TBA	M (R0193) 2 units M (R0195) 1 unit D (R0194) 1 unit D (R0196) 2 units	External experience in physics	D (R194) 1 unit D (R196) 2 units	External experience in physics	1 or 2	All instructors	The credit hours will be added if the course provides a different subject matter.
41		○		1st/2nd	*	*	D (R0185) 1st D (R0342) 2nd	Advanced Experiment in Physics V	D (R185) 1st D (R342) 2nd	Advanced Experiment in Physics V	4	All instructors of experimental physics	For first-year doctoral students of experimental physics
41		○		1st/2nd	*	*	D (R0186) 2nd D (R0343) 1st	Advanced Experiment in Physics VI	D (R186) 2nd D (R343) 1st	Advanced Experiment in Physics VI	4	All instructors of experimental physics	For first-year doctoral students of experimental physics
41		○		1st/2nd	*	*	D (R0187) 1st D (R0344) 2nd	Advanced Experiment in Physics VII	D (R187) 1st D (R344) 2nd	Advanced Experiment in Physics VII	4	All instructors of experimental physics	For second-year doctoral students of experimental physics
41		○		1st/2nd	*	*	D (R0188) 2nd D (R0345) 1st	Advanced Experiment in Physics VIII	D (R188) 2nd D (R345) 1st	Advanced Experiment in Physics VIII	4	All instructors of experimental physics	For second-year doctoral students of experimental physics
42				1st/2nd			D (R0225) 2nd D (R0998) 1st	Advanced Experiment in Physics IX		Advanced Experiment in Physics IX	2	All instructors of experimental physics	For third-year doctoral students of experimental physics
43		○		1st/2nd	*	*	D (R0189) 1st D (R0346) 2nd	Advanced Practice in Physics V	D (R189) 1st D (R346) 2nd	Advanced Practice in Physics V	4	All instructors of theoretical physics	For first-year doctoral students of theoretical physics
43		○		1st/2nd	*	*	D (R0190) 2nd D (R0347) 1st	Advanced Practice in Physics VI	D (R190) 2nd D (R347) 1st	Advanced Practice in Physics VI	4	All instructors of theoretical physics	For first-year doctoral students of theoretical physics
43		○		1st/2nd	*	*	D (R0191) 1st D (R0348) 2nd	Advanced Practice in Physics VII	D (R191) 1st D (R348) 2nd	Advanced Practice in Physics VII	4	All instructors of theoretical physics	For second-year doctoral students of theoretical physics
43		○		1st/2nd	*	*	D (R0192) 2nd D (R0349) 1st	Advanced Practice in Physics VIII	D (R192) 2nd D (R349) 1st	Advanced Practice in Physics VIII	4	All instructors of theoretical physics	For second-year doctoral students of theoretical physics
44				1st/2nd			D (R0226) 2nd D (R0999) 1st	Advanced Practice in Physics IX		Advanced Practice in Physics IX	2	All instructors of theoretical physics	For third-year doctoral students of theoretical physics

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	general relativity	R0101			1	Thurs day	2	2
Doctoral program								

Instructor(s)	Note
Serguei Ketov	

(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] final exam and comments
(4) Outside-class activities and assignments	
(5) Textbooks and course materials	
(6) Assessment and grading	
(7) Questions to the instructor (Office hours, etc.)	
(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	Statistical physics	R0102			1st	Fri.	4	2
Doctoral program								

Instructor(s)	Note
Kazumasa Hattori	

(1) Course policies and topics	Phase transitions and critical phenomena are reviewed from their basic ideas to some examples. The topics include, for example, magnetism, superfluidity, and superconductivity. To understand the essential aspect of spontaneous-symmetry breaking, the course gives a brief knowledge about group theory. The universality of critical phenomena is explained without knowledge about field-theoretical techniques.
(2) Knowledge/skills to be acquired and learning objectives/course goals	Understanding the idea of spontaneous symmetry breaking and how to construct free energy for given order parameters under symmetries in a system considered.
(3) Course schedule, subject matter, and classroom activities	1. Ferro- and antiferro-magnetic Ising model: a mean-field approximation 2. Bose condensations 3. Symmetry in quantum mechanics 4. Symmetry and group theory: irreducible representations 5. Symmetry and group theory: representation matrix and character 6. Order parameter 7. Correlation function 8. Scaling hypothesis 9. Landau theory and phase transitions 10. Liquid-gas transition 11. Nematicity and tricritical point 12. Superconductivity: Cooper problem 13. Superconductivity: Ginztburg-Landau theory 14. Upper critical field and vortex lattice 15. Explanation about the final report
(4) Outside-class activities and assignments	Study slides used in the lecture or read related part picked up in the lecture in textbooks. In the beginning of each class, students should solve elementary problems (paper exam.) related to the previous class. For the 1st class in April, the problems consists of elementary ones in quantum mechanics and statistical physics.
(5) Textbooks and course materials	J. J. Binney, N. J. Dorick, A. J. Fisher, and M. E. J. Newman "The Theory of Critical Phenomena - An Introduction to the Renormalization Group" , (Clarendon Press) M. Karder "Statistical Physics of fields", (Cambridge University Press) A. A. Abrikosov, "Fundamentals of the theory of metals", (Dover Publications) T. Inui and Y. Tanabe, "Group theory and its applications in physics", (Springer)
(6) Assessment and grading	A report (70%) and paper examinations (30%) in the beginning of each class.
(7) Questions to the instructor (Office hours, etc.)	Make an appointment or directly send questions by email.
(8) Special note	Knowledge about quantum mechanics, elementary statistical physics, and mathematical physics must be required.

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	Field theory	R0103			1	Friday	2	2
Doctoral program								

Instructor(s)	Note
Serguei Ketov	

(1) Course policies and topics	The lectures offer an introduction to classical and quantum field theories from the first principles to Feynman's graphs. Several applications to particle physics are provided. Knowledge of classical mechanics and electrodynamics is a prerequisite. The lectures are original and self-contained. Students shoud make notes during the lectures and study them at home again. The key objectives and skills to be acquired by students include basic knowledge of field theory and ability to do related calculations by using field-theoretical tools. Schedule and subjects of lectures: [1] field theory actions and equations of motion, [2] space-time and internal symmetries, Poincare algebra, [3] Maxwell theory of electromagnetism, [4] scalar field and its quantization, [5] Dirac field and its quantization, [6] Fock space of multi-particle states, [7] Green's functions and propagators, [8] group theory and group representations, [9] Lie algebras and Lie groups, [10] local gauge principle, [11] Yang-Mills field theory, [12] S-matrix and particle physics, [13] quantum field theories (QED, QCD, Standard Model), [14] Feynman rules, [15] Grand Unified Theories and quantum gravity
(2) Knowledge/skills to be acquired and learning objectives/course goals	The lectures are original (from the teacher) and will be given in English. Home reading of a textbook is recommended, for example, 1. V. Rubakov, "Classical Theory of Gauge Fields", 2. L.H. Ryder, "Quantum Field Theory", 3. S.V. Ketov, "Conformal Field Theory". The conditions for earning credits are attendance of lectures (at least 2/3 or more) and positive results of the written test at the end of the term. During the test, students are allowed to bring any literature with them. Office hours for questions and consulations with the teacher are on Mondays between 13:00-14:30 (reservations by email are recommended) Email address: ketov@tmu.ac.jp 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.
(3) Course schedule, subject matter, and classroom activities	
(4) Outside-class activities and assignments	

(5) Textbooks and course materials (6) Assessment and grading (7) Questions to the instructor (Office hours, etc.) (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	Fluid Mechanics	R0104			2nd	Mon.	2	2
Doctoral program								

Instructor(s)	Note
Rei Kurita	This course is also offered in the undergraduate program

(1) Course policies and topics	It is difficult to trace behaviors of each molecules in flow dynamics. Thus, continuum approximation is needed to describe the flow dynamics. Here the purpose of this course is to learn basis of the continuum approximation and the fluid mechanics.
(2) Knowledge/skills to be acquired and learning objectives/course goals	Knowledge of vectors, tensors, and differencial equations are required. Using those mathematical technique, you can learn essence of the fluid dynamics and nonlinear dynamics.
(3) Course schedule, subject matter, and classroom activities	1. Visualization and Eular description 2. Deformation tensor 3. Equation of continuity 4. Navie-Stokes equation 5. Reynolds' law of similarity 6. Mechanics of viscous fluids 7. Surface waves 8. Solitons 9. Shock waves 10. Convection 11. Critical Rayleigh number and linear stability analysis 12. Turbulence 13. Phase separation with hydrodynamics 14. Viscoelastic phase separations 15. 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	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	Nuclear Physics	R0105			1st	Thu.	3	2
Doctoral program								

Instructor(s)	Note
Tetsuo Hyodo	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 ncueli”. Closely related with “Particle physics”.

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	Particle physics	M(R0106)			1st	Mon	2	2
Doctoral program								

Instructor(s)	Note
Osamu Yasuda	This course is also offered in the undergraduate program

(1) Course policies and topics	Most of all the phenomena of particles to date can be successfully described by a theory called standard model of particle physics. This course gives an introductory description of the standard model.
(2) Knowledge/skills to be acquired and learning objectives/course goals	The student will understand a basis of spontaneous symmetry breaking, field theories with gauge symmetry, unification of electromagnetism and the weak force.
(3) Course schedule, subject matter, and classroom activities	01. Introduction: Natural unit, special relativity, Dirac equation 02. Field quantization, Lagrangian density 03. Gauge symmetry (Abelian case) 04. Gauge symmetry (Non-Abelian case) 05. Spontaneous symmetry breaking (Abelian case) 06. Spontaneous symmetry breaking (Non-Abelian case) 07. Nambu-Goldstone mode 08. Brout-Englert-Higgs mechanism 09. Foundation of the electroweak theory 10. Interactions of the electroweak theory 11. Foundation of quantum chromodynamics 12. Interactions of quantum chromodynamics 13. Basis of flavor mixing 14. Predictions from flavor mixing 15. Summary
(4) Outside-class activities and assignments	Lecture notes will be available on the course website (the URL will be given on the kibaco system). Students are expected to study the contents of the course in advance and understand the definition of the technical terms.
(5) Textbooks and course materials	The following are course materials: (i) "Quarks and leptons : an introductory course in modern particle physics", F. Halzen and A. D. Martin, Wiley , 1984 . (ii) "Gauge Theories", E. S. Abers and B. W. Lee, Phys. Rept. 9 (1973) 1.
(6) Assessment and grading	The final grade will be based on a written assignment toward the end of the lectures.
(7) Questions to the instructor (Office hours, etc.)	Office hours are not specified, and the student, who has a question, should send email to the instructor (the email address will be given on the kibaco system).
(8) Special note	Announcements will be sent to the students' email addresses ending with @ed.tmu.ac.jp, and the students should set up the TMU mail account so that all the emails addressed to @ed.tmu.ac.jp be forwarded to their private mail addresses.

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	Astrophysics	M(R0107)			2nd	Fri	2	2
Doctoral program								

Instructor(s)	Note
Yoshitaka Ishisaki	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	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	Selected Topics in Physics and Chemistry II (Atomic Physics)	M(R0108)	Selected Topics in Physics and Chemistry II (Atomic Physics)	M(R108)	1st	Tue	2	2
Doctoral program								

Instructor(s)	Note
Hajime Tanuma	

(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	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	Selected Topics in Physics and Chemistry II (Solid State Physics I)	M(R0109)			1st	Wed	2	2
Doctoral program								

Instructor(s)	Note
Emiko Arahata	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 Textbooks : Solid-State Physics: An Introduction to Principles of Materials Science (English Edition) (Harald Ibach, Hans Lüth)
(6) Assessment and grading	Term paper(70%) assignments in every class (30％)
(7) Questions to the instructor (Office hours, etc.)	Questions will be accepted at any time. Make an appointment in advance.
(8) Special note	Statistical mechanics and quantum mechanics have been learned. It is desirable to take Solid State Physics II.

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	Solid State Physics II	R0111			2nd	Wed.	2	2
Doctoral program								

Instructor(s)	Note
Tatsuma Matsuda	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 resonse of crystal 11th, 12th : low temperature, superconductivity, superfluid 13th, 14th : theoretical development 15th : prctices 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	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	Solid State Physics with Particle Beam	R0112			1st	Mon.	3	2
Doctoral program								

Instructor(s)	Note
Hiroaki Kadowaki	This course is also offered in the undergraduate program

(1) Course policies and topics	The subject of condensed matter physics is an aggregate of atoms, and its various structures (crystal, glass, liquid, etc.) give rise to a wide variety of physical properties. In this class, the microscopic structures of materials and their physical properties are explained with emphasis on scattering and diffraction experiments using waves (X-rays, neutron beams, and electron beams) to investigate them.
(2) Knowledge/skills to be acquired and learning objectives/course goals	Scattering and diffraction experiments using waves (X-rays, neutron beams, and electron beams) with wavelengths comparable to the interatomic distance are used to investigate the structure of materials. All of them use interference phenomena of these radiation (particle beams) as waves, and provide microscopic information on the crystal and electronic structures of materials. This course aims to provide students with a basic understanding of the fundamental and quantitative methodologies of elastic scattering and more advanced methods of inelastic scattering experiments, which reveal the structure of materials using (mainly) X-rays and neutron beams.
(3) Course schedule, subject matter, and classroom activities	The course will start with the concept of diffraction patterns and elastic/inelastic scattering cross sections obtained in scattering experiments using X-rays and neutrons, and will also explain the basic knowledge and techniques required for data analysis. The fundamentals of describing crystal structures (crystallography) will also be included. In the latter half of the course, more advanced topics such as magnetic scattering and experiments using polarized neutrons will be discussed. 1st: Wave and particle studies of physical properties 2nd: 1-, 2-, and 3-dimensional crystal lattices and reciprocal lattices 3rd: Crystal structure 4th: Space groups 5th: Scattering experiments and scattering cross sections: transition probabilities 6th: Scattering experiments and cross sections: Bragg scattering, structure factor 7th: Powder and single crystal diffraction experiments 8th: Powder Diffraction and Rietveld Analysis 9th: Scattering cross sections for inelastic scattering 10th: Scattering cross sections and response functions 11th: Phonons in solids and inelastic scattering by phonons 12th: Typical experimental setup for inelastic scattering 13th: Magnetic scattering, magnetic Bragg scattering 14th: Response function and time correlation function from magnetic scattering 15th: Experiments with polarized neutrons Method of teaching: Mostly given by lectures. (The class web page: http://bb.phys.se.tmu.ac.jp/~bb/NX_wiki/)
(4) Outside-class activities and assignments	After each class, review using references and materials.
(5) Textbooks and course materials	References are introduced when necessary. See http://bb.phys.se.tmu.ac.jp/~bb/NX_wiki/?Neutron_xray_1.
(6) Assessment and grading	Assessed by reports.
(7) Questions to the instructor (Office hours, etc.)	No specific office hours are provide. If you have questions, please make an appointment first by sending an email to kadowaki@tmu.ac.jp.
(8) Special note	Basic knowledge of Quantum Mechanics I and II is assumed.

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	Computational physics	M(R0114)			2nd	Wed	5	2
Doctoral program								

Instructor(s)	Note
Akira Shudo	

(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	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 Experimental Technique in Physics A	R0171			2nd A	Tue	3	1
Doctoral program	Advanced Experimental Technique in Physics A	R0172	Advanced Experimental Technique in Physics A	R172				

Instructor(s)	Note
Yuji Aoki	

(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	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 Experimental Technique in Physics B	R0937			2nd A	Tue	3	1
Doctoral program	Advanced Experimental Technique in Physics B	R0938	Advanced Experimental Technique in Physics B	R938				

Instructor(s)	Note
Hiroaki Kadowaki	

(1) Course policies and topics	In all fields of experimental research in physics, quantitative data analysis is performed after obtaining experimental data. The universally used method for the data analysis is the least-squares method, which is incorporated as a black box in commercially available (or free) curve-fitting packages and analysis packages developed in various research fields. This class aims to understand the fundamentals of the least-squares method and to improve its application.
(2) Knowledge/skills to be acquired and learning objectives/course goals	Although the least-squares method can often be used as a black box to obtain sufficient results without being aware of the methodology, when it comes to difficult experimental data analysis, one may modify software to use the least-squares method by oneself. In this class, students will understand the principles of nonlinear least squares using the Levenberg-Marquardt algorithm, which is currently in common use, and learn the basics of using the least squares method by doing exercises using programming.
(3) Course schedule, subject matter, and classroom activities	Starting from the simple least squares method learned in undergraduate student experiments, the course will explain the solution method and algorithm of linear least squares as applied mathematics, and the numerical solution method of nonlinear least squares using the Levenberg-Marquardt algorithm, which is an extension of the simple least squares method. The course will also explain the concept of error in experimental data and the general theory of applying test methods in statistics to data analysis using the least squares method. Based on this basic knowledge, exercises on linear least squares and nonlinear least squares will be conducted using the program. 1st: Introduction to least squares method as a physical experimental data analysis. 2nd: Mathematics and numerical solution of the linear least squares method 3rd: Error evaluation in the linear least squares method 4th: Tests and singular values in the linear least squares method 5th: Mathematics of nonlinear least squares 6th: Numerical solution of nonlinear least squares using the Levenberg-Marquardt algorithm 7th: Errors and tests for nonlinear least-squares methods 8th: How to deal with experimental data that cannot be easily handled by ordinary nonlinear least squares methods Method of teaching: Mostly given by lectures. (The class web page: http://bb.phys.se.tmu.ac.jp/~bb/LS_wiki/)
(4) Outside-class activities and assignments	Review after each class using references and materials. Try to do the exercises on your own.
(5) Textbooks and course materials	Reference book: Toru Nakagawa and Yoshio Koyanagi, "Experimental Data Analysis by the Least Squares Method - Program SALS (in Japanese)" (UP Applied Mathematics 7), University of Tokyo Press, 1982. Other references will be introduced during the course.
(6) Assessment and grading	Assessed by reports.
(7) Questions to the instructor (Office hours, etc.)	No specific office hours are provide. If you have questions, please make an appointment first by sending an email to kadowaki@tmu.ac.jp.
(8) Special note	Basic knowledge of linear algebra, statistics, and programming is assumed.

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	Selected Topics in Physics and Chemistry I (Advanced Experimental Technique in Physics C)	M(R0161)			2nd A	Wed	3	1
Doctoral program	Selected Topics in Physics and Chemistry I (Advanced Experimental	D(R0162)	Selected Topics in Physics and Chemistry I (Advanced Experimental	D(R162)				

Instructor(s)	Note
Hajime Tanuma	

(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	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 particle physics	M(R0097)			1st Intensive			1
Doctoral program	Advanced particle physics	D (R0098)	Advanced particle physics	D (R098)				

Instructor(s)	Note
Osamu Yasuda	Register during the first semester registration period.

(1) Course policies and topics	This course gives an introductory description of neutrino masses and mixings and related experiments.
(2) Knowledge/skills to be acquired and learning objectives/course goals	All the phenomena of particles in the center-of-mass energy range less than TeV can be successfully described by a theory called standard model of particle physics. Neutrino masses and lepton flavor mixing, discovered in the last twenty years, are the experimental results that cannot be explained by the standard model. The student will have a basic knowlegde to understand these experimental results.
(3) Course schedule, subject matter, and classroom activities	01. Theoretical description of neutrino mass 02. Propagation of neutrinos in vacuum and matter 03. Information of various neutrino experiments: reactor neutrinos 04. Information of various neutrino experiments: atmospheric neutrinos 05. Information of various neutrino experiments: solar neutrinos 06. Information of various neutrino experiments: accelerator neutrinos 07. Nonstandard framework of neutrino mixing: sterile neutrino, nonstandard Interaction 08. Nonstandard framework of neutrino mixing: unitarity violation
(4) Outside-class activities and assignments	Lecture slides will be available on the website (the URL will be given on the kibaco system). Students are expected to study the contents of the course in advance.
(5) Textbooks and course materials	The following is course material: "Phenomenology of neutrino oscillations", S. M. Bilenky, C. Giunti, W. Grimus, Prog.Part.Nucl.Phys. 43 (1999) 1-86 [e-Print: hep-ph/9812360].
(6) Assessment and grading	The final grade will be based on a written assignment toward the end of the lectures.
(7) Questions to the instructor (Office hours, etc.)	Office hours are not specified, and the student, who has a question, should send email to the instructor (the email address will be given on the kibaco system).
(8) Special note	Announcements will be sent to the students' email addresses ending with @ed.tmu.ac.jp, and the students should set up the TMU mail account so that all the emails addressed to the address last-first@ed.tmu.ac.jp be forwarded to their private mail addresses.

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 high-energy theoretical physics	R0099			2	Tuesday	2	1
Doctoral program	advanced high-energy theoretical physics	R0100	advanced high-energy theoretical physics	R100				

Instructor(s)	Note
Serguei Ketov	

(1) Course policies and topics	The lectures offer an introduction to theoretical cosmology of the Universe. Knowledge of field theory and general relativity is a prerequisite. The lectures are original from the teacher. Students should make notes during the lectures and study them at home again. The key objectives and skills to be acquired by students include basic knowledge of modern theory of cosmology, including related physics and mathematics. Schedule and subjects of lectures: [1] large scale structure of the Universe, [2] general relativity and Friedman universe, [3] dark energy and dark matter, [4] cosmological inflation, [5] reheating after inflation and Big Bang, [6] models of supersymmetric early universe, [7] CP violation, baryon asymmetry, and baryo-genesis, [8] superstring cosmology
(2) Knowledge/skills to be acquired and learning objectives/course goals	The lectures are advanced, and will be given in English. There is no textbook. The conditions for earning credits are attendance of lectures (at least 2/3 or more) and positive results of an oral test at the end of the term. During the test, students are allowed to bring any literature with them. Office hours for questions and consulations with the teacher are on Mondays between 13:00-14:30 (reservations by email are recommended) Email address: ketov@tmu.ac.jp
(3) Course schedule, subject matter, and classroom activities	The lectures are related to particle physics theory, general relativity theory and astrophysics theory.
(4) Outside-class activities and assignments	
(5) Textbooks and course materials	

(6) Assessment and grading (7) Questions to the instructor (Office hours, etc.) (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	Advanced subatomic physics	R0125			1st	Thu.	3	2
Doctoral program	Advanced subatomic physics	R0126	Advanced subatomic physics	R126				

Instructor(s)	Note
Tetsuo Hyodo	

(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	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 High Energy Astrophysics I	M (R0131)	Advanced High Energy Astrophysics I		2nd A	Fri.	3	1
Doctoral program	Advanced High Energy Astrophysics I	D (R0132)	Advanced High Energy Astrophysics I	D (R132)				

Instructor(s)	Note
Yutaka Fujita	

(1) Course policies and topics	This course introduces theories of high energy astrophysics. The aim of this course is to help students understand physical processes relevant to the structure and evolution of high-energy objects.
(2) Knowledge/skills to be acquired and learning objectives/course goals	At the end of the course, participants are expected to explain radiation processes based on physics such as electromagnetism and special relativity.
(3) Course schedule, subject matter, and classroom activities	1. Overview of high-energy astrophysics 2. Radiation from moving particles 3. Dipole emission 4. Special relativity 5. Synchrotron emission I 6. Synchrotron emission II 7. Inverse Compton scattering
(4) Outside-class activities and assignments	Participants are highly recommended to prepare each lecture by reading the textbook and review the things that they have learned in the lecture.
(5) Textbooks and course materials	Textbook is provided in the lecture. Reference book: Radiative Processes in Astrophysics (George B. Rybicki, Saul A. Teukolsky; Wiley)
(6) Assessment and grading	Your final grade will be calculated according to the following process: Usual performance score, Reports.
(7) Questions to the instructor (Office hours, etc.)	Make an appointment in advance.
(8) Special note	This course is complementary to “Advanced High Energy Astrophysics II”, in which specific phenomena such as accretion disks and cosmic-ray acceleration are dealt with.

Program	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 Nonlinear Physics	M(R0141)			1st	Mon	3	1
Doctoral program	Advanced Nonlinear Physics	D(R0141)	Advanced Nonlinear Physics	D(R0142)				

Instructor(s)	Note
Akira Shudo	

(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	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 statistical mechanics	M(R0117)			1st B	Tue.	3	1
Doctoral program	Advanced statistical mechanics	D(R0118)	Advanced statistical mechanics	D(R118)				

Instructor(s)	Note
Emiko Arahata	This course is offered for Physics and Chemistry majors and also in the undergraduate program

(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	Term paper(100%)
(7) Questions to the instructor (Office hours, etc.)	Questions will be accepted at any time. Make an appointment in advance.
(8) Special note	Statistical mechanics and quantum mechanics have been learned. It is desirable to take Advanced Quantum Many Body System

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 quantum many-body system	R0115	Advanced quantum many-body system	R115	1st intensive			1
Doctoral program	Advanced quantum many-body system	R0116	Advanced quantum many-body system	R116				

Instructor(s)	Note
Kazuhisa Hattori	

(1) Course policies and topics	Quantum field theories play crucial roles on modern condensed-matter physics. In this course, we start from second quantization and learn basic techniques about many-body perturbation theory.
(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	Students must download the pdf lecture note in kibaco and read it before the class starts. 16. Second quantization 17. Exact diagonalization 18. Free particles and mean-field approximations 19. Green's functions 20. Perturbation theory and Feynman diagram techniques 21. Dyson's equation 22. Mean-field theory in terms of Green function methods 23. Random-phase approximation The detail about the schedule will be announced by the middle of April.
(4) Outside-class activities and assignments	Study at least one of the books in (5) or similar textbooks by yourself.
(5) Textbooks and course materials	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.)	Make an appointment or directly send questions by email.
(8) Special note	Register during the registration period in the first semester.

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 Physics of Magnetism	R0123	-	-	2nd A	Mon	3	1
Doctoral program	Advanced Physics of Magnetism	R0124	Advanced Physics of Magnetism	R124				

Instructor(s)	Note
Takashi Hotta	

(1) Course policies and topics	We learn from the basics about the magnetic properties of matter. After reviewing the basics of solid-state electron theory, we seek a magnetic phase diagram by molecular field approximation of itinerant magnetic materials, and we further discuss the importance of spin fluctuations. Next, after showing that the Heisenberg model can be understood as an effective Hamiltonian in the Mott insulator of the Hubbard model, we will learn about spin-wave approximation.
(2) Knowledge/skills to be acquired and learning objectives/course goals	It is possible to acquire basic theoretical methods and basic concepts such as molecular field approximation and correlation function. We also understand that they are indispensable for understanding actual magnetic materials.
(3) Course schedule, subject matter, and classroom activities	1. Magnetic ions 2. One-electron approximation, Bloch's theorem, Band structure 3. Free electron gas model, Hubbard model 4. Theory of itinerant magnetic material I 5. Theory of itinerant magnetic material II 6. Theory of magnetic insulators I 7. Theory of magnetic insulators II 8. Announcement and commentary on report assignment Classroom activities: Classes centered on lectures will be conducted.
(4) Outside-class activities and assignments	It is necessary to prepare for the next lesson range 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 depends on the report assignment.
(7) Questions to the instructor (Office hours, etc.)	Office hours are not set in particular, but if the student wants to ask a question directly, I will accept it. He/she should make an appointment by email in advance. Email: hotta@tmu.ac.jp
(8) Special note	Knowledge of quantum mechanics and statistical mechanics is assumed.

Program	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 High Energy Physics I	R0119	Advanced High Energy Physics I	R119	1st B	Fri.	3	1
Doctoral program	Advanced High Energy Physics I	R0120	Advanced High Energy Physics I	R120				

Instructor(s)	Note
Hidekazu Kakuno	

(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 those 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	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 Astrophyics	R0127			1st A	Wed	3	1
Doctoral program	Advanced Astrophysics	R0128	Advanced Astrophysics	R128				

Instructor(s)	Note
Yuichiro Ezoe	

(1) Course policies and topics	Advanced Astrophysics. The lectures will cover topics which are necessary for those who will be engaging to the fundamental and development research on astrophysics.
(2) Knowledge/skills to be acquired and learning objectives/course goals	understanding of representative radiation detectors and data analysis.
(3) Course schedule, subject matter, and classroom activities	1st : principle of radiation detectors 2nd : gas detectors (proportional counters, gas scintillation proportional counters) 3rd : solid, semiconductor detectors (scintillators, Si detector, CdTe detector) 4th : imaging sensors, gratings (CCD, CMOS, DepFET, gratings) 5th : low temperature detectors (microcalorimetors, STJ, cryocoolers) 6th : other necessary technologies (X-ray generators, ASIC, signal processing) 7th : data analysis (error, chi square, data fitting) 8th : Reports and comments 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	Evaluate marks in a question-and answer session and in reports
(7) Questions to the instructor (Office hours, etc.)	Send an appointment e-mail to instructor.
(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	Advanced Correlated Electron Physics I	R0149			2nd A	Thu.	3	1
Doctoral program	Advanced Correlated Electron Physics I	R0150	Advanced Correlated Electron Physics I	R150				

Instructor(s)	Note
Tatsuma Matsuda	

(1) Course policies and topics	Advanced Solid State Physics. The lectures will cover topics which are necessary for those who will be engaging to the fundamental and development research on solid materials.
(2) Knowledge/skills to be acquired and learning objectives/course goals	understanding of basis of strongly corelated electron systems, heavy-electron states, quantum critical phenomena, anisotropic superconductivity, understanding of principle of experimental techniques (transport, thermal, and quantum beam)
(3) Course schedule, subject matter, and classroom activities	1st : electron configuration of an atom 2nd : crystalline electric field, magnetism in crystal 3rd : physical properties of localized f-electron state 4th : multipole degrees of freedon in the rare-earth systems 5th : Kondo-effect, RKKY interaction, strongly correlated electron systems 6th : quantum critical phenomena (anomalous behavior, emergence of superconducting state) 7th : typical phenomena in the strongly correlated electron systems 8th : experimental techniques 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 two reports assignments
(7) Questions to the instructor (Office hours, etc.)	Send an appointment e-mail to instructor.
(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	Selected Topics in Physics and Chemistry I (Advanced Nanoscience, Surface, and Interface Physics I)	M(R0147)			2nd A	Tue.	2	1
Doctoral program	Selected Topics in Physics and Chemistry I (Advanced Nanoscience, Surface, and Interface Physics I)	D (R0148)	Selected Topics in Physics and Chemistry I (Advanced Nanoscience, Surface, and Interface physics I)	D (R148)				

Instructor(s)	Note
Yasumitsu Miyata	This course is offered for Physics and Chemistry majors

(1) Course policies and topics	
(2) Knowledge/skills to be acquired and learning objectives/course goals	The objectives of this course are to learn the basics of electronic band calculations using the tight-biding approximation, to draw the band structures of simple materials such as graphene, and to derive physical properties such as density of states and Fermi velocities. Students will also acquire basic knowledge to extract information contained in measurement results.
(3) Course schedule, subject matter, and classroom activities	[Course schedule and subject matter] 1. Hybridization and energy of atomic orbitals 2. Tight biding calculation 3. Electronic structure of polyacetylene 4. Symmetry and electronic structure of polyacetylene 5. Electronic structure of graphene 6. Dimensionality and density of states 7. Relationship between band structure and electrical and optical properties [classroom activities] The class will be conducted mainly through lectures and exercises.
(4) Outside-class activities and assignments	The students are expected to solve the exercises given at the end of each class before the next class. Explanations will be given in the next lecture.
(5) Textbooks and course materials	Materials describing the lecture and exercises will be distributed at the beginning of each class. Reference materials will be introduced during the lecture.
(6) Assessment and grading	Evaluation will be based on reports (70%) and class participation (attendance, in-class exercises) (30%).
(7) Questions to the instructor (Office hours, etc.)	It is desirable to have taken Fundamentals of Condensed Matter Physics I, II, or equivalent courses.
(8) Special note	Office hours are not set. Questions may be asked in the instructor’s office (Room 528) or by e-mail (miyata-yasumitsu_at_tmu.ac.jp). (_at_ is converted to @)

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 Neutron Scattering and Magnetism I	R0157			2nd B	Tue	4	1
Doctoral program	Advanced Neutron Scattering and Magnetism I	R0158	Advanced Neutron Scattering and Magnetism I	R158				

Instructor(s)	Note
Hiroaki Kadowaki	

(1) Course policies and topics	The subject of condensed matter physics is an aggregate of atoms, whose various structures (crystal, glass, liquid, etc.) give rise to a wide variety of physical properties. In order to investigate the microscopic structure of materials, scattering and diffraction experiments are used, which employ wavelengths (neutron beams and X-rays) with wavelengths comparable to the interatomic distance. As an application of the previous lecture " Solid State Physics with Particle Beam", which explained the basics of neutron scattering experiments, this lecture focuses on how neutron scattering experiments have been used in the past and recent studies of physical properties to obtain microscopic information on materials.
(2) Knowledge/skills to be acquired and learning objectives/course goals	The ability to read and understand the latest research papers will be developed.
(3) Course schedule, subject matter, and classroom activities	Some past and recent research papers using neutron scattering experiments will be given during the lecture. The students will be assigned to read and understand those research papers by themselves. 1st: Deciphering and explaining Kubo's formula. 2nd: Deciphering and explanation of the papers on response functions of neutron scattering. 3rd: Deciphering and explanation of the papers on phonon measurement experiments. 4th: Deciphering and explanation of the paper on the analysis of phonon experiments using density functional theory. 5th: Deciphering and explanation of papers on experimental studies of quantum spin liquid states. 6th: Deciphering and explanation of papers on theoretical studies of quantum spin liquid states. 7th: Deciphering and explanation of papers on the principle of the MF-RPA method and the analysis of experimental data using the method. Methods: Mostly by lectures.
(4) Outside-class activities and assignments	After each class, review using references and materials.
(5) Textbooks and course materials	Reference books, references, and materials will be introduced during the lecture as appropriate.
(6) Assessment and grading	Assessed by reports.
(7) Questions to the instructor (Office hours, etc.)	No specific office hours are provide. If you have questions, please make an appointment first by sending an email to kadowaki@tmu.ac.jp.
(8) Special note	It is recommended to have learned Solid State Physics with Particle Beam.

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	Selected Topics in Physics and Chemistry I (Advanced Soft Matter Physics I)	R0151			1stB	Thu.	3	1
Doctoral program	Selected Topics in Physics and Chemistry I (Advanced Soft Matter Physics I)	R0152	Selected Topics in Physics and Chemistry I (Advanced Soft Matter Physics I)	R152				

Instructor(s)	Note
Rei Kurita	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	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	Selected Topics in Physics and Chemistry I (Advanced Materials Science: Minimum)	R0110			2nd A	Fri	2	1
Doctoral program	Selected Topics in Physics and Chemistry I (Advanced Materials Science: Minimum)	R0113	Selected Topics in Physics and Chemistry I (Advanced Materials Science: Minimum)	R113				

Instructor(s)	Note
Yuji Aoki	This course is offered for Physics and Chemistry majors.

(1) Course policies and topics	This course is designed for students to acquire the minimum basics for condensed matter physics, especially for master's course experimental research works. In principle, this course assumes that students have already acquired credits for basic lectures and experiments in physics courses such as mechanics, electromagnetism, thermodynamics and statistical mechanics, quantum mechanics, and basic physics experiments. Emphasis will be placed on reviewing and organizing these lectures and their applications to the fields of materials science, as well as on learning the basic experimental research techniques.
(2) Knowledge/skills to be acquired and learning objectives/course goals	To review classical mechanics, electromagnetism, thermodynamics and statistical mechanics, quantum mechanics, and physics experiments, and to organize a minimum level of physics fundamentals appropriate for students in the physics course. In addition, introductory lectures and exercises will be given on experimental physics and materials science. Students will also learn how to conduct experiments safely, science writing techniques, presentation methods, and the most basic and important manners necessary for conducting research works.
(3) Course schedule, subject matter, and classroom activities	1. What is "materials science"? 2-3. How to carry out experiments safely, writing techniques, presentation methods, etc. 4-6 Review of mathematics, classical mechanics and electromagnetism. Summary of the main points. 7-8 Review of quantum mechanics, thermal and statistical mechanics. Summary of the main points. The class will be conducted mainly by lectures.
(4) Outside-class activities and assignments	The scope of preparations and reviews will be given in the lecture. Students are expected to review the course materials in advance to clarify questions and understand the meaning of technical terms before attending the class.
(5) Textbooks and course materials	Lecture materials will be posted on kibaco.
(6) Assessment and grading	Assignment reports (70%) and class activities (30%) will be used for evaluation.
(7) Questions to the instructor (Office hours, etc.)	How to ask questions (office hours, etc.) The office hours will be held on Mondays during the 4th period. 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	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 English for science	R0139	-	-	2nd A	Tue.	2	1
Doctoral program	Advanced English for science	R0140	Advanced English for science	R140				

Instructor(s)	Note
Hiroyuki Mori	

(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 8. Explanation of reports [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.

Chemistry / Molecular Materials Chemistry
(General courses for Graduate School of Science and Graduate School of Science and Engineering)

Notes on course enrollment

(Master's program)

1. The following courses are required for the master's degree.
   - Advanced Research of Chemistry IA, IB, IIA, IIB, and
   - Seminar on Advanced Chemistry I, II No credit will be added when taking the same Advanced Research of Chemistry course more than once. In principle, Advanced Research of Chemistry I A and II B should be taken in the first year, and Advanced Research of Chemistry II A and II B should be taken in the second year. Also, students admitted in April should take Seminar on Advanced Chemistry I in the first semester and Seminar on Advanced Chemistry II in the second semester. Likewise, students admitted in October should take Seminar on Advanced Chemistry I in the second semester and Seminar on Advanced Chemistry II in the first semester.
2. The subject matter of Advanced Theoretical Chemistry considers graduate students of other majors. In order to acquire a solid knowledge in non-major subjects, students majoring in chemistry are required to take two or more units from each of the following groups, for a total of eight or more units to meet the master's degree requirement.
   Group 1: Advanced Inorganic Chemistry, Advanced Cosmochemistry
   Group 2: Advanced Organic Chemistry, Advanced Biological Chemistry
   Group 3: Advanced Molecular Spectroscopy, Advanced Physical Chemistry of Condensed Matter, Advanced Theoretical Chemistry
3. Lecture of Advanced Chemistry I is given by guest lecturers to explain basics by sharing their latest research and topics on their expertise. Students are encouraged to take this course to acquire broader knowledge.
4. In general, students are not allowed to take the same course more than once but may retake the same course for the following courses and earn credits if the course provides different subject matter.
   - Lecture of Advanced Chemistry I
   - Lecture of Advanced Chemistry II
   - Internship of Chemistry
   - Seminar on Advanced Chemistry I, II

(Doctoral program)

1. The following courses are required for the doctorate.
   - Advanced Research of Chemistry IIIA, IIIB, IVA, IVB and
   - Seminar on Advanced Chemistry III, IV No credit will be added when taking the same Advanced Research of Chemistry course more than once. In principle, Advanced Research of Chemistry IIIA and IIIB should be taken in the first year, and Advanced Research of Chemistry IVA and IVB should be taken in the second year. Also, students admitted in April should take Seminar on Advanced Chemistry III in the first semester and Seminar on Advanced Chemistry IV in the second semester. Likewise, students admitted in October should take Seminar on Advanced Chemistry III in the second semester and Seminar on Advanced Chemistry IV in the first semester.
2. Lecture of Advanced Chemistry I is given by guest lecturers to explain basics by sharing their latest research and topics on their expertise. Students are encouraged to take this course to acquire broader knowledge.
3. In general, students are not allowed to take the same course more than once but may take the same course more than once for the following courses and earn credits if the course provides different subject matter.
   - Lecture of Advanced Chemistry I
   - Lecture of Advanced Chemistry II
   - Internship of Chemistry
   - Seminar on Advanced Chemistry III, IV

* M = master's courses, D = doctoral courses
* NA 2022 = Courses not offered in the academic year 2022

Course outline	M	D	NA 2022	Semester	Day	Time	[Graduate School of Science]		Credit Hours	Instructor(s)	Note (enrollment requirements, subject matter, etc.)
							Course Number	Course Name			
1	○			1st	Fri.	1	M(R0221)	Advanced Inorganic Chemistry	2	Ken'ichi Sugiura, Shiro Kubuki, Seiji Yamazoe	
2	○			2nd	Tue.	2	M(R0222)	Advanced Geo-and Cosmochemistry	2	Nobuyuki Takegawa, Yasuji Oura	
3	○			1st	Wed.	2	M(R0223)	Advanced Organic Chemistry	2	Toshio Shimizu, Kotohiro Nomura, Akiko Inagaki, Abdellatif Mohammed M.	
4	○			2nd	Wed.	2	M(R0224)	Advanced Biological Chemistry	2	Kouji Hirota, Yutaka Ito, Masato Taoka, Teppei Iketani	
5	○	○		2nd	Wed.	1	M(R0163) D (R0164)	Advanced Molecular Spectroscopy	2	Reika Kanya	This course is offered for Physics and Chemistry majors
6	○	○		1st	Wed.	1	M(R0165) D (R0166)	Advanced Physical Chemistry of Condensed Matter	2	Yasushi Hirose	This course is offered for Physics and Chemistry majors
7	○	○		1st	Tue.	2	M(R0167) D (R0168)	Selected Topics in Physics and Chemistry (Advanced Theoretical Chemistry)	2	Masahiko Hada, Naoki Nakatani	This course is offered for Physics and Chemistry majors
8	○	○		1st	Tue.	2	M(R0108) D (R0205)	Selected Topics in Physics and Chemistry II (Atomic physics)	2	Hajime Tanuma	This course is offered for Physics and Chemistry majors (See syllabus in Physics)
9	○	○		1st	Wed.	2	M(R0109) D (R0206)	Selected Topics in Physics and Chemistry II (Solid State Physics I)	2	Emiko Arahata	This course is offered for Physics and Chemistry majors (See syllabus in Physics)
10	○			1st	Thu.	1	M(R0231)	Advanced Lecture in Chemistry II (Organic Reaction Mechanisms)	2	Kotohiro Nomura	Doctoral students who wish to enroll in the 2022 academic year must apply to the Academic Affairs Division of the Faculty of Science during the application period.
	○		△	1st	Mon.	2	M(R0233)	Advanced Lecture in Chemistry (Advanced Material Science)	2	* TBA	
11	○			2nd	Fri.	1	M(R0300)	Advanced Lecture in Chemistry (Functional Material Science)	2	Toru Nishinaga, Masatoshi Ishida	Doctoral students who wish to enroll in the 2022 academic year must apply to the Academic Affairs Division of the Faculty of Science during the application period.
12	○			2nd	Fri.	2	M(R0299)	Advanced Lecture in Chemistry II (Advanced Materials Chemistry)	2	Kotohiro Nomura	Doctoral students who wish to enroll in the 2022 academic year must apply to the Academic Affairs Division of the Faculty of Science during the application period.
13	○			2nd	Wed.	5	M(R0234)	Advanced English in Chemistry	2	* Julian Koe	
14	○	○		Intensive course			M (R0295) 1 unit M (R0297) 2 units D (R0296) 1 unit D (R0298) 2 units	Internship of Chemistry	1 or 2	Multiple instructors	
	○	○		Intensive course				Lecture of Advanced Chemistry I	1	* TBA	
	○	○		Intensive course				Selected Topics in Physics and Chemistry I	1	* TBA	
15	○	○		2nd A	Tue.	2	M(R0147) D (R0148)	Selected Topics in Physics and Chemistry II (Advanced Nanoscience, Surface, and Interface Physics I)	1	Yasumitsu Miyata	This course is offered for Physics and Chemistry majors (See syllabus in Physics)
	○	○	△	1st B	Tue.	1	M(R0137) D (R0138)	Selected Topics in Physics and Chemistry I (Advanced Nanoscience, Surface, and Interface Physics II)	1	Kazuhiro Yanagi	This course is offered for Physics and Chemistry majors
16	○	○		1st B	Thu.	3	M(R0151) D (R0152)	Selected Topics in Physics and Chemistry I (Advanced Soft Matter Physics I)	1	Rei Kurita	This course is offered for Physics and Chemistry majors (See syllabus in Physics)
	○	○	△	1st B	Thu.	3	M(R0143) D (R0144)	Selected Topics in Physics and Chemistry I (Advanced Soft Matter Physics II)	1	Rei Kurita	This course is offered for Physics and Chemistry majors
17	○	○		2nd A	Fri.	2	M(R0110) D(R0113)	Selected Topics in Physics and Chemistry I (Advanced Minimum Material Science)	1	Yuji Aoki	This course is offered for Physics and Chemistry majors (See syllabus in Physics)
18	○	○		2nd A	Wed.	3	M(R0161) D (R0162)	Selected Topics in Physics and Chemistry II (Advanced Experimental Technique in Physics C)	1	Hajime Tanuma	This course is offered for Physics and Chemistry majors (See syllabus in Physics)
19	○	○		2nd B	Mon.	3	M(R0159) D (R0160)	Selected Topics in Physics and Chemistry I (Advanced Experimental Technique in Physics D)	1	* Toshiyuki Azuma	This course is offered for Physics and Chemistry majors

20	○			1st	Mon.	3, 4	Ⅰ:M(R0235)	Seminar on Advanced Chemistry I (Master's program)	2	Hirose	
21	○			2nd	Mon.	1, 2	Ⅱ:M(R0236	Seminar on Advanced Chemistry II (Master's program)	2	Hirose	
20	○			1st	Mon.	1, 2	Ⅰ:M(R0239)	Seminar on Advanced Chemistry I (Master's program)	2	Takegawa	
21	○			2nd	Mon.	1, 2	Ⅱ:M(R0240)	Seminar on Advanced Chemistry II (Master's program)	2	Takegawa	
20	○			1st	Mon.	1, 2	Ⅰ:M(R0241)	Seminar on Advanced Chemistry I (Master's program)	2	Hirota, Taoka	
21	○			2nd	Mon.	1, 2	Ⅱ:M(R0242)	Seminar on Advanced Chemistry II (Master's program)	2	Hirota, Taoka	
20	○			1st	Mon.	3, 4	Ⅰ:M(R0243)	Seminar on Advanced Chemistry I (Master's program)	2	Kanya	
21	○			2nd	Mon.	1, 2	Ⅱ:M(R0244)	Seminar on Advanced Chemistry II (Master's program)	2	Kanya	
20	○			1st	Tue.	4, 5	Ⅰ:M(R0245)	Seminar on Advanced Chemistry I (Master's program)	2	Hada, Nakatani	
21	○			2nd	Mon.	4, 5	Ⅱ:M(R0246)	Seminar on Advanced Chemistry II (Master's program)	2	Hada, Nakatani	
20	○			1st	Mon.	3, 4	Ⅰ:M(R0247)	Seminar on Advanced Chemistry I (Master's program)	2	Shimizu	
21	○			2nd	Mon.	3, 4	Ⅱ:M(R0248)	Seminar on Advanced Chemistry II (Master's program)	2	Shimizu	
20	○			1st	Fri.	3, 4	Ⅰ:M(R0249)	Seminar on Advanced Chemistry I (Master's program)	2	Kubuki	
21	○			2nd	Fri.	1, 2	Ⅱ:M(R0250)	Seminar on Advanced Chemistry II (Master's program)	2	Kubuki	
20	○			1st	Mon.	1, 2	Ⅰ:M(R0251)	Seminar on Advanced Chemistry I (Master's program)	2	Sugiura, Ishida	
21	○			2nd	Mon.	1, 2	Ⅱ:M(R0252)	Seminar on Advanced Chemistry II (Master's program)	2	Sugiura, Ishida	
20	○			1st	Mon.	5, 6	Ⅰ:M(R0253)	Seminar on Advanced Chemistry I (Master's program)	2	Nomura, Inagaki, Mohamed	
21	○			2nd	Mon.	5, 6	Ⅱ:M(R0254)	Seminar on Advanced Chemistry II (Master's program)	2	Nomura, Inagaki, Mohamed	
20	○			1st	Fri.	4, 5	Ⅰ:M(R0255)	Seminar on Advanced Chemistry I (Master's program)	2	Yamazoe, Oura	
21	○			2nd	Fri.	4, 5	Ⅱ:M(R0256)	Seminar on Advanced Chemistry II (Master's program)	2	Yamazoe, Oura	
20	○			1st	Fri.	5, 6	Ⅰ:M(R0257)	Seminar on Advanced Chemistry I (Master's program)	2	Ito, Iketani, Nishinaga	
21	○			2nd	Fri.	5, 6	Ⅱ:M(R0258)	Seminar on Advanced Chemistry II (Master's program)	2	Ito, Iketani, Nishinaga	
22		○		1st	Mon.	3, 4	III: D (R0259)	Seminar on Advanced Chemistry III (Doctoral program)	2	Hirose	
23		○		2nd	Mon.	1, 2	IV: D (R0260)	Seminar on Advanced Chemistry IV (Doctoral program)	2	Hirose	
22		○		1st	Mon.	1, 2	III: D (R0263)	Seminar on Advanced Chemistry III (Doctoral program)	2	Takegawa	
23		○		2nd	Mon.	1, 2	IV: D (R0264)	Seminar on Advanced Chemistry IV (Doctoral program)	2	Takegawa	
22		○		1st	Mon.	1, 2	III: D (R0265)	Seminar on Advanced Chemistry III (Doctoral program)	2	Hirota, Taoka	
23		○		2nd	Mon.	1, 2	IV: D (R0266)	Seminar on Advanced Chemistry IV (Doctoral program)	2	Hirota, Taoka	
22		○		1st	Mon.	3, 4	III: D (R0267)	Seminar on Advanced Chemistry III (Doctoral program)	2	Kanya	
23		○		2nd	Mon.	1, 2	IV: D (R0268)	Seminar on Advanced Chemistry IV (Doctoral program)	2	Kanya	
22		○		1st	Tue.	4, 5	III: D (R0269)	Seminar on Advanced Chemistry III (Doctoral program)	2	Hada, Nakatani	
23		○		2nd	Mon.	4, 5	IV: D (R0270)	Seminar on Advanced Chemistry IV (Doctoral program)	2	Hada, Nakatani	
22		○		1st	Mon.	3, 4	III: D (R0271)	Seminar on Advanced Chemistry III (Doctoral program)	2	Shimizu	
23		○		2nd	Mon.	3, 4	IV: D (R0272)	Seminar on Advanced Chemistry IV (Doctoral program)	2	Shimizu	
22		○		1st	Fri.	3, 4	III: D (R0273)	Seminar on Advanced Chemistry III (Doctoral program)	2	Kubuki	
23		○		2nd	Fri.	1, 2	IV: D (R0274)	Seminar on Advanced Chemistry IV (Doctoral program)	2	Kubuki	
22		○		1st	Mon.	1, 2	III: D (R0275)	Seminar on Advanced Chemistry III (Doctoral program)	2	Sugiura, Ishida	
23		○		2nd	Mon.	1, 2	IV: D (R0276)	Seminar on Advanced Chemistry IV (Doctoral program)	2	Sugiura, Ishida	
22		○		1st	Mon.	5, 6	III: D (R0277)	Seminar on Advanced Chemistry III (Doctoral program)	2	Nomura, Inagaki, Mohamed	
23		○		2nd	Mon.	5, 6	IV: D (R0278)	Seminar on Advanced Chemistry IV (Doctoral program)	2	Nomura, Inagaki, Mohamed	
22		○		1st	Fri.	4, 5	III: D (R0279)	Seminar on Advanced Chemistry III (Doctoral program)	2	Yamazoe, Oura	
23		○		2nd	Fri.	4, 5	IV: D (R0280)	Seminar on Advanced Chemistry IV (Doctoral program)	2	Yamazoe, Oura	
22		○		1st	Fri.	5, 6	III: D (R0281)	Seminar on Advanced Chemistry III (Doctoral program)	2	Ito, Iketani, Nishinaga	
23		○		2nd	Fri.	5, 6	IV: D (R0282)	Seminar on Advanced Chemistry IV (Doctoral program)	2	Ito, Iketani, Nishinaga	
24	○			1st			Ⅰ A:M(R0284)	Advanced Research of Chemistry IA (Master's program)	2	Multiple instructors	
25	○			2nd			Ⅰ B:M(R0285)	Advanced Research of Chemistry IB (Master's program)	2	Multiple instructors	
26	○			1st			Ⅱ A:M(R0287)	Advanced Research of Chemistry IIA (Master's program)	2	Multiple instructors	
27	○			2nd			Ⅱ B:M(R0288)	Advanced Research of Chemistry IIB (Master's program)	2	Multiple instructors	
28		○		1st			IIIA: D (R0290)	Advanced Research of Chemistry IIIA (Doctoral)	2	Multiple instructors	
29		○		2nd			Ⅲ B:M(R0291)	Advanced Research of Chemistry IIIB (Doctoral)	2	Multiple instructors	
30		○		1st			IVA: D (R0293)	Advanced Research of Chemistry IVA (Doctoral)	2	Multiple instructors	
31		○		2nd			IVB: D (R0294)	Advanced Research of Chemistry IVB (Doctoral)	2	Multiple instructors	

20	○			2nd	Mon.	1, 2	Ⅰ:M(R0951)	Seminar on Advanced Chemistry I (Master's program)	2	Hirose	
21	○			1st	Mon.	3, 4	Ⅱ:M(R0950)	Seminar on Advanced Chemistry II (Master's program)	2	Hirose	
20	○			2nd	Mon.	1, 2	Ⅰ:M(R0955)	Seminar on Advanced Chemistry I (Master's program)	2	Takegawa	
21	○			1st	Mon.	1, 2	Ⅱ:M(R0954)	Seminar on Advanced Chemistry II (Master's program)	2	Takegawa	
20	○			2nd	Mon.	1, 2	Ⅰ:M(R0957)	Seminar on Advanced Chemistry I (Master's program)	2	Hirota, Taoka	
21	○			1st	Mon.	1, 2	Ⅱ:M(R0956)	Seminar on Advanced Chemistry II (Master's program)	2	Hirota, Taoka	
20	○			2nd	Mon.	1, 2	Ⅰ:M(R0959)	Seminar on Advanced Chemistry I (Master's program)	2	Kanya	
21	○			1st	Mon.	3, 4	Ⅱ:M(R0958)	Seminar on Advanced Chemistry II (Master's program)	2	Kanya	
20	○			2nd	Mon.	4, 5	Ⅰ:M(R0961)	Seminar on Advanced Chemistry I (Master's program)	2	Hada, Nakatani	
21	○			1st	Tue.	4, 5	Ⅱ:M(R0960)	Seminar on Advanced Chemistry II (Master's program)	2	Hada, Nakatani	
20	○			2nd	Mon.	3, 4	Ⅰ:M(R0963)	Seminar on Advanced Chemistry I (Master's program)	2	Shimizu	
21	○			1st	Mon.	3, 4	Ⅱ:M(R0962)	Seminar on Advanced Chemistry II (Master's program)	2	Shimizu	
20	○			2nd	Fri.	1, 2	Ⅰ:M(R0965)	Seminar on Advanced Chemistry I (Master's program)	2	Kubuki	
21	○			1st	Fri.	3, 4	Ⅱ:M(R0964)	Seminar on Advanced Chemistry II (Master's program)	2	Kubuki	
20	○			2nd	Mon.	1, 2	Ⅰ:M(R0967)	Seminar on Advanced Chemistry I (Master's program)	2	Sugiura, Ishida	
21	○			1st	Mon.	1, 2	Ⅱ:M(R0966)	Seminar on Advanced Chemistry II (Master's program)	2	Sugiura, Ishida	
20	○			2nd	Mon.	5, 6	Ⅰ:M(R0969)	Seminar on Advanced Chemistry I (Master's program)	2	Nomura, Inagaki, Mohamed	
21	○			1st	Mon.	5, 6	Ⅱ:M(R0968)	Seminar on Advanced Chemistry II (Master's program)	2	Nomura, Inagaki, Mohamed	
20	○			2nd	Fri.	4, 5	Ⅰ:M(R0971)	Seminar on Advanced Chemistry I (Master's program)	2	Yamazoe, Oura	
21	○			1st	Fri.	4, 5	Ⅱ:M(R0970)	Seminar on Advanced Chemistry II (Master's program)	2	Yamazoe, Oura	
20	○			2nd	Fri.	5, 6	Ⅰ:M(R0973)	Seminar on Advanced Chemistry I (Master's program)	2	Ito, Iketani, Nishinaga	
21	○			1st	Fri.	5, 6	Ⅱ:M(R0972)	Seminar on Advanced Chemistry II (Master's program)	2	Ito, Iketani, Nishinaga	
22		○		2nd	Mon.	1, 2	III: D (R0975)	Seminar on Advanced Chemistry III (Doctoral program)	2	Kikuchi	
23		○		1st	Mon.	3, 4	IV: D (R0974)	Seminar on Advanced Chemistry IV (Doctoral program)	2	Kikuchi	
22		○		2nd	Mon.	1, 2	III: D (R0979)	Seminar on Advanced Chemistry III (Master's)	2	Takegawa	
23		○		1st	Mon.	1, 2	IV: D (R0978)	Seminar on Advanced Chemistry IV (Doctoral program)	2	Takegawa	
22		○		2nd	Mon.	1, 2	III: D (R0981)	Seminar on Advanced Chemistry III (Doctoral program)	2	Hirota, Taoka	
23		○		1st	Mon.	1, 2	IV: D (R0980)	Seminar on Advanced Chemistry IV (Doctoral program)	2	Hirota, Taoka	
22		○		2nd	Mon.	1, 2	III: D (R0983)	Seminar on Advanced Chemistry III (Doctoral program)	2	Kanya	
23		○		1st	Mon.	3, 4	IV: D (R0982)	Seminar on Advanced Chemistry IV (Doctoral program)	2	Kanya	
22		○		2nd	Mon.	4, 5	III: D (R0985)	Seminar on Advanced Chemistry III (Doctoral program)	2	Hada, Nakatani	
23		○		1st	Tue.	4, 5	IV: D (R0984)	Seminar on Advanced Chemistry IV (Doctoral program)	2	Hada, Nakatani	
22		○		2nd	Mon.	3, 4	III: D (R0987)	Seminar on Advanced Chemistry III (Doctoral program)	2	Shimizu	
23		○		1st	Mon.	3, 4	IV: D (R0986)	Seminar on Advanced Chemistry IV (Doctoral program)	2	Shimizu	
22		○		2nd	Fri.	1, 2	III: D (R0989)	Seminar on Advanced Chemistry III (Doctoral program)	2	Kubuki	
23		○		1st	Fri.	3, 4	IV: D (R0988)	Seminar on Advanced Chemistry IV (Doctoral program)	2	Kubuki	
22		○		2nd	Mon.	1, 2	III: D (R0991)	Seminar on Advanced Chemistry III (Doctoral program)	2	Sugiura, Ishida	
23		○		1st	Mon.	1, 2	IV: D (R0990)	Seminar on Advanced Chemistry IV (Doctoral program)	2	Sugiura, Ishida	
22		○		2nd	Mon.	5, 6	III: D (R0993)	Seminar on Advanced Chemistry III (Doctoral program)	2	Nomura, Inagaki, Mohamed	
23		○		1st	Mon.	5, 6	IV: D (R0992)	Seminar on Advanced Chemistry IV (Doctoral program)	2	Nomura, Inagaki, Mohamed	
22		○		2nd	Fri.	4, 5	III: D (R0995)	Seminar on Advanced Chemistry III (Doctoral program)	2	Yamazoe, Oura	
23		○		1st	Fri.	4, 5	IV: D (R0994)	Seminar on Advanced Chemistry IV (Doctoral program)	2	Yamazoe, Oura	
22		○		2nd	Fri.	5, 6	III: D (R0997)	Seminar on Advanced Chemistry III (Doctoral program)	2	Ito, Iketani, Nishinaga	
23		○		1st	Fri.	5, 6	IV: D (R0996)	Seminar on Advanced Chemistry IV (Doctoral program)	2	Ito, Iketani, Nishinaga	
24	○			2nd			Ⅰ A:M(R0941)	Advanced Research of Chemistry IA (Master's program)	2	Multiple instructors	
25	○			1st			Ⅰ B:M(R0940)	Advanced Research of Chemistry IB (Master's program)	2	Multiple instructors	
26	○			2nd			Ⅱ A:M(R0943)	Advanced Research of Chemistry IIA (Master's program)	2	Multiple instructors	
27	○			1st			Ⅱ B:M(R0942)	Advanced Research of Chemistry IIB (Master's program)	2	Multiple instructors	
28		○		2nd			IIIA: D (R0945)	Advanced Research of Chemistry IIIA (Doctoral)	2	Multiple instructors	
29		○		1st			IIIB: D (R0944)	Advanced Research of Chemistry IIIB (Doctoral)	2	Multiple instructors	
30		○		2nd			IVA: D (R0947)	Advanced Research of Chemistry IVA (Doctoral)	2	Multiple instructors	
31		○		1st			IV IIB: D (R0946)	Advanced Research of Chemistry IVB (Doctoral)	2	Multiple instructors	

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 Inorganic Chemistry	M(R0221)	Advanced Inorganic Chemistry	M(R221)	1st	Fri.	1	2
Doctoral program								

Instructor(s)	Note
Ken'ichi Sugiura, Seiji Yamazoe, Tohru Nishinaga, Shiro Kubuki,	

(1) Course policies and topics	Dr. Kubuki provides the first seven lectures, and the latter seven ones are by prof. Sugiura. The remaining lecture is presented by either instructor concerning a cutting-edge topic in the specialized field.
(2) Knowledge/skills to be acquired and learning objectives/course goals	<Letctures by Dr. Kubuki> The attending students will study the relationship between structures and physical properties of inorganic solid material such as metal, ionic solids and glass-ceramics. <Letctures by prof. Sugiura> Molecular orbital (MO) theory is one of the most important "tool" for the contenporary inorganic chemistry. This class introduces the basics of MO theory using the simple inorganic molecules as examples.
(3) Course schedule, subject matter, and classroom activities	<1st half (Kubuki)> 1. Crystal structure (1) Notification of crystal structures (ccp, hcp, bcc) 2. Crystal structure (2) Lattice and unit cell, 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, Antiferromagnetism, Ferrimagnetism 6. Superconductivity: Discovery and theory of superconductivity 7. Summary <2nd half (Sugiura)> 8. Basics of MO theory and hydrogen molecule (H_2) 9. Extension of H_2 to triangle H_3^+, linear Hn oligomers, and metallic hydrogen 10. MOs of symmetric and/or unsymmetric diatomic molecules 11. MOs of AH_2, AH_3, and AH_4 (1) 12. MOs of AH_2, AH_3, and AH_4 (2) 13. MOs of aromatic molecules 14. Chemical reactivities 15. A cutting edge topic in the specialized field (by Sugiura or Kubuki)
(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. <Sugiura> None
(5) Textbooks and course materials	<Kubuki> L. Smart and E. Moore "Solid State Chemistry -an introduction" (Chapman and Hall)

	<Sugiura> Albright, Burdett, Whangbo, “Orbital interactions in chemistry” (John Wiley & Sons)
(6) Assessment and grading	<Kubuki> The rating is done by the assigned reports(100 points). <Sugiura> Written examination will be performed (100 points). The total score is the average of each instructor's evaluation. If one of the ratings is less than 60%, the credit may not be provided.
(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	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 Geo-and Cosmochemistry	M(R0222)			2nd	Tue.	2	2
Doctoral program								

Instructor(s)	Note
Nobuyuki Takegawa, Yasuji Oura	

(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: Optical properties of aerosol particles 4: Clouds and precipitation 5: Radiative transfer in the atmosphere 6: Geochemical cycles in the atmosphere and the oceans 7: Climate change 8: Solar elemental abundance and B_2FH theory 9: Radiochemistry-1 (nuclear stability, radioactive decay) 10: Radiochemistry-2 (nuclear reactions) 11: Nucleosynthesis-1 (fundametal thermonuclear reactions) 12: Nucleosynthesis-2 (thermonuclear fusion) 13: Nucleosynthesis-3 (s-process) 14: Nucleosynthesis-4 (r-process) 15: Exercises and explanations 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 assigned. If you have any questions, please make an appointment in advance by e-mail. Contact via Kibako is also acceptable.
(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	Advanced Organic Chemistry	R0223			1st	Wed.	2	2
Doctoral program								

Instructor(s)	Note
Toshio Shimizu, Kotohiro Nomura, Akdellatif Mohamed M., Akiko Inagaki	none

(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 instructors.
(2) Knowledge/skills to be acquired and learning objectives/course goals	Through this lecture series, the students will acquires knowledges concerning historical flow and basics in modern organic chemistry and materials chemistry. For example, supla molecular 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 lectures by each introructors. 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 introcued
(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
(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	Advanced Biological Chemistry	M(R0224)			2nd	Wed.	2	2
Doctoral program								

Instructor(s)	Note
Kouji Hirota, Yutaka Ito, Masato Taoka, Teppei Ikeya	

(1) Course policies and topics	(1) The goal is to deepen understanding of the relationship between new "chemistry" and "life" based on the network of biological macromolecules.
(2) Knowledge/skills to be acquired and learning objectives/course goals	(2) The life sciences have made remarkable progress, and new interdisciplinary fields are emerging that differ from the conventional framework of academic disciplines. In such advanced fields, it is necessary to objectively review and reconstruct chemical concepts that have been built up over a long time. In this lecture, recent trends in biochemistry, molecular biology, and structural biology against the background of genomic information of living organisms will be explained.
(3) Course schedule, subject matter, and classroom activities	(3) The 15 sessions will cover recent trends in biochemistry, molecular biology, and structural biology in the context of genomic information of living organisms.
(4) Outside-class activities and assignments	(4) Assigning reports in lectures
(5) Textbooks and course materials	(5) Handouts will be distributed in lectures.
(6) Assessment and grading	(6) Evaluation is based on reports and attendance.
(7) Questions to the instructor (Office hours, etc.)	(7) You can ask questions to each instructor at the e-mail address below. Hirota(khirota@tmu.ac.jp), Ito(ito-yutaka@tmu.ac.jp), Taoka(mango@tmu.ac.jp), and Ikeya(tikeya@tmu.ac.jp)
(8) Special note	(8) N/A

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 Molecular Spectroscopy	R0163	Selected Topics in Physics and Chemistry Ⅱ Advanced Molecular Spectroscopy	R164	2nd	Wed.	1	2
Doctoral program	Advanced Molecular Spectroscopy	R0164	Selected Topics in Physics and Chemistry Ⅱ Advanced Molecular Spectroscopy	R164				

Instructor(s)	Note
Reika Kanya	

(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. Phase shift of scattered wave, 07. Born approximation, 08. Intermediate examination, 09. Reviews and exercises, 10. Electron scattering by molecules and the independent atom model, 11. Molecular orientation and the effect of molecular vibration, 12. Molecular scattering curve and radial distribution function, 13. Analyses of electron diffraction images, 14. Recent studies in time-resolved electron diffraction method, 15. Final examination.
(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	

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 Physical Chemistry of Condensed Matter	R0165			1st	Wed.	1	2
Doctoral program	Advanced Physical Chemistry of Condensed Matter	R0166						

Instructor(s)	Note
Yasushi Hirose	This course is also offered for Physics 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. - Crystal structure - Defects and doping - Band structure in solid - Conductivity of semiconductors (Temperature dependence, Intrinsic and Extrinsic semiconductors, Drude model, Seebeck effect, Difusion, Drift current, Recombination, etc). - Photo-absorption - Metal-semiconductor junction - p-n junction - Transistor - Optoelectronic devices - Semiconductor photoelectrodes and photocatalysis
(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 homeworks (or semester exam).
(7) Questions to the instructor (Office hours, etc.)	Questions and concerns are accepted 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	Selected Topics in Physics and Chemistry II (Advanced Theoretical Chemistry)	R0167			1st	Tue.	2	2
Doctoral program	Selected Topics in Physics and Chemistry II (Advanced Theoretical Chemistry)	R0168						

Instructor(s)	Note
Masahiko Hada, Naoki Nakatani	This course is offered for Physics and Chemistry Majors

(1) Course policies and topics	In this course, we provide an advanced lecture about “molecular electronic structure theory”, one of the topics in “quantum chemistry”. Particularly, we focused on the practical methods to compute electronic structures (such that energy, geometry, and properties of molecules). In recent years, it is able to predict the physical properties with the extremely high accuracy. On the other hand, it is also applied for large molecular systems such as proteins and nano-materials, with an appropriate approximation. We will overview these state of the art methods and their applications, too.
(2) Knowledge/skills to be acquired and learning objectives/course goals	Students will learn advanced and practical knowledge about quantum chemistry and computational chemistry which can be applied for own research topics. Students will learn the recent reseach results in the lecture to caltivate 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	Course schedule is provided as follows. [01] Derivation of HF energy (N. Nakatani) [02] Derivation of CI energy (N. Nakatani) [03] Exercise using Excel 1 (N. Nakatani) [04] Derivation of MP2 energy (N. Nakatani) [05] Exercise using Excel 2 (N. Nakatani) [06] Overview on multi-reference methods (N. Nakatani) [07] Density functional theory – Basic idea (N. Nakatani) [08] Density functional theory – Applications (N. Nakatani) [09] Transition state search (N. Nakatani) [10] Electro and magnetic properties (M. Hada) [11] NMR and chemical shift – Derivation of selection rule (M. Hada) [12] NMR and chemical shift – Analysis of spectrum (M. Hada) [13] Relativistic correction on electronic structure calculation 1 (M. Hada) [14] Relativistic correction on electronic structure calculation 2 (M. Hada) [15] Extra day NOTE: Course schecule can be changed due to number of registed students, major field of students, and instructor’s circumstances.
(4) Outside-class activities and assignments	Students are assigned for some homeworks to summarize the lecture.
(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 some homeworks and mini-quiz in the lecture (at most 20%).
(7) Questions to the instructor (Office hours, etc.)	Though we do not arrange the office-hour, we accept questions directly and by e-mail. In the e-mail, please specify your name in the subject and use an e-mail address which we can reply by internet (we do not accept e-mails including special characters which only available for mobile phone).
(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	Advanced Lecture in Chemistry Ⅱ(Organic Reaction Mechanisms)	R0231			1st	Thu.	1	2
Doctoral program								

Instructor(s)	Note
Kotohiro Nomura	none

(1) Course policies and topics	For students who leraned 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 coordinationchemistry: 18 electron rules, structure and properties, bonding etc. 4-8) Basiscs 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	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 in Chemistry II (Functional material chemistry)	R0300			second	Fri	1st	2
Doctoral program								

Instructor(s)	Note
Tohru Nishinaga	

(1) Course policies and topics	Various π-conjugated systems and transition metal complexes combined with π-conjugated ligands have been designed and synthesized to develop the materials showing electronic properties such as electrical conductivity, photoelectric conversion and thermoelectric conversion, optical properties such as absorption and light emission, ferromagnetism and ferrimagnetism, etc. In this lecture, the basics of the structure-physical property correlation will be lectured and the recent progress in this chemistry will be introduced.
(2) Knowledge/skills to be acquired and learning objectives/course goals	A basic for understanding the designing molecular compounds aiming the various functions and understanding the latest research contents. The goal is to acquire these knowledge.
(3) Course schedule, subject matter, and classroom activities	. The basics and outline of the latest research examples for electronic properties, optical properties, magnetism and its structure-physical properties phase exhibited by molecular compounds such as π-conjugated systems and metal complexes and their aggregates will be lectured
(4) Outside-class activities and assignments	Report on the tasks shown during class.
(5) Textbooks and course materials	Materials will be introduced during class.
(6) Assessment and grading	Assessment and grading will be evaluated by attendance and assignment report
(7) Questions to the instructor (Office hours, etc.)	No office hours will be definced. Ask via 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	Advanced Lecture in Chemistry Ⅱ	R0299			2nd	Fri	2	2
Doctoral program								

Instructor(s)	Note
Kotohiro Nomura	

(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, presentation of literature reviews concerning advanced materials chemistry (by graduate students) and discussion. The person in the presentation 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	None, will be distributed (handout).
(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	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 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. Examination / Comment
(4) Outside-class activities and assignments	Interactive lecture including short presentation and conversation practice. 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	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 of Chemistry	R0295 R0297			Intensive course			1 or 2
Doctoral program	Internship of Chemistry	R0296 R0298						

Instructor(s)	Note

(1) Course policies and topics	The purpose of this program is to help students acquire a wide range of practical academic skills by granting credits for off-campus learning (work experience, research/study experience, volunteer activities) related to specialized education in chemistry that fulfills certain requirements.
(2) Knowledge/skills to be acquired and learning objectives/course goals	Depends on the internship site.
(3) Course schedule, subject matter, and classroom activities	Depends on the internship site.
(4) Outside-class activities and assignments	Follow the instructions of your instructor.
(5) Textbooks and course materials	Depends on the internship site.
(6) Assessment and grading	See Special Notes.
(7) Questions to the instructor (Office hours, etc.)	Office hours are not set, but if students wish to ask questions in person, they may do so at any time, so please contact the office in advance by e-mail.
(8) Special note	Number of credits, etc.: One or two credits may be earned in designated courses, which may be taken concurrently. The credits may be added to the credits required for graduation. Requirements for enrollment: (1) As a rule, courses must be offered over several days during holidays. (2) The content of the course must be equivalent to the undergraduate curriculum and related to specialized education in chemistry. The portion of the internship that corresponds to this training must not be a requirement for the recognition of other credits or qualifications. (3) If the university or research institution is inviting external participants, a copy of the announcement must be available. In the case of a company or training school, there must be a letter of acceptance signed and stamped with the name, affiliation, and contact information of the person in charge of supervising the host institution. The applicant must have "Accident Insurance for Student Education and Research" and "Liability Insurance for Internships, Care Experience Activities, Educational Training, etc." or equivalent or higher accident insurance and liability insurance. (4) Have a certificate of completion issued by the organizer (lecturer) or agree to have the organizer (lecturer) sign and seal the attached certificate of completion. (5) Students who wish to receive

	credits must submit a preliminary application to the Academic Affairs Committee with the documents mentioned in (3) above, along with the contact information of the host institution, the student's contact information during the training, and materials describing the content and purpose of the training, and obtain permission before the training takes place. (6) After the completion of the practical training, the student must submit a several-page report summarizing his/her impressions of the content and a journal of the practical training, along with the documents mentioned in (4) above, to the Academic Affairs Committee members. (7) Credit will be granted by the Academic Affairs Committee members based on the conformity with the above objectives, the evaluation by the organizer, and the grade of the report.

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	Seminar on Advanced Chemistry I				1st			2
Doctoral program								

Instructor(s)	Note

(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. Session 1: Review of each laboratory's specialized topics and explanation of future seminar plans Session 2: Detailed reading of introductory foreign-language literature1 related to the theme of the course Session 3: Introductory foreign-language literature 1 on the theme of your specialty Session 4: Detailed reading of introductory foreign-language literature 2 in accordance with the theme of your specialty Session 5: Explanation of introductory foreign-language literature 2 in accordance with the theme of your specialty Session 6: Detailed reading of introductory foreign-language literature 3 in accordance with the theme of your specialty Session 7: Explanation of introductory foreign-language literature 3 in accordance with the theme of the specialty Session 8: Detailed reading of related paper 1 Session 9: Explanation of related paper 1 Session 10: Detailed reading of related paper 2 Session 11: Commentary on related paper 2 12th: Detailed reading of related paper 3 Session 13: Explanation of related paper 3 Session 14: Summary of basic knowledge acquired Session 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	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	Seminar on Advanced Chemistry II				2nd			2
Doctoral program								

Instructor(s)	Note

(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. Session 1: Review of each laboratory's specialized topics and explanation of future seminar plans Session 2: Detailed reading of introductory foreign-language literature1 related to the theme of the course Session 3: Introductory foreign-language literature 1 on the theme of your specialty Session 4: Detailed reading of introductory foreign-language literature 2 in accordance with the theme of the specialty Session 5: Explanation of introductory foreign-language literature 2 in accordance with the theme of the specialty Session 6: Detailed reading of introductory foreign-language literature 3 in accordance with the theme of the specialty Session 7: Explanation of introductory foreign-language literature 3 in accordance with the theme of the specialty Session 8: Detailed reading of related paper 1 Session 9: Explanation of related paper 1 Session 10: Detailed reading of related paper 2 Session 11: Commentary on related paper 2 12th: Detailed reading of related paper 3 Session 13: Explanation of related paper 3 Session 14: Summary of basic knowledge acquired Session 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.)	Follow the instructions of your instructor.
(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					1st			2
Doctoral program	Seminar on Advanced Chemistry III							

Instructor(s)	Note

(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 content of the program will vary depending on the specialized theme of each laboratory that the student belong 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	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					2nd			2
Doctoral program	Seminar on Advanced Chemistry IV							

Instructor(s)	Note

(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 content of the program will vary depending on the specialized theme of each laboratory that the student belong 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	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 Research of Chemistry IA				2nd			2
Doctoral program								

Instructor(s)	Note

(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 appropleate 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 belong to. Session 1: Overview of research conducted in each laboratory Session 2: Establishment of a research theme and research plan (Part 1): Literature review and problem search Session 3: Establishment of a research theme and research plan (Part 2): Setting subject Session 4: Establishment of a research theme and research plan (Part 3): Research planning Session 5: Mastering experimental and computational methods necessary for research (Part 1): Investigation of experimental and computational methods Session 6: Mastering experimental and computational methods necessary for research (Part 2): Conducting experiments and calculations Session 7: Mastering experimental and computational methods necessary for research (Part 3): Reconfirming problems Session 8: Interim debriefing on research plan and experimental and computational methods Session 9: Preliminary experiments (Part 1): Investigations for conducting preliminary experiments Session 10: Preliminary experiments (Part 2): Conducting experiments Session 11: Preliminary experiments (Part 3): Discussion of problems Session 12: Preliminary experiments (Part 4): Re-experimentation based

	on the results of the study Session 13: Data analysis and organization of preliminary experiments (Part 1) Session 14: Data analysis and organization of preliminary experiments (Part 2) Session 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	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 Research of Chemistry IB				1st			2
Doctoral program								

Instructor(s)	Note

(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 belong to. Session 1: Overview of research conducted in each laboratory Session 2: Research planning for basic experiments (Part 1): Literature review and problem search Session 3: Research planning for basic experiments (Part 2): Setting subject Session 4: Research planning for basic experiments (Part 3): Research planning Session 5: Conducting Basic Experiments (Part 1): Investigations for conducting basic experiments Session 6: Conducting Basic Experiments (Part 2): Conducting Experiments Session 7: Conducting Basic Experiments (Part 3): Examining Problems Session 8: Conducting basic experiments (Part 4): Re-experimentation based on the results of the study Session 9: Conducting basic experiments (Part 5): Summary of basic experiments Session 10: Interim debriefing of basic experiments Session 11: Data analysis and organization of basic experiments (Part 1) Session 12: Data analysis and organization of basic experiments (Part 2): Organizing Analysis Results Session 13: Discussion of basic experiment results (Part 1): Comparison

	with literature, etc. Session 14: Discussion of basic experiment results (Part 2): Discussion of results Session 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	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 Research of Chemistry IIA				2nd			2
Doctoral program								

Instructor(s)	Note

(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	Session 1: Confirmation of outline of applied experiments to be conducted in Advanced Research of Chemistry IIA. Session 2: Research planning for applied experiments (Part 1): Literature Review and problem search Session 3: Research planning for applied experiments (Part 2): Setting subject Session 4: Research planning for applied experiments (Part 3): Research planning Session 5: Conducting applied experiments (Part 1): Investigations for conducting applied experiments Session 6: Conducting applied experiments (Part 2): Conducting Experiment Session 7: Conducting applied experiments (Part 3): Examining problems Session 8: Conducting applied experiments (Part 4): Re-experimentation based on the results of the study Session 9: Conducting applied experiments (Part 5): Summary of applied experiments Session 10: Interim debriefing of applied experiments Session 11: Data analysis and organization of applied experiments (Part 1) Session 12: Data Analysis and organization of applied experiments (Part 2): organizing analysis results Session 13: Discussion of applied experimental results (Part 1): Comparison with literature, etc.

	Session 14: Discussion of applied experimental results (Part 2): Discussion of results Session 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	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 Research of Chemistry IIB				1st			2
Doctoral program								

Instructor(s)	Note

(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	Session 1: Confirmation of outline of applied experiments to be conducted in Advanced Research of Chemistry IIB. Session 2: Research planning for advanced experiments (Part 1): Literature Review and problem search Session 3: Research planning for advanced experiments (Part 2): Setting subject Session 4: Research planning for advanced experiments (Part 3): Research planning Session 5: Conducting advanced experiments (Part 1): Investigations for conducting advanced experiments Session 6: Conducting advanced experiments (Part 2): Conducting Experiment Session 7: Conducting advanced experiments (Part 3): Examining problems Session 8: Conducting advanced experiments (Part 4): Re-experimentation based on the results of the study Session 9: Conducting advanced experiments (Part 5): Summary of advanced experiments Session 10: Interim debriefing of advanced experiments Session 11: Data analysis and organization of advanced experiments (Part 1) Session 12: Data Analysis and organization of advanced experiments (Part 2): organizing analysis results

	Session 13: Discussion of advanced experimental results (Part 1): Comparison with literature, etc. Session 14: Discussion of advanced experimental results (Part 2): Discussion of results Session 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	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					2nd			2
Doctoral program	Advanced Research of Chemistry IIIA							

Instructor(s)	Note

(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	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					1st			2
Doctoral program	Advanced Research of Chemistry IIIB							

Instructor(s)	Note

(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	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					2nd			2
Doctoral program	Advanced Research of Chemistry IVA							

Instructor(s)	Note

(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	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					1st			2
Doctoral program	Advanced Research of Chemistry IVB							

Instructor(s)	Note

(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	

Biological Sciences
(General courses for Graduate School of Science and Graduate School of Science and Engineering)

Notes on course enrollment

1. Biological Sciences offers the following courses:
   - Advanced Experimental Techniques in Biological Sciences (2 units)
   - Seminar in Biological Sciences (2 units)
   - Special Course in Biological Sciences (1 or 2 units)
   - Advanced Lecture on Biological Sciences (2 units)
   - Special Lecture on Biological Sciences (1 unit)
   - Special Seminar in Biological Sciences (1 unit)
   - Special Experiment in Biological Sciences (1 unit)
   - Special Practice in Biological Sciences (2 units)
   - Practice in Biological Sciences (Radioisotope Techniques; 1 unit)
   - Internship in Biological Sciences (1 or 2 units)

2. Advanced Experimental Techniques in Biological Sciences and Seminar in Biological Sciences will be offered at respective research laboratories. For the following courses, the subject matter and lecture format consider graduate students of other majors.
   - Special Course in Biological Sciences
   - Advanced Lecture on Biological Sciences
   - Special Lecture on Biological Sciences
   - Special Seminar in Biological Sciences
   - Special Experiment in Biological Sciences
   - Special Practice in Biological Sciences
   - Practice in Biological Sciences (Radioisotope Techniques) Advanced Lecture courses focus on the basic subject matter at the master's level in each field. Special Lecture courses provide the more specialized and advanced subject matter in each field. Special Practice courses are offered when there is a particular need.

3. In general, classes start on schedule. However, Advanced Experimental Techniques in Biological Sciences courses may be held on an irregular schedule based on the research topic. If a student spends a large amount of time on activities at off-campus research institutions and field research, the student may be allowed to complete the course by submitting home assignments and reports. The same can be applied to graduate students who work full time and have a hard time attending classes. Students who require such arrangements should consult the graduate/doctoral advisor and the course instructor in advance.

4. Graduate students' off-campus learning activities may be approved as completing the Special Experiment in Biological Sciences (Experimental Techniques) or Internship in Biological Sciences course after the review of the Academic Affairs Committee based on the student or graduate/doctoral advisor's request.

5. Registration is required for all courses. Students may retake the same course (lecture, practice, experiment, or seminar that has the same name) more than once if respective courses provide different subject matter. The credit hours of both courses will be added.

6. Some of the special lectures on Biological Sciences require the recommendation of the graduate/doctoral advisor and the approval of the Academic Affairs Committee of the department. It is recommended that students select the course carefully, considering the specialized field of each student. Read the syllabus of each course carefully.

7. Note that some credits may be transferred from Ochanomizu University.

8. It is strongly recommended that students take at least one of the following courses:
   - Biology Course in Planning and Management
   - Biology Course in International Research Experiences
   - Biology Course in Research Evaluation

(Master's program)

1. In order to complete the master's program, a total of 30 or more credits are required. Of these credits, 20 or more credits must be earned in courses other than Seminar in Biological Sciences or Advanced Experimental Techniques in Biological Sciences offered by the research laboratory where the student belongs.
2. Upon approval of the Academic Affairs Committee of the department, up to 10 credits from graduate courses outside of Biological Sciences can be considered as credits earned in courses other than Seminar in Biological Sciences or Advanced Experimental Techniques in Biological Sciences offered by the research laboratory where the student belongs mentioned above. Also, upon approval of the graduate advisor and the Academic Affairs Committee of the department, up to 10 credits from undergraduate courses can be considered as credits earned in courses other than Seminar in Biological Sciences or Advanced Experimental Techniques in Biological Sciences offered by the research laboratory where the student belongs mentioned above. However, a total of up to 10 credits are allowed from non-major courses and courses other than Seminar in Biological Sciences or Advanced Experimental Techniques in Biological Sciences offered by the research laboratory where the student belongs.
3. In principle, for Seminar in Biological Sciences and Advanced Experimental Techniques in Biological Sciences, students shall take only the courses offered in the research laboratory where the student is assigned. We encourage students to take four or more advanced courses as well as the Special Seminar in Biological Sciences.
4. Since students will need to spend time working on the master's thesis in the second year, we encourage students to earn about two-thirds of the required credits in the first year.

(Doctoral program)

1. In order to complete the doctoral program, a total of 20 or more credits from doctoral courses are required. We encourage students to earn eight or more credits from courses other than Seminar in Biological Sciences or Advanced Experimental Techniques in Biological Sciences offered by the research laboratory where the student belongs.
2. Students are not allowed to retake the same course that was taken in the master's program.
3. In principle, for Seminar in Biological Sciences and Advanced Experimental Techniques in Biological Sciences, students shall take only the courses offered in the research laboratory where the student is assigned as well as the Special Seminar in Biological Sciences.

2022 Graduate School Course Catalog

Graduate School of Science (Biological Sciences); Graduate School of Science and Engineering (Biological Sciences)

* M = master's courses, D = doctoral courses
* NA 2022 = Courses not offered in the academic year 2022
★ This course is primarily for high school teachers, working people, and students interested in high school education.

Course outline	M	D	NA 2022	Semester	Day	Time	[Graduate School of Science] Course Number	[Graduate School of Science] Course Name	[Graduate School of Science and Engineering] Course Number	[Graduate School of Science and Engineering] Course Name	Credit Hours	Instructor(s)	Note (enrollment requirements, subject matter, etc.)
1	○	○		Second Semester	Thu.	1	M(R0359) D(R0360)	Advanced Lecture on Biological Information	D(R360)	Advanced Lecture on Biological Information	2	Takaomi Sakai, Makoto Kurokawa, A. Weitemier	Physiological biochemistry of the brain and nervous system, molecular biology
2	○	○		First Semester	Fri.	1	M(R0363) D(R0364)	Advanced Lecture on Biochemistry	D(R364)	Advanced Lecture on Biochemistry	2	Hiroyuki Kawahara, Takashi Okamoto	Biochemistry of protein metabolism
3	○	○		First Semester	Thu.	1	M(R0369) D(R0370)	Advanced Lecture on Developmental Biology	D(R370)	Advanced Lecture on Developmental Biology	2	Kimiko Fukuda, Naohito Takatori	Modern developmental biology
4	○	○		Second Semester	Fri.	1	M(R0371) D(R0372)	Advanced Lecture on Molecular Biology	D(R372)	Advanced Lecture on Molecular Biology	2	Jun-ichi Kato, Shigeki Ehira, Shin Haruta	Basics and practice of genomic science
-	○	○	△					Advanced Lecture on Evolutionary Genetics		Advanced Lecture on Evolutionary Genetics	2	Koichiro Tamura, Aya Takahashi, Masafumi Nozawa	Evolutionary biology from the perspective of genetics and ecology
-	○	○	△					Advanced Lecture on Ecology		Advanced Lecture on Ecology	2	Fumio Hayashi, Jun-Ichirou Suzuki, Yasukazu Okada	Modern ecology with examples of basic research
-	○	○	△					Advanced Lecture on Cell Biology		Advanced Lecture on Cell Biology	2	Takeshi Kanegae Rei Narikawa	Light sensing and environmental adaptation of plants
-	○	○	△					Advanced Lecture on Taxonomy		Advanced Lecture on Taxonomy	2	Noriaki Murakami, Katsuyuki Eguchi	Phylogenetic evolution and diversity of plants and insects
5	○	○		First Semester	Intensive course		M(R0377) D (R0378)	Advanced Lecture on Biological Sciences	D (R378)	Advanced Lecture on Biological Sciences	2	* Hiroyuki Yokomizo	Basic statistical analysis using RStudio for biological systems
6	○	○		First Semester	Intensive course		M(R0365) D (R0366)	Advanced Lecture on Biological Sciences	D (R366)	Advanced Lecture on Biological Sciences	2	* Keita Fukasawa	An introduction to R programming language for biological systems
7	○	○		First Semester	Intensive course		M(R0403) D (R0404)	Advanced Lecture on Biological Sciences	D (R404)	Advanced Lecture on Biological Sciences	2	* Chiaki Maruyama, * Mitsunori Seo, * Akihito Ishigami, * Takahiko Hara, * Yoshihiro Ito	Digest of the latest biomedical research 1
8	○	○		2nd B	Fri.	2	M(R0391) D(R0392)	Special Lecture on Genetic Information	D(R392)	Special Lecture on Genetic Information	1	Koichiro Tamura, Aya Takahashi, Masafumi Nozawa	Population genetics and molecular evolution
9	○	○		1st B	Fri.	2	M(R0393) D(R0394)	Special Lecture on Ecological Science	D(R394)	Special Lecture on Ecological Science	1	Fumio Hayashi, Jun-Ichirou Suzuki, Yasukazu Okada	Animal behavior and society, renewal of plant communities
10	○	○		1st A	Fri.	2	M(R0397) D(R0398)	Special Lecture on Responses to Environment	D(R398)	Special Lecture on Responses to Environment	1	Takeshi Kanegae, Rei Narikawa	Environmental response and speciation of plants
11	○	○		2nd A	Tue.	1	M(R0373) D(R0374)	Special Lecture on Systematics and Evolution	D(R374)	Special Lecture on Systematics and Evolution	1	Noriaki Murakami, Katsuyuki Eguchi	Phylogenetic evolution of plants and animals
-	○	○	△					Special Lecture on Cellular communication		Special Lecture on Cellular communication	1	Takaomi Sakai, Makoto Kurokawa, A. Weitemier	Physiology and biochemistry of the brain
-	○	○	△					Special Lecture on Biomolecules		Special Lecture on Biomolecules	1	Hiroyuki Kawahara, Takashi Okamoto	Cell differentiation and development
-	○	○	△					Special Lecture on Developmental and Regenerative Biology		Special Lecture on Developmental and Regenerative Biology	1	Kimiko Fukuda, Naohito Takatori	Modern developmental biology research and presentation methods
-	○	○	△					Special Lecture on Cell Biology		Special Lecture on Cell Biology	1	Jun-ichi Kato, Shigeki Ehira, Shin Haruta	The latest of genetics and molecular biology
12	○	○		First Semester	Intensive course		M(R0401) D (R0402)	★ Special Lecture on Biological Sciences	D (R402)	★ Special Lecture on Biological Sciences	1	Multiple instructors	The continuous education of modern biology
13	○	○		Second Semester	Intensive course		M(R0395) D(R0396)	Special Lecture on Genetic Information	D(R396)	Special Lecture on Genetic Information	1	* Jun Kitano	
14	○	○		Second Semester	Intensive course		M(R0763) D(R0764)	Special Lecture on Responses to Environment	D(R764)	Special Lecture on Responses to Environment	1	* Shunichi Takahashi	
15	○	○		First Semester	Intensive course		M(R0759) D(R0760)	Special Lecture on Responses to Environment	D(R760)	Special Lecture on Responses to Environment	1	* Wataru Kimura	
16	○	○		First Semester	Intensive course		M(R0761) D(R0762)	Special Lecture on Cell Biology	D(R762)	Special Lecture on Cell Biology	1	* Kaoru Yamada	
17	○	○		First Semester	Intensive course		M(R0375) D(R0376)	Special Lecture on Cellular Cmmunication	D(R376)	Special Lecture on Cellular Cmmunication	1	* Satomi Chiken	
18	○	○		First Semester	Intensive course		M(R0415) D (R0416)	Special Lecture on Biological Sciences	D (R416)	Special Lecture on Biological Sciences	1	* Azusa Inoue, Yuri Miura, Kohei Ueno, Takashi Nonaka	Digest of the latest biomedical research 2
19	○	○		First Semester	Intensive course		M(R0421) D (R0422)	Special Course in Biological Sciences Ⅱ (English for Biology)	D (R422)	Special Course in Biological Sciences Ⅱ (English for Biology)	1	* Yuka Iijima	English for science: listening and speaking
20	○	○		Second Semester	Intensive course		M(R0423) D (R0424)	Special Course in Biological Sciences Ⅱ (English for Biology)	D (R424)	Special Course in Biological Sciences Ⅱ (English for Biology)	1	* Reina Nakamura	How to write English papers
21	○	○		First Semester	Mon.	4	M(R0425) D (R0426)	Special Course in Biological Sciences Ⅱ Special Course in Biology Ⅱ	D (R426)	Special Course in Biological Sciences Ⅱ (English Communication for Biology)	1	* Elisabeth Zielinska	Nature talk, science and culture
22	○	○		Second Semester	Mon.	3	M(R0427) D (R0428)	Special Course in Biological Sciences Ⅱ (English Communication for Biology)	D (R428)	Special Course in Biological Sciences Ⅱ (English Communication for Biology)	1	* Elisabeth Zielinska	How to create a persuasive presentation
23	○	○		Second Semester	Mon.	4	M(R0429) D (R0430)	Special Course in Biological Sciences Ⅱ (English Communication for Biology)	D (R430)	Special Course in Biological Sciences Ⅱ (English Communication for Biology)	1	* Elisabeth Zielinska	Nature talk (part II)
24	○	○		2nd A	Fri.	2	M(R0433) D (R0434)	Special Course in Biological Sciences Ⅲ (Technique for Research Communication)	D (R434)	Special Course in Biological Sciences Ⅲ (Technique for Research Communication)	1	Kanae Ando, A. Cronin、A.Weitemier	Technique for Research Communication
25	○	○		First Semester	Intensive course		M(R0439) D (R0440)	Special Course in Biological Sciences Ⅰ (Computer Practice: Basics)	D (R440)	Special Course in Biological Sciences Ⅰ (Computer Practice: Basics)	1	Koichiro Tamura, Masafumi Nozawa	Computer Practice: Basics
	○	○	△					Special Course in Biological Sciences Ⅰ (Computer Practice: Application)		Special Course in Biological Sciences Ⅰ (Computer Practice: Application)	1	Naohito Takatori, Kimiko Fukuda, Akiko Asada	Computer Practice: Application
26	○	○		First Semester	Intensive course		M(R0431) D (R0432)	★ Special Lecture on Biological Sciences I	D (R432)	★ Special Lecture on Biological Sciences I	1	Yuuya Tachiki	Modern Biology Recurrent Practice 1
27	○	○		First Semester	Intensive course		M(R0361) D (R0362)	★ Special Lecture on Biological Sciences I	D (R362)	★ Special Lecture on Biological Sciences I	1	Takahiro Yoshida	Modern Biology Recurrent Practice 2
28	○	○		First Semester	Tue.	2	M(R0443) D (R0444)	Biology course in planning and management 1	D (R444)	Biology course in planning and management 1	1	Shin Haruta and other instructors	Biology Course in Planning and Management
29	○	○		Second Semester	Tue.	2	M(R0445) D (R0446)	Biology course in planning and management 2	D (R446)	Biology course in planning and management 2	1	Shin Haruta and other instructors	Biology Course in Planning and Management
30	○	○		First Semester	Tue.	3	M(R0447) D (R0448)	Biology course in international research experiences 1	D (R448)	Biology course in international research experiences 1	1	Kimiko Fukuda and other instructors	Training for developing global leadership skills
31	○	○		Second Semester	Tue.	3	M(R0449) D (R0450)	Biology course in international research experiences 2	D (R450)	Biology course in international research experiences 2	1	Kimiko Fukuda and other instructors	Training for developing global leadership skills
32	○	○		First Semester	Wed.	1	M(R0451) D (R0452)	Biology course in research evaluation 1	D (R452)	Biology course in research evaluation 1	1	Jun-Ichirou Suzuki and other instructors	Evaluation of research proposals and applications
33	○	○		Second Semester	Wed.	1	M(R0453) D (R0454)	Biology course in research evaluation 2	D (R0454)	Biology course in research evaluation 2	1	Jun-Ichirou Suzuki and other instructors	Evaluation of research presentation
34	○	○		Second Semester	Intensive course.		M(R0455) D(R0456)	Practice in Biological Sciences (Radioisotope Techniques)	D(R456)	Practice in Biological Sciences (Radioisotope Techniques)	1	Takashi Okamoto, Taro Saito, Tsunaki Asano	Basic techniques for handling radiolabeled compounds
35	○	○		At all times			M(R0693) D (R0694)	Internship in Biological Sciences 1	M(R693) D (R694)	Internship in Biological Sciences 1	1	Multiple instructors	Internship
35	○	○		At all times			M (R0695) 2 units D (R0696) 2 units M (R0411) 1 unit D (R0412) 1 unit	Internship in Biological Sciences 2	D (R696) 2 units D (R412) 1 unit	Internship in Biological Sciences 2	1 or 2	Multiple instructors	Internship
36	○	○		First Semester	Fri.	5	M(R0457) D (R0458)	Special Seminar in Biological Sciences 1	D (R458)	Special Seminar in Biological Sciences 1	1	Multiple instructors	The latest issues in Biological Sciences (classroom seminar)
37	○	○		Second Semester	Fri.	5	M(R0459) D (R0460)	Special Seminar in Descriptive Science 2	D (R460)	Special Seminar in Descriptive Science 2	1	Multiple instructors	The latest issues in biological sciences (classroom seminar)

Course outline	M	D	NA 2022	Semester	Day	Time	[Graduate School of Science]		[Graduate School of Science and Engineering]		Credit Hours	Instructor(s)	Note (enrollment requirements, subject matter, etc.)
							Course Number	Course Name	Course Number	Course Name			
38	○	○		2nd A	Mon.	1	M(R0009) D(R0010)	Special Lecture on Biological Sciences	D (R716)	Special Lecture on Biological Sciences	1	Noriaki Murakami, Katsuyuki Eguchi	No online registration. A retake is not allowed for students who took this course in the undergraduate program. The approval of the Academic Affairs Committee of the Graduate School is required. Special Lecture in Taxonomy: Course in English
39	○	○		2nd A	Mon.	2	M(R0715) D (R0716)	Special Lecture on Biological Sciences	D (R716)	Special Lecture on Biological Sciences	1	Adam Cronin	No online registration. A retake is not allowed for students who took this course in the undergraduate program. The approval of the Academic Affairs Committee of the Graduate School is required. Special Lecture in Evolutionary Biology 1: Course in English
40	○	○		2nd A	Tue.	1	M(R0705) D(R0706)	Special Lecture on Biological Sciences	D(R706)	Special Lecture on Biological Sciences	1	Hiroyuki Kawahara, Rei Narikawa	No online registration. A retake is not allowed for students who took this course in the undergraduate program. The approval of the Academic Affairs Committee of the Graduate School is required. Special Lecture in Biochemistry: Course in English
41	○	○		2nd A	Tue.	2	M(R0707) D(R0708)	Special Lecture on Biological Sciences	D(R708)	Special Lecture on Biological Sciences	1	Kanae Ando	No online registration. A retake is not allowed for students who took this course in the undergraduate program. The approval of the Academic Affairs Committee of the Graduate School is required. Special Lecture in Molecular Biology 1: Course in English
42	○	○		2nd A	Wed.	1	M(R0731) D(R0732)	Special Lecture on Biological Sciences	D(R732)	Special Lecture on Biological Sciences	1	Koichiro Tamura, Aya Takahashi	No online registration. A retake is not allowed for students who took this course in the undergraduate program. The approval of the Academic Affairs Committee of the Graduate School is required. Special Lecture in Genetics: Course in English
43	○	○		2nd A	Wed.	2	M(R0733) D(R0734)	Special Lecture on Biological Sciences	D(R734)	Special Lecture on Biological Sciences	1	Takeshi Kanegae, Makoto Kurokawa	No online registration. A retake is not allowed for students who took this course in the undergraduate program. The approval of the Academic Affairs Committee of the Graduate School is required. Special Lecture in Physiology: Course in English
44	○	○		2nd A	Thu.	1	M(R0735) D(R0736)	Special Lecture on Biological Sciences	D(R736)	Special Lecture on Biological Sciences	1	Shin Haruta, Shigeki Ehira	No online registration. A retake is not allowed for students who took this course in the undergraduate program. The approval of the Academic Affairs Committee of the Graduate School is required. Special Lecture in Microbiology: Course in English
45	○	○		2nd A	Thu.	2	M(R0669) D(R0670)	Special Lecture on Biological Sciences	D(R670)	Special Lecture on Biological Sciences	1	Adam Weitemier	No online registration. A retake is not allowed for students who took this course in the undergraduate program. The approval of the Academic Affairs Committee of the Graduate School is required. Special Lecture in Scientific Writing: Course in English
46	○	○		2nd A	Fri.	1	M(R0717) D(R0718)	Special Lecture on Biological Sciences	D(R718)	Special Lecture on Biological Sciences	1	Adam Weitemier	No online registration. A retake is not allowed for students who took this course in the undergraduate program. The approval of the Academic Affairs Committee of the Graduate School is required. Special Lecture in Physiology 1: Course in English
47	○	○		2nd B	Fri.	1	M(R0749) D (R0750)	Special Lecture on Biological Sciences	D (R750)	Special Lecture on Biological Sciences	1	Adam Weitemier	No online registration. A retake is not allowed for students who took this course in the undergraduate program. The approval of the Academic Affairs Committee of the Graduate School is required. Special Lecture in Physiology 2: Course in English
48	○	○		2nd A	Wed.	1	M(R0709) D(R0710)	Special Lecture on Biological Sciences	D(R0710)	Special Lecture on Biological Sciences	1	Kimiko Takahashi, NaohitoTakatori	No online registration. A retake is not allowed for students who took this course in the undergraduate program. The approval of the Academic Affairs Committee of the Graduate School is required. Special Lecture on Developmental Biology.
49	○	○		2nd A	Wed.	2	M(R0721) D(R0722)	Special Lecture on Biological Sciences	D(R0722)	Special Lecture on Biological Sciences	1	Junichi Kato	No online registration. A retake is not allowed for students who took this course in the undergraduate program. The approval of the Academic Affairs Committee of the Graduate School is required. Special Lecture on Molecular Biology
50	○	○		2nd A	Thu.	1	M(R0711) D(R0712)	Special Lecture on Biological Sciences	D(R0712)	Special Lecture on Biological Sciences	1	Junichiro Suzuki, Yasukazu Okada	No online registration. A retake is not allowed for students who took this course in the undergraduate program. The approval of the Academic Affairs Committee of the Graduate School is required. Special Lecture on Ecology
51	○	○		2nd A	Thu.	2	M(R0713) D(R0714)	Special Lecture on Biological Sciences	D(R0714)	Special Lecture on Biological Sciences	1	Takashi Okamoto, Takaomi Sakai	No online registration. A retake is not allowed for students who took this course in the undergraduate program. The approval of the Academic Affairs Committee of the Graduate School is required. Special Lecture on Cell Biology
52	○	○		2nd A	Fri.	1	M(R0723) D(R0724)	Special Lecture on Biological Sciences	D(R0724)	Special Lecture on Biological Sciences	1	Masafumi Nozawa, Noriaki Murakami	No online registration. A retake is not allowed for students who took this course in the undergraduate program. The approval of the Academic Affairs Committee of the Graduate School is required. Special Lecture on Evolutionary Biology
53	○	○		First Semester	Intensive course		M(R0737) D (R0738)	Special Lecture on Biological Sciences	D (R738)	Special Lecture on Biological Sciences	1	* Haruhisa Wago	No online registration. A retake is not allowed for students who took this course in the undergraduate program. The approval of the Academic Affairs Committee of the Graduate School is required. Special Lecture on Biology (Immunobiology)
54	○	○		First Semester	Intensive course		M(R0739) D (R0740)	Special Lecture on Biological Sciences	D (R740)	Special Lecture on Biological Sciences	1	* Kintake Sonoike	No online registration. A retake is not allowed for students who took this course in the undergraduate program. The approval of the Academic Affairs Committee of the Graduate School is required. Light stress and defense mechanisms in plants
55	○	○		First Semester	Intensive course		M(R0725) D (R0726)	Special Lecture on Biological Sciences	D (R726)	Special Lecture on Biological Sciences	1	* Florian Reyda	Course in English
56	○	○		First Semester	Intensive course		M(R0727) D (R0728)	Special Lecture on Biological Sciences	D (R728)	Special Lecture on Biological Sciences	1	* Florian Reyda	Course in English
57	○	○		First Semester	Intensive course		M(R0719) D (R0720)	Special Lecture on Biological Sciences	D (R720)	Special Lecture on Biological Sciences	1	* Diego Tavares Vasques	Students are not allowed to retake this course if already taken last year. Course in English
58	○	○		First Semester	Intensive course		M(R0729) D (R0730)	Special Lecture on Biological Sciences	D (R730)	Special Lecture on Biological Sciences	1	* Ben Wallen	Course in English
59	○	○		First Semester	Mon.	1	M(R0461) D (R0462)	Seminar in Biological Sciences 1 (Molecular Neurobiology 1)	D (R462)	Seminar in Biological Sciences 1 (Molecular Neurobiology 1)	2	Kanae Ando, Taro Saito, Akiko Asada	Seminar offered at respective research laboratories
60	○	○		Second Semester	Mon.	1	M(R0463) D (R0464)	Seminar in Biological Sciences 2 (Molecular Neurobiology 1)	D (R464)	Seminar in Biological Sciences 2 (Molecular Neurobiology 1)	2	Kanae Ando, Taro Saito, Akiko Asada	Seminar offered at respective research laboratories
59	○	○		First Semester	Mon.	2	M(R0465) D (R0466)	Seminar in Biological Sciences 1 (Molecular Neurobiology 2)	D (R466)	Seminar in Biological Sciences 1 (Molecular Neurobiology 2)	2	Kanae Ando, Taro Saito, Akiko Asada	Seminar offered at respective research laboratories
60	○	○		Second Semester	Mon.	2	M(R0467) D (R0468)	Seminar in Biological Sciences 2 (Molecular Neurobiology 2)	D (R468)	Seminar in Biological Sciences 2 (Molecular Neurobiology 2)	2	Kanae Ando, Taro Saito, Akiko Asada	Seminar offered at respective research laboratories
59	○	○		First Semester	Fri.	3	M(R0469) D (R0470)	Seminar in Biological Sciences 1 (Molecular Neurobiology 3)	D (R470)	Seminar in Biological Sciences 1 (Molecular Neurobiology 3)	2	Kanae Ando, Taro Saito, Akiko Asada	Seminar offered at respective research laboratories
60	○	○		Second Semester	Fri.	3	M(R0471) D (R0472)	Seminar in Biological Sciences 2 (Molecular Neurobiology 3)	D (R472)	Seminar in Biological Sciences 2 (Molecular Neurobiology 3)	2	Kanae Ando, Taro Saito, Akiko Asada	Seminar offered at respective research laboratories
59	○	○		First Semester	Fri.	4	M(R0473) D (R0474)	Seminar in Biological Sciences 1 (Molecular Neurobiology 4)	D (R474)	Seminar in Biological Sciences 1 (Molecular Neurobiology 4)	2	Kanae Ando, Taro Saito, Akiko Asada	Seminar offered at respective research laboratories
60	○	○		Second Semester	Fri.	4	M(R0475) D (R0476)	Seminar in Biological Sciences 2 (Molecular Neurobiology 4)	D (R476)	Seminar in Biological Sciences 2 (Molecular Neurobiology 4)	2	Kanae Ando, Taro Saito, Akiko Asada	Seminar offered at respective research laboratories
59	○	○		First Semester	Wed.	6	M(R0477) D (R0478)	Seminar in Biological Sciences 1 (Neurobiology 1)	D (R478)	Seminar in Biological Sciences 1 (Neurobiology 1)	2	Makoto Kurokawa, Adam Weitemier	Seminar offered at respective research laboratories
60	○	○		Second Semester	Wed.	6	M(R0479) D (R0480)	Seminar in Biological Sciences 2 (Neurobiology 1)	D (R480)	Seminar in Biological Sciences 2 (Neurobiology 1)	2	Makoto Kurokawa, Adam Weitemier	Seminar offered at respective research laboratories
59	○	○		First Semester	Wed.	7	M(R0481) D (R0482)	Seminar in Biological Sciences 1 (Neurobiology 2)	D (R482)	Seminar in Biological Sciences 1 (Neurobiology 2)	2	Makoto Kurokawa, Adam Weitemier	Seminar offered at respective research laboratories
60	○	○		Second Semester	Wed.	7	M(R0483) D (R0484)	Seminar in Biological Sciences 2 (Neurobiology 2)	D (R484)	Seminar in Biological Sciences 2 (Neurobiology 2)	2	Makoto Kurokawa, Adam Weitemier	Seminar offered at respective research laboratories
59	○	○		First Semester	Tue.	4	M(R0485) D (R0486)	Seminar in Biological Sciences 1 (Plant Development and Physiology 1)	D (R486)	Seminar in Biological Sciences 1 (Plant Development and Physiology 1)	2	Takashi Okamoto, Toshiko Furukawa, Atsuko Kinoshita	Seminar offered at respective research laboratories

Course outline	M	D	NA 2022	Semester	Day	Time	[Graduate School of Science]		[Graduate School of Science and Engineering]		Credit Hours	Instructor(s)	Note (enrollment requirements, subject matter, etc.)
							Course Number	Course Name	Course Number	Course Name			
60	○	○		Second Semester	Tue.	4	M(R0487) D (R0488)	Seminar in Biological Sciences 2 (Plant Development and Physiology 1)	D (R488)	Seminar in Biological Sciences 2 (Plant Development and Physiology 1)	2	Takashi Okamoto, Toshiko Furukawa, Atsuko Kinoshita	Seminar offered at respective research laboratories
59	○	○		First Semester	Tue.	5	M(R0489) D (R0490)	Seminar in Biological Sciences 1 (Plant Development and Physiology 2)	D (R490)	Seminar in Biological Sciences 1 (Plant Development and Physiology 2)	2	Takashi Okamoto, Toshiko Furukawa, Atsuko Kinoshita	Seminar offered at respective research laboratories
60	○	○		Second Semester	Tue.	5	M(R0491) D (R0492)	Seminar in Biological Sciences 2 (Plant Development and Physiology 2)	D (R492)	Seminar in Biological Sciences 2 (Plant Development and Physiology 2)	2	Takashi Okamoto, Toshiko Furukawa, Atsuko Kinoshita	Seminar offered at respective research laboratories
59	○	○		First Semester	Fri.	3	M(R0493) D (R0494)	Seminar in Biological Sciences 1 (Plant Development and Physiology 3)	D (R494)	Seminar in Biological Sciences 1 (Plant Development and Physiology 3)	2	Takashi Okamoto, Toshiko Furukawa, Atsuko Kinoshita	Seminar offered at respective research laboratories
60	○	○		Second Semester	Fri.	3	M(R0495) D (R0496)	Seminar in Biological Sciences 2 (Plant Development and Physiology 3)	D (R496)	Seminar in Biological Sciences 2 (Plant Development and Physiology 3)	2	Takashi Okamoto, Toshiko Furukawa, Atsuko Kinoshita	Seminar offered at respective research laboratories
59	○	○		First Semester	Fri.	4	M(R0497) D (R0498)	Seminar in Biological Sciences 1 (Plant Development and Physiology 4)	D (R498)	Seminar in Biological Sciences 1 (Plant Development and Physiology 4)	2	Takashi Okamoto, Toshiko Furukawa, Atsuko Kinoshita	Seminar offered at respective research laboratories
60	○	○		Second Semester	Fri.	4	M(R0499) D (R0500)	Seminar in Biological Sciences 2 (Plant Development and Physiology 4)	D (R500)	Seminar in Biological Sciences 2 (Plant Development and Physiology 4)	2	Takashi Okamoto, Toshiko Furukawa, Atsuko Kinoshita	Seminar offered at respective research laboratories
59	○	○		First Semester	Mon.	1	M(R0501) D (R0502)	Seminar in Biological Sciences 1 (Plant environmental responses 1)	D (R502)	Seminar in Biological Sciences 1 (Plant environmental responses 1)	2	Takeshi Kanegae, Rei Narikawa	Seminar offered at respective research laboratories
60	○	○		Second Semester	Mon.	1	M(R0503) D (R0504)	Seminar in Biological Sciences 2 (Plant environmental responses 1)	D (R504)	Seminar in Biological Sciences 2 (Plant environmental responses 1)	2	Takeshi Kanegae, Rei Narikawa	Seminar offered at respective research laboratories
59	○	○		First Semester	Mon.	2	M(R0505) D (R0506)	Seminar in Biological Sciences 1 (Plant environmental responses 2)	D (R506)	Seminar in Biological Sciences 1 (Plant environmental responses 2)	2	Takeshi Kanegae, Rei Narikawa	Seminar offered at respective research laboratories
60	○	○		Second Semester	Mon.	2	M(R0507) D (R0508)	Seminar in Biological Sciences 2 (Plant environmental responses 2)	D (R508)	Seminar in Biological Sciences 2 (Plant environmental responses 2)	2	Takeshi Kanegae, Rei Narikawa	Seminar offered at respective research laboratories
59	○	○		First Semester	Mon.	1	M(R0509) D (R0510)	Seminar in Biological Sciences 1 (Cytogenetics 1)	D (R510)	Seminar in Biological Sciences 1 (Cytogenetics 1)	2	Takaomi Sakai, Tsunaki Asano, Satomi Takeo	Seminar offered at respective research laboratories
60	○	○		Second Semester	Mon.	1	M(R0511) D (R0512)	Seminar in Biological Sciences 2 (Cytogenetics 1)	D (R512)	Seminar in Biological Sciences 2 (Cytogenetics 1)	2	Takaomi Sakai, Tsunaki Asano, Satomi Takeo	Seminar offered at respective research laboratories
59	○	○		First Semester	Mon.	2	M(R0513) D (R0514)	Seminar in Biological Sciences 1 (Cytogenetics 2)	D (R514)	Seminar in Biological Sciences 1 (Cytogenetics 2)	2	Takaomi Sakai, Tsunaki Asano, Satomi Takeo	Seminar offered at respective research laboratories
60	○	○		Second Semester	Mon.	2	M(R0515) D (R0516)	Seminar in Biological Sciences 2 (Cytogenetics 2)	D (R516)	Seminar in Biological Sciences 2 (Cytogenetics 2)	2	Takaomi Sakai, Tsunaki Asano, Satomi Takeo	Seminar offered at respective research laboratories
59	○	○		First Semester	Mon.	1	M(R0517) D (R0518)	Seminar in Biological Sciences 1 (Evolutionary Genetics 1)	D (R518)	Seminar in Biological Sciences 1 (Evolutionary Genetics 1)	2	Koichiro Tamura, Aya Takahashi, Masafumi Nozawa	Seminar offered at respective research laboratories
60	○	○		Second Semester	Mon.	1	M(R0519) D (R0520)	Seminar in Biological Sciences 2 (Evolutionary Genetics 1)	D (R520)	Seminar in Biological Sciences 2 (Evolutionary Genetics 1)	2	Koichiro Tamura, Aya Takahashi, Masafumi Nozawa	Seminar offered at respective research laboratories
59	○	○		First Semester	Mon.	2	M(R0521) D (R0522)	Seminar in Biological Sciences 1 (Evolutionary Genetics 2)	D (R522)	Seminar in Biological Sciences 1 (Evolutionary Genetics 2)	2	Koichiro Tamura, Aya Takahashi, Masafumi Nozawa	Seminar offered at respective research laboratories
60	○	○		Second Semester	Mon.	2	M(R0523) D (R0524)	Seminar in Biological Sciences 2 (Evolutionary Genetics 2)	D (R524)	Seminar in Biological Sciences 2 (Evolutionary Genetics 2)	2	Koichiro Tamura, Aya Takahashi, Masafumi Nozawa	Seminar offered at respective research laboratories
59	○	○		First Semester	Mon.	1	M(R0525) D (R0526)	Seminar in Biological Sciences 1 (Molecular Genetics 1)	D (R526)	Seminar in Biological Sciences 1 (Molecular Genetics 1)	2	Jun-ichi Kato Shigeki Ehira	Seminar offered at respective research laboratories
60	○	○		Second Semester	Mon.	1	M(R0527) D (R0528)	Seminar in Biological Sciences 2 (Molecular Genetics 1)	D (R528)	Seminar in Biological Sciences 2 (Molecular Genetics 1)	2	Jun-ichi Kato Shigeki Ehira	Seminar offered at respective research laboratories
59	○	○		First Semester	Mon.	2	M(R0529) D (R0530)	Seminar in Biological Sciences 1 (Molecular Genetics 2)	D (R530)	Seminar in Biological Sciences 1 (Molecular Genetics 2)	2	Jun-ichi Kato Shigeki Ehira	Seminar offered at respective research laboratories
60	○	○		Second Semester	Mon.	2	M(R0531) D (R0532)	Seminar in Biological Sciences 2 (Molecular Genetics 2)	D (R532)	Seminar in Biological Sciences 2 (Molecular Genetics 2)	2	Jun-ichi Kato Shigeki Ehira	Seminar offered at respective research laboratories
59	○	○		First Semester	Tue.	4	M(R0533) D (R0534)	Seminar in Biological Sciences 1 (Animal Ecology 1)	D (R534)	Seminar in Biological Sciences 1 (Animal Ecology 1)	2	Fumio Hayashi Yasukazu Okada	Seminar offered at respective research laboratories
60	○	○		Second Semester	Tue.	4	M(R0535) D (R0536)	Seminar in Biological Sciences 2 (Animal Ecology 1)	D (R536)	Seminar in Biological Sciences 2 (Animal Ecology 1)	2	Fumio Hayashi Yasukazu Okada	Seminar offered at respective research laboratories
59	○	○		First Semester	Tue.	5	M(R0537) D (R0538)	Seminar in Biological Sciences 1 (Animal Ecology 2)	D (R538)	Seminar in Biological Sciences 1 (Animal Ecology 2)	2	Fumio Hayashi Yasukazu Okada	Seminar offered at respective research laboratories
60	○	○		Second Semester	Tue.	5	M(R0539) D (R0540)	Seminar in Biological Sciences 2 (Animal Ecology 2)	D (R540)	Seminar in Biological Sciences 2 (Animal Ecology 2)	2	Fumio Hayashi Yasukazu Okada	Seminar offered at respective research laboratories
59	○	○		First Semester	Fri.	3	M(R0541) D (R0542)	Seminar in Biological Sciences 1 (Plant Ecology 1)	D (R542)	Seminar in Biological Sciences 1 (Plant Ecology 1)	2	Jun-Ichirou Suzuki Yuuya Tachiki	Seminar offered at respective research laboratories
60	○	○		Second Semester	Fri.	3	M(R0543) D (R0544)	Seminar in Biological Sciences 2 (Plant Ecology 1)	D (R544)	Seminar in Biological Sciences 2 (Plant Ecology 1)	2	Jun-Ichirou Suzuki Yuuya Tachiki	Seminar offered at respective research laboratories
59	○	○		First Semester	Fri.	4	M(R0545) D (R0546)	Seminar in Biological Sciences 1 (Plant Ecology 2)	D (R546)	Seminar in Biological Sciences 1 (Plant Ecology 2)	2	Jun-Ichirou Suzuki Yuuya Tachiki	Seminar offered at respective research laboratories
60	○	○		Second Semester	Fri.	4	M(R0547) D (R0548)	Seminar in Biological Sciences 2 (Plant Ecology 2)	D (R548)	Seminar in Biological Sciences 2 (Plant Ecology 2)	2	Jun-Ichirou Suzuki Yuuya Tachiki	Seminar offered at respective research laboratories
59	○	○		First Semester	Fri.	6	M(R0549) D (R0550)	Seminar in Biological Sciences 1 (Plant Ecology 3)	D (R550)	Seminar in Biological Sciences 1 (Plant Ecology 3)	2	Jun-Ichirou Suzuki Yuuya Tachiki	Seminar offered at respective research laboratories
60	○	○		Second Semester	Fri.	6	M(R0551) D (R0552)	Seminar in Biological Sciences 2 (Plant Ecology 3)	D (R552)	Seminar in Biological Sciences 2 (Plant Ecology 3)	2	Jun-Ichirou Suzuki Yuuya Tachiki	Seminar offered at respective research laboratories
59	○	○		First Semester	Wed.	6	M(R0561) D (R0562)	Seminar in Biological Sciences 1 (Developmental Biology 1)	D (R562)	Seminar in Biological Sciences 1 (Developmental Biology 1)	2	Kimiko Fukuda Naohito Takatori	Seminar offered at respective research laboratories
60	○	○		Second Semester	Wed.	6	M(R0563) D (R0564)	Seminar in Biological Sciences 2 (Developmental Biology 1)	D (R564)	Seminar in Biological Sciences 2 (Developmental Biology 1)	2	Kimiko Fukuda Naohito Takatori	Seminar offered at respective research laboratories
59	○	○		First Semester	Wed.	7	M(R0565) D (R0566)	Seminar in Biological Sciences 1 (Developmental Biology 2)	D (R566)	Seminar in Biological Sciences 1 (Developmental Biology 2)	2	Kimiko Fukuda Naohito Takatori	Seminar offered at respective research laboratories
60	○	○		Second Semester	Wed.	7	M(R0567) D (R0568)	Seminar in Biological Sciences 2 (Developmental Biology 2)	D (R568)	Seminar in Biological Sciences 2 (Developmental Biology 2)	2	Kimiko Fukuda Naohito Takatori	Seminar offered at respective research laboratories
59	○	○		First Semester	Tue.	6	M(R0569) D (R0570)	Seminar in Biological Sciences 1 (Developmental Biology 3)	D (R570)	Seminar in Biological Sciences 1 (Developmental Biology 3)	2	Kimiko Fukuda Naohito Takatori	Seminar offered at respective research laboratories
60	○	○		Second Semester	Tue.	6	M(R0571) D (R0572)	Seminar in Biological Sciences 2 (Developmental Biology 3)	D (R572)	Seminar in Biological Sciences 2 (Developmental Biology 3)	2	Kimiko Fukuda Naohito Takatori	Seminar offered at respective research laboratories
59	○	○		First Semester	Tue.	5	M(R0577) D (R0578)	Seminar in Biological Sciences 1 (Systematic Zoology 1)	D (R578)	Seminar in Biological Sciences 1 (Systematic Zoology 1)	2	Katsuyuki Eguchi, Adam Cronin, Takahiro Yoshida	Seminar offered at respective research laboratories
60	○	○		Second Semester	Tue.	4	M(R0579) D (R0580)	Seminar in Biological Sciences 2 (Systematic Zoology 1)	D (R580)	Seminar in Biological Sciences 2 (Systematic Zoology 1)	2	Katsuyuki Eguchi, Adam Cronin, Takahiro Yoshida	Seminar offered at respective research laboratories
59	○	○		First Semester	Tue.	6	M(R0581) D (R0582)	Seminar in Biological Sciences 1 (Systematic Zoology 2)	D (R582)	Seminar in Biological Sciences 1 (Systematic Zoology 2)	2	Katsuyuki Eguchi, Adam Cronin, Takahiro Yoshida	Seminar offered at respective research laboratories
60	○	○		Second Semester	Tue.	5	M(R0583) D (R0584)	Seminar in Biological Sciences 2 (Systematic Zoology 2)	D (R584)	Seminar in Biological Sciences 2 (Systematic Zoology 2)	2	Katsuyuki Eguchi, Adam Cronin, Takahiro Yoshida	Seminar offered at respective research laboratories
59	○	○		First Semester	Fri.	3	M(R0585) D (R0586)	Seminar in Biological Sciences 1 (Systematic Botany 1)	D (R586)	Seminar in Biological Sciences 1 (Systematic Botany 1)	2	Noriaki Murakami, Hidetoshi Kato	Seminar offered at respective research laboratories
60	○	○		Second Semester	Fri.	3	M(R0587) D (R0588)	Seminar in Biological Sciences 2 (Systematic Botany 1)	D (R588)	Seminar in Biological Sciences 2 (Systematic Botany 1)	2	Noriaki Murakami, Hidetoshi Kato	Seminar offered at respective research laboratories
59	○	○		First Semester	Fri.	4	M(R0589) D (R0590)	Seminar in Biological Sciences 1 (Systematic Botany 2)	D (R590)	Seminar in Biological Sciences 1 (Systematic Botany 2)	2	Noriaki Murakami, Hidetoshi Kato	Seminar offered at respective research laboratories
60	○	○		Second Semester	Fri.	4	M(R0591) D (R0592)	Seminar in Biological Sciences 2 (Systematic Botany 2)	D (R592)	Seminar in Biological Sciences 2 (Systematic Botany 2)	2	Noriaki Murakami, Hidetoshi Kato	Seminar offered at respective research laboratories
59	○	○		First Semester	Mon.	5	M(R0593) D (R0594)	Seminar in Biological Sciences 1 (Environmental Microbiology 1)	D (R594)	Seminar in Biological Sciences 1 (Environmental Microbiology 1)	2	Shin Haruta	Seminar offered at respective research laboratories
60	○	○		Second Semester	Mon.	5	M(R0595) D (R0596)	Seminar in Biological Sciences 2 (Environmental Microbiology 1)	D (R596)	Seminar in Biological Sciences 2 (Environmental Microbiology 1)	2	Shin Haruta	Seminar offered at respective research laboratories
59	○	○		First Semester	Mon.	6	M(R0597) D (R0598)	Seminar in Biological Sciences 1 (Environmental Microbiology 2)	D (R598)	Seminar in Biological Sciences 1 (Environmental Microbiology 2)	2	Shin Haruta	Seminar offered at respective research laboratories
60	○	○		Second Semester	Mon.	6	M(R0599) D (R0600)	Seminar in Biological Sciences 2 (Environmental Microbiology 2)	D (R600)	Seminar in Biological Sciences 2 (Environmental Microbiology 2)	2	Shin Haruta	Seminar offered at respective research laboratories
59	○	○		First Semester	Fri.	3	M(R0601) D (R0602)	Seminar in Biological Sciences 1 (Cellular Biochemistry 1)	D (R602)	Seminar in Biological Sciences 1 (Cellular Biochemistry 1)	2	Hiroyuki Kawahara Naoto Yokota	Seminar offered at respective research laboratories

Course outline	M	D	NA 2022	Semester	Day	Time	[Graduate School of Science]		[Graduate School of Science and Engineering]		Credit Hours	Instructor(s)	Note (enrollment requirements, subject matter, etc.)
							Course Number	Course Name	Course Number	Course Name			
60	○	○		Second Semester	Fri.	3	M(R0603) D (R0604)	Seminar in Biological Sciences 2 (Cellular Biochemistry 1)	D (R604)	Seminar in Biological Sciences 2 (Cellular Biochemistry 1)	2	Hiroyuki Kawahara Naoto Yokota	Seminar offered at respective research laboratories
59	○	○		First Semester	Fri.	4	M(R0605) D (R0606)	Seminar in Biological Sciences 1 (Cellular Biochemistry 2)	D (R606)	Seminar in Biological Sciences 1 (Cellular Biochemistry 2)	2	Hiroyuki Kawahara Naoto Yokota	Seminar offered at respective research laboratories
60	○	○		Second Semester	Fri.	4	M(R0607) D (R0608)	Seminar in Biological Sciences 2 (Cellular Biochemistry 2)	D (R608)	Seminar in Biological Sciences 2 (Cellular Biochemistry 2)	2	Hiroyuki Kawahara Naoto Yokota	Seminar offered at respective research laboratories
59	○	○		First Semester	Mon.	1	M(R0435) D (R0436)	Seminar in Biological Sciences 1 (Stem Cell Modulation 1)	D (R436)	Seminar in Biological Sciences 1 (Stem Cell Modulation 1)	2	Takahiko Hara	Seminar offered at respective research laboratories
60	○	○		Second Semester	Mon.	1	M(R0437) D (R0438)	Seminar in Biological Sciences 2 (Stem Cell Modulation 1)	D (R438)	Seminar in Biological Sciences 2 (Stem Cell Modulation 1)	2	Takahiko Hara	Seminar offered at respective research laboratories
59	○	○		First Semester	Mon.	2	M(R0573) D (R0574)	Seminar in Biological Sciences 1 (Stem Cell Modulation 2)	D (R574)	Seminar in Biological Sciences 1 (Stem Cell Modulation 2)	2	Takahiko Hara	Seminar offered at respective research laboratories
60	○	○		Second Semester	Mon.	2	M(R0575) D (R0576)	Seminar in Biological Sciences 2 (Stem Cell Modulation 2)	D (R576)	Seminar in Biological Sciences 2 (Stem Cell Modulation 2)	2	Takahiko Hara	Seminar offered at respective research laboratories
59	○	○		First Semester	Mon.	1	M(R0921) D(R0922)	Seminar in Biological Sciences 1 (Molecular Regulation of Aging 1)	D(R0922)	Seminar in Biological Sciences 1 (Molecular Regulation of Aging 1)	2	Akihito Ishigami	Seminar offered at respective research laboratories
60	○	○		Second Semester	Mon.	1	M(R0923) D(R0924)	Seminar in Biological Sciences 2 (Molecular Regulation of Aging 1)	D(R0924)	Seminar in Biological Sciences 2 (Molecular Regulation of Aging 1)	2	Akihito Ishigami	Seminar offered at respective research laboratories
59	○	○		First Semester	Mon.	2	M(R0925) D(R0926)	Seminar in Biological Sciences 1 (Molecular Regulation of Aging 2)	D(R0926)	Seminar in Biological Sciences 1 (Molecular Regulation of Aging 2)	2	Akihito Ishigami	Seminar offered at respective research laboratories
60	○	○		Second Semester	Mon.	2	M(R0927) D(R0928)	Seminar in Biological Sciences 2 (Molecular Regulation of Aging 2)	D(R0928)	Seminar in Biological Sciences 2 (Molecular Regulation of Aging 2)	2	Akihito Ishigami	Seminar offered at respective research laboratories
59	○	○		First Semester	Mon.	1	M(R0929) D (R0930)	Seminar in Biological Sciences 1 (Plant Growth Regulation 1)	D (R0930)	Seminar in Biological Sciences 1 (Plant Growth Regulation 1)	2	Mitsunori Seo	Seminar offered at respective research laboratories
60	○	○		Second Semester	Mon.	1	M(R0931) D (R0932)	Seminar in Biological Sciences 2 (Plant Growth Regulation 1)	D (R0932)	Seminar in Biological Sciences 2 (Plant Growth Regulation 1)	2	Mitsunori Seo	Seminar offered at respective research laboratories
59	○	○		First Semester	Mon.	2	M(R0933) D (R0934)	Seminar in Biological Sciences 1 (Plant Growth Regulation 2)	D (R0934)	Seminar in Biological Sciences 1 (Plant Growth Regulation 2)	2	Mitsunori Seo	Seminar offered at respective research laboratories
60	○	○		Second Semester	Mon.	2	M(R0935) D (R0936)	Seminar in Biological Sciences 2 (Plant Growth Regulation 2)	D (R0936)	Seminar in Biological Sciences 2 (Plant Growth Regulation 2)	2	Mitsunori Seo	Seminar offered at respective research laboratories
59	○	○		First Semester	Mon.	1	M(R0351) D (R0352)	Seminar in Biological Sciences 1 (Chemical Biology 1)	D (R352)	Seminar in Biological Sciences 1 (Chemical Biology 1)	2	Yoshihiro Ito	Seminar offered at respective research laboratories
60	○	○		Second Semester	Mon.	1	M(R0353) D (R0354)	Seminar in Biological Sciences 2 (Chemical Biology 1)	D (R354)	Seminar in Biological Sciences 2 (Chemical Biology 1)	2	Yoshihiro Ito	Seminar offered at respective research laboratories
59	○	○		First Semester	Mon.	2	M(R0357) D (R0358)	Seminar in Biological Sciences 1 (Chemical Biology 2)	D (R358)	Seminar in Biological Sciences 1 (Chemical Biology 2)	2	Yoshihiro Ito	Seminar offered at respective research laboratories
60	○	○		Second Semester	Mon.	2	M(R0367) D (R0368)	Seminar in Biological Sciences 2 (Chemical Biology 2)	D (R368)	Seminar in Biological Sciences 2 (Chemical Biology 2)	2	Yoshihiro Ito	Seminar offered at respective research laboratories
61	○	○		At all times			M(R0609) D (R0610)	Special Experiment in Biological Sciences (Experimental Teches) (Experimental Techniques 1)	D(R610)	Special Experiment in Biological Sciences (Experimental Teches) (Experimental Techniques 1)	1	Multiple instructors	Basic experimental methods in each field of biological science This course is open to students of other majors.
61	○	○		At all times			M(R0611) D (R0612)	Special Experiment in Biological Sciences (Experimental Teches) (Experimental Techniques 2)	D(R612)	Special Experiment in Biological Sciences (Experimental Teches) (Experimental Techniques 2)	1	Multiple instructors	Basic experimental methods in each field of biological science This course is open to students of other majors.
61	○	○		At all times			M(R0613) D (R0614)	Special Experiment in Biological Sciences (Experimental Teches) (Experimental Techniques 3)	D(R614)	Special Experiment in Biological Sciences (Experimental Teches) (Experimental Techniques 3)	1	Multiple instructors	Basic experimental methods in each field of biological science This course is open to students of other majors.
61	○	○		At all times			M(R0615) D (R0616)	Special Experiment in Biological Sciences (Experimental Teches) (Experimental Techniques 4)	D(R616)	Special Experiment in Biological Sciences (Experimental Teches) (Experimental Techniques 4)	1	Multiple instructors	Basic experimental methods in each field of biological science This course is open to students of other majors.
61	○	○		At all times			M(R0617) D (R0618)	Special Experiment in Biological Sciences (Experimental Teches) (Experimental Techniques 5)	D(R618)	Special Experiment in Biological Sciences (Experimental Teches) (Experimental Techniques 5)	1	Multiple instructors	Basic experimental methods in each field of biological science This course is open to students of other majors.
61	○	○		At all times			M(R0619) D (R0620)	Special Experiment in Biological Sciences (Experimental Teches) (Experimental Techniques 6)	D(R620)	Special Experiment in Biological Sciences (Experimental Teches) (Experimental Techniques 6)	1	Multiple instructors	Basic experimental methods in each field of biological science This course is open to students of other majors.
62	○	○		At all times			M(R0621) D (R0622)	Special Practice in Biological Sciences II (Research Techniques 1)	D(R622)	Special Practice in Biological Sciences II (Research Techniques 1)	2	Multiple instructors	Basic experimental methods in each field of biological science and practical research methods
62	○	○		At all times			M(R0623) D (R0624)	Special Practice in Biological Sciences II (Research Techniques 2)	D(R624)	Special Practice in Biological Sciences II (Research Techniques 2)	2	Multiple instructors	Basic experimental methods in each field of biological science and practical research methods
62	○	○		At all times			M(R0625) D (R0626)	Special Practice in Biological Sciences II (Research Techniques 3)	D(R626)	Special Practice in Biological Sciences II (Research Techniques 3)	2	Multiple instructors	Basic experimental methods in each field of biological science and practical research methods
62	○	○		At all times			M(R0627) D (R0628)	Special Practice in Biological Sciences II (Research Techniques 4)	D(R628)	Special Practice in Biological Sciences II (Research Techniques 4)	2	Multiple instructors	Basic experimental methods in each field of biological science and practical research methods
62	○	○		At all times			M(R0629) D (R0630)	Special Practice in Biological Sciences II (Research Techniques 5)	D(R630)	Special Practice in Biological Sciences II (Research Techniques 5)	2	Multiple instructors	Basic experimental methods in each field of biological science and practical research methods
62	○	○		At all times			M(R0631) D (R0632)	Special Practice in Biological Sciences II (Research Techniques 6)	D(R632)	Special Practice in Biological Sciences II (Research Techniques 6)	2	Multiple instructors	Basic experimental methods in each field of biological science and practical research methods
63	○	○		First Semester	Thu.	6, 7	M(R0633) D (R0634)	Advanced Experimental Techniques in Biological Sciences 1 (Molecular Neurobiology)	D(R634)	Advanced Experimental Techniques in Biological Sciences 1 (Molecular Neurobiology)	2	Kanae Ando, Taro Saito, Akiko Asada	Advanced research technologies in different branches of biological sciences
64	○	○		Second Semester	Thu.	6, 7	M(R0635) D (R0636)	Advanced Experimental Techniques in Biological Sciences 2 (Molecular Neurobiology)	D(R636)	Advanced Experimental Techniques in Biological Sciences 2 (Molecular Neurobiology)	2	Kanae Ando, Taro Saito, Akiko Asada	Advanced research technologies in different branches of biological sciences
63	○	○		First Semester	Thu.	6, 7	M(R0637) D (R0638)	Advanced Experimental Techniques in Biological Sciences 1 (Neurobiology)	D(R638)	Advanced Experimental Techniques in Biological Sciences 1 (Neurobiology)	2	Makoto Kurokawa, Adam Weitemier	Advanced research technologies in different branches of biological sciences
64	○	○		Second Semester	Thu.	6, 7	M(R0639) D (R0640)	Advanced Experimental Techniques in Biological Sciences 2 (Neurobiology)	D(R640)	Advanced Experimental Techniques in Biological Sciences 2 (Neurobiology)	2	Makoto Kurokawa, Adam Weitemier	Advanced research technologies in different branches of biological sciences
63	○	○		First Semester	Thu.	6, 7	M(R0641) D (R0642)	Advanced Experimental Techniques in Biological Sciences 1 (Plant Development and Physiology)	D(R642)	Advanced Experimental Techniques in Biological Sciences 1 (Plant Development and Physiology)	2	Takashi Okamoto, Toshiko Furukawa, Atsuko Kinoshita	Advanced research technologies in different branches of biological sciences
64	○	○		Second Semester	Thu.	6, 7	M(R0643) D (R0644)	Advanced Experimental Techniques in Biological Sciences 2 (Plant Development and Physiology)	D(R644)	Advanced Experimental Techniques in Biological Sciences 2 (Plant Development and Physiology)	2	Takashi Okamoto, Toshiko Furukawa, Atsuko Kinoshita	Advanced research technologies in different branches of biological sciences
63	○	○		First Semester	Thu.	6, 7	M(R0645) D (R0646)	Advanced Experimental Techniques in Biological Sciences 1 (Plant Environmental Responses)	D(R646)	Advanced Experimental Techniques in Biological Sciences 1 (Plant Environmental Responses)	2	Takeshi Kanegae, Rei Narikawa	Advanced research technologies in different branches of biological sciences
64	○	○		Second Semester	Thu.	6, 7	M(R0647) D (R0648)	Advanced Experimental Techniques in Biological Sciences 2 (Plant Environmental Responses)	D(R648)	Advanced Experimental Techniques in Biological Sciences 2 (Plant Environmental Responses)	2	Takeshi Kanegae, Rei Narikawa	Advanced research technologies in different branches of biological sciences
63	○	○		First Semester	Thu.	6, 7	M(R0649) D (R0650)	Advanced Experimental Techniques in Biological Sciences 1 (Cytogenetics)	D(R650)	Advanced Experimental Techniques in Biological Sciences 1 (Cytogenetics)	2	Takaomi Sakai, Tsunaki Asano, Satomi Takeo	Advanced research technologies in different branches of biological sciences
64	○	○		Second Semester	Thu.	6, 7	M(R0651) D (R0652)	Advanced Experimental Techniques in Biological Sciences 2 (Cytogenetics)	D(R652)	Advanced Experimental Techniques in Biological Sciences 2 (Cytogenetics)	2	Takaomi Sakai, Tsunaki Asano, Satomi Takeo	Advanced research technologies in different branches of biological sciences
63	○	○		First Semester	Thu.	6, 7	M(R0653) D (R0654)	Advanced Experimental Techniques in Biological Sciences 1 (Evolutionary Genetics)	D(R654)	Advanced Experimental Techniques in Biological Sciences 1 (Evolutionary Genetics)	2	Koichiro Tamura, Aya Takahashi, Masafumi Nozawa	Advanced research technologies in different branches of biological sciences
64	○	○		Second Semester	Thu.	6, 7	M(R0655) D (R0656)	Advanced Experimental Techniques in Biological Sciences 2 (Evolutionary Genetics)	D(R656)	Advanced Experimental Techniques in Biological Sciences 2 (Evolutionary Genetics)	2	Koichiro Tamura, Aya Takahashi, Masafumi Nozawa	Advanced research technologies in different branches of biological sciences

Course outline	M	D	NA 2022	Semester	Day	Time	[Graduate School of Science]		[Graduate School of Science and Engineering]		Credit Hours	Instructor(s)	Note (enrollment requirements, subject matter, etc.)
							Course Number	Course Name	Course Number	Course Name			
63	○	○		First Semester	Thu.	6, 7	M(R0657) D (R0658)	Advanced Experimental Techniques in Biological Sciences 1 (Molecular Genetics)	D(R658)	Advanced Experimental Techniques in Biological Sciences 1 (Molecular Genetics)	2	Jun-ichi Kato Shigeki Ehira	Advanced research technologies in different branches of biological sciences
64	○	○		Second Semester	Thu.	6, 7	M(R0659) D (R0660)	Advanced Experimental Techniques in Biological Sciences 2 (Molecular Genetics)	D(R660)	Advanced Experimental Techniques in Biological Sciences 2 (Molecular Genetics)	2	Jun-ichi Kato Shigeki Ehira	Advanced research technologies in different branches of biological sciences
63	○	○		First Semester	Thu.	6, 7	M(R0661) D (R0662)	Advanced Experimental Techniques in Biological Sciences 1 (Animal Ecology)	D(R662)	Advanced Experimental Techniques in Biological Sciences 1 (Animal Ecology)	2	Fumio Hayashi Yasukazu Okada	Advanced research technologies in different branches of biological sciences
64	○	○		Second Semester	Thu.	6, 7	M(R0663) D (R0664)	Advanced Experimental Techniques in Biological Sciences 2 (Animal Ecology)	D(R664)	Advanced Experimental Techniques in Biological Sciences 2 (Animal Ecology)	2	Fumio Hayashi Yasukazu Okada	Advanced research technologies in different branches of biological sciences
63	○	○		First Semester	Thu.	6, 7	M(R0665) D (R0666)	Advanced Experimental Techniques in Biological Sciences 1 (Plant Ecology)	D(R666)	Advanced Experimental Techniques in Biological Sciences 1 (Plant Ecology)	2	Jun-Ichirou Suzuki Yuuya Tachiki	Advanced research technologies in different branches of biological sciences
64	○	○		Second Semester	Thu.	6, 7	M(R0667) D (R0668)	Advanced Experimental Techniques in Biological Sciences 2 (Plant Ecology)	D(R668)	Advanced Experimental Techniques in Biological Sciences 2 (Plant Ecology)	2	Jun-Ichirou Suzuki Yuuya Tachiki	Advanced research technologies in different branches of biological sciences
63	○	○		First Semester	Thu.	6, 7	M(R0673) D (R0674)	Advanced Experimental Techniques in Biological Sciences 1 (Developmental Biology)	D(R674)	Advanced Experimental Techniques in Biological Sciences 1 (Developmental Biology)	2	Kimiko Fukuda Naohito Takatori	Advanced research technologies in different branches of biological sciences
64	○	○		Second Semester	Thu.	6, 7	M(R0675) D (R0676)	Advanced Experimental Techniques in Biological Sciences 2 (Developmental Biology)	D(R676)	Advanced Experimental Techniques in Biological Sciences 2 (Developmental Biology)	2	Kimiko Fukuda Naohito Takatori	Advanced research technologies in different branches of biological sciences
63	○	○		First Semester	Thu.	6, 7	M(R0677) D (R0678)	Advanced Experimental Techniques in Biological Sciences 1 (Systematic Zoology)	D(R678)	Advanced Experimental Techniques in Biological Sciences 1 (Systematic Zoology)	2	Katsuyuki Eguchi, Adam Cronin, Takahiro Yoshida	Advanced research technologies in different branches of biological sciences
64	○	○		Second Semester	Thu.	6, 7	M(R0679) D (R0680)	Advanced Experimental Techniques in Biological Sciences 2 (Systematic Zoology)	D(R680)	Advanced Experimental Techniques in Biological Sciences 2 (Systematic Zoology)	2	Katsuyuki Eguchi, Adam Cronin, Takahiro Yoshida	Advanced research technologies in different branches of biological sciences
63	○	○		First Semester	Thu.	6, 7	M(R0681) D (R0682)	Advanced Experimental Techniques in Biological Sciences 1 (Systematic Botany)	D(R682)	Advanced Experimental Techniques in Biological Sciences 1 (Systematic Botany)	2	Noriaki Murakami, Yoko Kakugawa, Hidetoshi Kato	Advanced research technologies in different branches of biological sciences
64	○	○		Second Semester	Thu.	6, 7	M(R0683) D (R0684)	Advanced Experimental Techniques in Biological Sciences 2 (Systematic Botany)	D(R684)	Advanced Experimental Techniques in Biological Sciences 2 (Systematic Botany)	2	Noriaki Murakami, Yoko Kakugawa, Hidetoshi Kato	Advanced research technologies in different branches of biological sciences
63	○	○		First Semester	Thu.	6, 7	M(R0685) D (R0686)	Advanced Experimental Techniques in Biological Sciences 1 (Environmental Microbiology)	D(R686)	Advanced Experimental Techniques in Biological Sciences 1 (Environmental Microbiology)	2	Shin Haruta	Advanced research technologies in different branches of biological sciences
64	○	○		Second Semester	Thu.	6, 7	M(R0687) D (R0688)	Advanced Experimental Techniques in Biological Sciences 2 (Environmental Microbiology)	D(R688)	Advanced Experimental Techniques in Biological Sciences 2 (Environmental Microbiology)	2	Shin Haruta	Advanced research technologies in different branches of biological sciences
63	○	○		First Semester	Thu.	6, 7	M(R0689) D (R0690)	Advanced Experimental Techniques in Biological Sciences 1 (Cellular Biochemistry)	D(R690)	Advanced Experimental Techniques in Biological Sciences 1 (Cellular Biochemistry)	2	Hiroyuki Kawahara Naoto Yokota	Advanced research technologies in different branches of biological sciences
64	○	○		Second Semester	Thu.	6, 7	M(R0691) D (R0692)	Advanced Experimental Techniques in Biological Sciences 2 (Cellular Biochemistry)	D(R692)	Advanced Experimental Techniques in Biological Sciences 2 (Cellular Biochemistry)	2	Hiroyuki Kawahara Naoto Yokota	Advanced research technologies in different branches of biological sciences
63	○	○		First Semester	Thu.	6, 7	M(R0407) D (R0408)	Advanced Experimental Techniques in Biological Sciences 1 (Stem Cell Modulation)	D (R408)	Advanced Experimental Techniques in Biological Sciences 1 (Stem Cell Modulation)	2	Takahiko Hara	Advanced research technologies in different branches of biological sciences
64	○	○		Second Semester	Thu.	6, 7	M(R0409) D (R0410)	Advanced Experimental Techniques in Biological Sciences 2 (Stem Cell Modulation)	D (R410)	Advanced Experimental Techniques in Biological Sciences 2 (Stem Cell Modulation)	2	Takahiko Hara	Advanced research technologies in different branches of biological sciences
63	○	○		First Semester	Thu.	6, 7	M(R0741) D (R0742)	Advanced Experimental Techniques in Biological Sciences 1 (Molecular Regulation of Aging)	D (R742)	Advanced Experimental Techniques in Biological Sciences 1 (Molecular Regulation of Aging)	2	Akihito Ishigami	Advanced research technologies in different branches of biological sciences
64	○	○		Second Semester	Thu.	6, 7	M(R0743) D (R0744)	Advanced Experimental Techniques in Biological Sciences 2 (Molecular Regulation of Aging)	D (R744)	Advanced Experimental Techniques in Biological Sciences 2 (Molecular Regulation of Aging)	2	Akihito Ishigami	Advanced research technologies in different branches of biological sciences
63	○	○		First Semester	Thu.	6, 7	M(R0745) D (R0746)	Advanced Experimental Techniques in Biological Sciences 1 (Plant Growth Regulation)	D (R746)	Advanced Experimental Techniques in Biological Sciences 1 (Plant Growth Regulation)	2	Mitsunori Seo	Advanced research technologies in different branches of biological sciences
64	○	○		Second Semester	Thu.	6, 7	M(R0747) D (R0748)	Advanced Experimental Techniques in Biological Sciences 2 (Plant Growth Regulation)	D (R748)	Advanced Experimental Techniques in Biological Sciences 2 (Plant Growth Regulation)	2	Mitsunori Seo	Advanced research technologies in different branches of biological sciences
63	○	○		First Semester	Thu.	6, 7	M(R0381) D (R0382)	Advanced Experimental Techniques in Biological Sciences 1 (Chemical Biology)	D (R382)	Advanced Experimental Techniques in Biological Sciences 1 (Chemical Biology)	2	Yoshihiro Ito	Advanced research technologies in different branches of biological sciences
64	○	○		Second Semester	Thu.	6, 7	M(R0387) D (R0388)	Advanced Experimental Techniques in Biological Sciences 2 (Chemical Biology)	D (R388)	Advanced Experimental Techniques in Biological Sciences 2 (Chemical Biology)	2	Yoshihiro Ito	Advanced research technologies in different branches of biological sciences

Program	Graduate School of Science		Graduate School of Science and Engineering		Semester	Day	Time	Credit
	Course Name	Course Number	Course Name	Course Number				
Master's program	Advanced Lecture on Biological Information	R0359	—	—	2nd	Thr	1	2
Doctoral program	Advanced Lecture on Biological Information	R0360	Advanced Lecture on Biological Information	R360				

Instructor(s)	Note
Weitemier, Kurokawa and Sakai	

(1) Course policies and topics	In this course, research that has revealed the basis of neurobiology using various experimental animals will be introduced through review of background research papers and the latest research results.
(2) Knowledge/skills to be acquired and learning objectives/course goals	You will learn the latest knowledge on neurological information such as neuronal function, structure of the synapse, synaptic transmission, the biological basis of memory, and the biological basis of behavioral disorders.
(3) Course schedule, subject matter, and classroom activities	TENTATIVE COURSE SCHEDULE 1. Physiology of excitable cells 1 (M. Kurokawa) 2. Physiology of excitable cells 2 (M. Kurokawa) 3. Physiology of synapses 1 (M. Kurokawa) 4. Physiology of synapses 2 (M. Kurokawa) 5. Synaptic plasticity (M. Kurokawa) 6. Learning & Memory 1 (T. Sakai) 7. Learning & Memory 2 (T. Sakai) 8. Learning & Memory 3 (T. Sakai) 9. Learning & Memory 4 (T. Sakai) 10. Learning & Memory 5 (T. Sakai) 11. Classical and Instrumental Conditioning (A. Weitemier) 12. Receptors and Drugs (A. Weitemier) 13. Neural Control of Emotion (A. Weitemier) 14. Brain reward system and Addiction (A. Weitemier) 15. Psychiatric Disorders (A. Weitemier)
(4) Outside-class activities and assignments	Preparing and reviewing lessons and working on report assignments, etc.
(5) Textbooks and course materials	Prints will be distributed in class. For further background refer to Bear, Mark F., Barry W. Connors, and Michael A. Paradiso. Neuroscience: Exploring the Brain, English mini-library, room 8-246
(6) Assessment and grading	Comprehensive evaluation based on learning attitudes, reports, etc.
(7) Questions to the instructor (Office hours, etc.)	Office hours are not set. If you would like to ask questions directly, please make an appointment by email in advance.
(8) Special note	Lectures 11-15 (Weitemier) will be delivered in English. Those who wish to take the remaining lectures in English should contact the lecturers. A note on the lecture by Sakai will be given in the first lecture (6th).

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 Biochemistry	R0363	—	—	1st	Fri	1	2
Doctoral program	Advanced Lecture on Biochemistry	R0364	Advanced Lecture on Biochemistry	R364				

Instructor(s)	Note
Kawahara and Okamoto	

(1) Course policies and topics	How Breakthrough Discoveries Are Made - Primarily Conducting Research Paper Reading
(2) Knowledge/skills to be acquired and learning objectives/course goals	Much of the current research in biochemistry and molecular cell biology is based on the findings of past researchers. Learning the process will be useful not only in advancing current graduate research topics but also in broadly understanding problem setting and how to solve them. Students will not only increase their knowledge, but will also learn from past successes in a way that can be used for future research.
(3) Course schedule, subject matter, and classroom activities	[1st half] The objective of this research is to select several original papers that reported epoch-making discoveries in biochemistry and molecular cell biology, and to approach the contents of these papers in the form of a paper lecture. I would like to present a wide range of papers covering molecular biology, cell biology, and biochemistry, from classical papers (such as biosynthesis of membrane proteins) to recent papers (such as Professor Yamanaka's iPS cells). A discussion leader was appointed for each lecture, and the leader explained the background, presentation of data, and consideration of each paper. At the same time, with all participants, 1) What was the author's perspective on starting the study? 2) What were the problems to be solved? 3) How did the author approach the problem? deepen discussions on. Each discussion leader must prepare a presentation. All participants are also asked to prepare for the paper. For this purpose, at the time of the first lecture, an extra copy of the target paper (approximately 7 papers) is distributed to all students, and at the time of the second lecture, a discussion leader corresponding to each paper is determined. [2nd half] You will introduce and discuss papers on the developmental phenomena of organisms, tissues, and cells that are covered in your research topics.
(4) Outside-class activities and assignments	Preparation and review of the research papers are required.
(5) Textbooks and course materials	[1st half] Copies of important papers describing landmark discoveries in biochemistry and molecular cell biology, many of which were Nobel Prize-winning studies, will be distributed in advance. Relevant documentation should also be distributed as appropriate. [2nd half] The paper is distributed.
(6) Assessment and grading	Students are given a comprehensive evaluation of their attitudes toward teaching, mini-reports, and reports. The performance evaluation of this subject will be based on attendance, achievement of literature introduction, and questions and answers. We particularly value their active participation in the exercise.
(7) Questions to the instructor (Office hours, etc.)	Questions are answered as needed after adjusting the schedule by mail. Kawahara: hkawa@tmu.ac.jp (9-488) Okamoto: okamoto-takashi@tmu.ac.jp (8-320)
(8) Special note	Students can take this course in English. Those who wish to take the course in English should contact the class lecturers.

Program	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 Developmental Biology	R0369	—	—	1st	Thr	1	2
Doctoral program	Advanced Lecture on Developmental Biology	R0370	Advanced Lecture on Developmental Biology	R370				

Instructor(s)	Note
Fukuda and Takatori	

(1) Course policies and topics	[Advanced Developmental Biology] The aim is to acquire knowledge of the latest developmental biology, and to acquire the ability to read English papers critically and to introduce and present them accurately.
(2) Knowledge/skills to be acquired and learning objectives/course goals	-Ability to understand the structure of a paper and read critically -Ability to introduce articles accurately and ask questions -Acquiring the latest knowledge of developmental biology
(3) Course schedule, subject matter, and classroom activities	Learn how to compose, read, and present scientific papers. Excellent papers on developmental biology are taken u. Articles which each person has read are presented, and questions and answers are carried out. Each person is required to make at least two announcements. Discussion is required of all participants at the presentation. In response to students' requests, lectures on the latest developmental biology and discussions on their research are held.
(4) Outside-class activities and assignments	Read papers and prepare for presentations outside of class.
(5) Textbooks and course materials	There are no textbooks. Instructors will introduce the articles.
(6) Assessment and grading	The participation challenge and attitude to the class are mainly evaluated.
(7) Questions to the instructor (Office hours, etc.)	Students can Contact Dr. Fukuda (kokko@tmu.ac.jp) or Dr. Takatori (takatori-naohito1@tmu.ac.jp) via e-mail.
(8) Special note	Students can take this course in English. Those who wish to take the course in English should contact the class staff.

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 Molecular Biology	R0371	—	—	2nd	Fri	1	2
Doctoral program	Advanced Lecture on Molecular Biology	R0372	Advanced Lecture on Molecular Biology	R372				

Instructor(s)	Note
Kato, Ehira and Haruta	

(1) Course policies and topics	The theme is the latest research of molecular biology for microorganisms. Junichi Kato (molecular genetics), Shigeki Ehira (microbial molecular physiology) and Shin Haruta (environmental microbiology) are in charge.
(2) Knowledge/skills to be acquired and learning objectives/course goals	Understand the basics and applications of molecular biology and genome science.
(3) Course schedule, subject matter, and classroom activities	Advances in sequencing have now revealed the genome structure of many organisms, and molecular biology and genome science techniques are now widely used, from basic fields such as transcriptional analysis and identification of essential genes to medical and industrial fields. And, various metaomics analysis technology such as metagenome analysis which analyzes DNA of microbial community in the environment is developed. In this lecture, we introduce the latest research in several fields of molecular biology and genome science, focusing on the study of microorganisms. Some outside researchers are invited to give an omnibus lecture.
(4) Outside-class activities and assignments	A report will be assigned after the lecture (Kato). Students are required to read relevant research papers (Ehira, Haruta).
(5) Textbooks and course materials	No text specified.
(6) Assessment and grading	Evaluate by active participation in class and reports.
(7) Questions to the instructor (Office hours, etc.)	We don't set office hours, but if you want to ask a question directly, we will accept it anytime, so please make an appointment by email in advance.
(8) Special note	Students can take this course in English. Those who wish to take the course in English should contact the lecturers.

Program	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 Genetic Information	R0391	—	—	2nd II	Fri	2	1
Doctoral program	Special Lectures on Genetic Information	R0392	Special Lectures on Genetic Information	R392				

Instructor(s)	Note
Tamura, Takahashi and Nozawa	—

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

Program	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 Ecological Science	R0393	—	—	1st II	Fri	2	1
Doctoral program	Special Lectures in Ecological Sciences	R0394	Special Lectures in Ecological Sciences	R394				

Instructor(s)	Note
Hayashi, Suzuki and Okada	

(1) Course policies and topics	[dynamics of animal and plant communities] How to grasp the dynamics of animal communities and how to do it (Fumio Hayashi and Yasukazu Okada) Understanding interspecific interactions and material production in plant communities (Junichiro Suzuki)
(2) Knowledge/skills to be acquired and learning objectives/course goals	Through this lecture, students will develop their own learning abilities, logical thinking skills, and English skills.
(3) Course schedule, subject matter, and classroom activities	Research methods on the dynamics of animal communities (Fumio Hayashi and Yasukazu Okada) Introduction of research and development on dynamics of plant communities, reading of basic documents, and presentation of its contents (Junichiro Suzuki)
(4) Outside-class activities and assignments	To arrange related papers and related matters outside of class hours and prepare a report.
(5) Textbooks and course materials	Print and other materials are distributed as needed (Fumio HAYASHI and Yasukazu OKADA). Distribute materials (Junichiro SUZUKI)
(6) Assessment and grading	Evaluated by both active participation in classes and reports (Fumio Hayashi and Yasukazu Okada) Submission of mini-reports during lecture hours and their contents and presentations are evaluated together (Junichiro SUZUKI)
(7) Questions to the instructor (Office hours, etc.)	If you have any questions, please contact us by email (First half: jsuzuki@tmu.ac.jp, Second half: fhayashi@tmu.ac.jp and yasu_okada@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.

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 Responses to Environment	R0397	—	—	1st I	Fri	2	1
Doctoral program	Special Lecture on Responses to Environment	R0398	Special Lecture on Responses to Environment	R398				

Instructor(s)	Note
Kanegae and Narikawa	

(1) Course policies and topics	One of the most significant functions of living organisms is to respond to surrounding environmental information. The purpose of this class is to understand the physiological responses and phenomena related to the environment focusing on the light signal that evolved in various organisms such as plants and cyanobacteria and to understand various methods to analyze photoreceptor molecules.
(2) Knowledge/skills to be acquired and learning objectives/course goals	Part 1: This course will introduce recent research on light sensing in plants. At the end of this course, students will be able to explain how light as environment information is accepted by plant photoreceptors and how information is expressed. Part 2: In this course, students will understand the methods to analyze the photoreceptors in vitro, which would be applicable to the other proteins.
(3) Course schedule, subject matter, and classroom activities	Classes are conducted using Zoom. Please confirm the URL up to kibaco by the day before. [Part 1] 1. Post-transcriptional regulation of photomorphogenesis 2. Molecular mechanisms of plant photoperiodism 3. RNA modification and flowering 4. Review and discussion [Part 2] 1. Cloning and mutagenesis 2. Protein purification 3. Spectroscopy 4. Various biochemical and biophysical studies
(4) Outside-class activities and assignments	Homework will be given after each class or you should review the last lecture every week.
(5) Textbooks and course materials	Text: Handouts will be provided. [Part 1] Lecture materials will be uploaded to kibaco '資料' by the day before. Please download it before class starts.
(6) Assessment and grading	Assessment: The mean score from Part 1 and Part 2 will be the final grade. Parts 1 & 2: Class participation/discussion 30%, Quiz or Report submission 70 %
(7) Questions to the instructor (Office hours, etc.)	Particular office hour is not set. For queries, please make an appointment via e-mail.
(8) Special note	This class will be offered in Japanese (Class may be offered in English). Those who wish to take the course in English should contact the class lecturer.

Program	Graduate School of Science		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 Systematics and Evolution	R0373	—	—	2nd I	Tue	1	1
Doctoral program	Special Lecture on Systematics and Evolution	R0374	Special Lecture on Systematics and Evolution	R374				

Instructor(s)	Note
Murakami and Eguchi	

(1) Course policies and topics	Phylogenetics] Deepen understanding of the field by introducing recent research to explore issues of animal and plant diversity and evolution.
(2) Knowledge/skills to be acquired and learning objectives/course goals	Learn the thought processes by which researchers use information to understand the lineage and evolution of living organisms.
(3) Course schedule, subject matter, and classroom activities	Eguchi) Southeast Asia is considered the most species-diverse region in the world. In many animal groups, however, the speciation is poorly understood. There is also a lack of knowledge about the geographical genetic structure and origin of individual species and lineages. This lecture presents recent research on species classification and phylogeography of terrestrial invertebrates in Southeast Asia. (MURAKAMI) Many species of ferns have stopped sexual reproduction and have become asexual, called apogamy. And, though it is difficult to distinguish by the form. The presence of many hidden species with distinct reproductive isolation is also characteristic of ferns. This paper outlines our research on apogamous and hidden species of fern plants, and discusses it with students.
(4) Outside-class activities and assignments	To deepen understanding of research by reading short papers and expressing opinions on research directions and issues. It is necessary to make a small report on the main points and impressions of the lecture at home.
(5) Textbooks and course materials	The lecture proceeds mainly on the handout, and references and papers, etc. are introduced as appropriate.
(6) Assessment and grading	Evaluate based on participation in classes and reports.
(7) Questions to the instructor (Office hours, etc.)	Questions are always welcome, so please make an appointment in advance by email. Eguchi: antist@tmu.ac.jp Murakami: nmurak@tmu.ac.jp
(8) Special note	Students can take this course in English. Those who wish to take the course in English should contact the class lecturers.

Program	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 Cell Biology	R0761	—	—	1st Intensive	—	—	1
Doctoral program	Special Lecture on Cell Biology	R0762	Special Lecture on Cell Biology	R762				

Instructor(s)	Note
Kaoru Yamada*	

(1) Course policies and topics	Instructor: Kaoru Yamada Course description The course aims to convey theoretical and practical knowledges on the pathophysiology of Alzheimer's diseases (AD) for students who are interested in basic, translational and clinical research of AD. Topics will include not only the clinical manifestations of AD, but also patho-mechanisms of AD development, and current research models of the disease, development of diagnosis biomarkers, treatment strategy for AD.
(2) Knowledge/skills to be acquired and learning objectives/course goals	Couse objective After completion of the course, students should be able to - explain how biochemical properties of proteins can lead to AD. - describe animal models and cell culture models that are critical to AD research. - explain and interpret the importance of biomarkers for the diagnosis of AD. - explain how basic research can be translated into therapeutic development for AD
(3) Course schedule, subject matter, and classroom activities	Tentative course schedule 1 Lecture (general principle of AD pathophysiology) 2 Students' oral presentation 3 Lecture (AD diagnosis and treatment strategy for AD) 4 Students' oral presentation
(4) Outside-class activities and assignments	Out of class activity requirement Reading selected articles and preparation for presentation will be required.
(5) Textbooks and course materials	Materials Handouts might be distributed at the lecture.
(6) Assessment and grading	Evaluation Engaged class participation 50% Oral presentation 50%
(7) Questions to the instructor (Office hours, etc.)	Please E-mail to the instructor.
(8) Special note	This course is given by Kaoru Yamada, Graduate School of Medicine, University of Tokyo. Please E-mail to Kanae Ando (k_ando@tmu.ac.jp) for more information.

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 (English for Biology)	R0421	—	—	1st Intensive	—	—	2
Doctoral program	Special Course in Biology Ⅱ (English for Biology)	R0422	Special Course in Biology Ⅱ (English for Biology)	R422				

Instructor(s)	Note
Yuka Iijima*	

(1) Course policies and topics	Speaking/Listening
(2) Knowledge/skills to be acquired and learning objectives/course goals	This course will be a listening/speaking course in English for science students. Students will practice 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, attending lectures, or when visiting or working in laboratories overseas. 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 practiced. The class will be conducted in English using an interactive workshop style for active listening and speaking practice.
(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: 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.)	Through e-mail.
(8) Special note	The lecturer of this course is Yuka Iijima. Students are required to bring notebook computers (which can access the Internet via WiFi) and earphones to class. Students should also have a Gmail account.

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 (English for Biology)	R0423	—	—	2nd Intensive	—	—	2
Doctoral program	Special Course in Biology Ⅱ (English for Biology)	R0424	Special Course in Biology Ⅱ (English for Biology)	R424				

Instructor(s)	Note
Rena Nakamura*	

(1) Course policies and topics	Writing
(2) Knowledge/skills to be acquired and learning objectives/course goals	In this course, students will learn how to write scientific empirical research articles (RAs) in English.
(3) Course schedule, subject matter, and classroom activities	This course is open to students who will be writing empirical RAs for academic journals, abstracts for international conferences or their dissertation, or are in the process of preparing to do so. In the course, students will analyze the structure and other features of empirical RAs in order to help improve their reading and writing skills for these articles. Students will also be writing on their own research. The class will be conducted in English.
(4) Outside-class activities and assignments	What to bring to the first class: Bring electronic copies of three empirical RAs in the field of your study. These RAs must be written in English and have been published in well-respected peer-reviewed journals. If a student has done little or no research and cannot write about his/her research, he/she must also bring an electronic copy of a full-length Japanese RA in the field of his/her study. Both the English and Japanese RAs should consist of the following sections: Introduction, Methods/Procedure, Results, Discussion, and Conclusion. (Given that these are typical names of sections, names of the sections in RAs you select can deviate slightly from the above-mentioned section names)
(5) Textbooks and course materials	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	Active class participation: 30% Short writing and other assignments: 40% Final writing assignment: 30%
(7) Questions to the instructor (Office hours, etc.)	By e-mail.
(8) Special note	The lecturer for this course is Dr. Reina Nakamura. Students are required to bring laptop computers (which can access the Internet via WiFi) to class. Students are also 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 issues.
(3) Course schedule, subject matter, and classroom activities	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). Final, written (open book) exam will conclude the classes at the end of the semester. The test might be conducted online.
(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	Assessment: Class participation (10%), end semester exam (90%).
(7) Questions to the instructor (Office hours, etc.)	The lecturer of this course is Ms. Elizabeth Zielinska (elietutmu@tmu.ac.jp). You can contact the lecturer 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 the level of nervousness so that you can be better perceived and understood by other English speakers. At the same time, we will work on pronunciation – to smooth the delivery 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 content, have fun, learn a lot, and I look forward to your attendance. In case of emergency, classes will be conducted online using Zoom.
(3) Course schedule, subject matter, and classroom activities	Content: Body and posture/body language Memory or paper Telling stories (homework) Introducing the topic (homework) PC and poster presentations Presenting an experiment(homework) Vowels and intonation Presenting your research (homework) Emphases, rhythm and stress in speaking Dealing with questions Repeating, recapping and rephrasing, chunking Being persuasive (homework) Preparing a concise presentation Final presentation
(4) Outside-class activities and assignments	Some homework/short presentations (see above) will be given.
(5) Textbooks and course materials	Handouts will be uploaded to Kibaco.
(6) Assessment and grading	Assessment: Class participation (50%), End semester presentation (50%).
(7) Questions to the instructor (Office hours, etc.)	The lecturer of this course is Ms. Elizabeth Zielinska (elietutmu@tmu.ac.jp). You can contact the lecturer 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 issues.
(3) Course schedule, subject matter, and classroom activities	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). Final, written (open book) exam will conclude the classes at the end of the semester. The test might be conducted online.
(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	Assessment: Class participation (10%), End semester exam (90%).
(7) Questions to the instructor (Office hours, etc.)	The lecturer of this course is Ms. Elizabeth Zielinska (elietutmu@tmu.ac.jp). You can contact the lecturer 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 I (Research Presentation)	R0433	—	—	2nd I	Fri	2	1
Doctoral program	Special Course in Biology I (Research Presentation)	R0434	Special Course in Biology I (Research Presentation)	R434				

Instructor(s)	Note
Ando, Cronin and Weitemier	

(1) Course policies and topics	Course Title: 'Special course in Biology I (Research presentation)' 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 on their individual research projects.
(2) Knowledge/skills to be acquired and learning objectives/course goals	Course goal: 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 State University of NY Oneonta and Western Sydney University.

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 Ⅰ (Computer Practice : Basic)	R0439	—	—	1st Intensive	—	—	1
Doctoral program	Special Course in Biology Ⅰ (Computer Practice : Basic)	R0440	Special Course in Biology Ⅰ (Computer Practice : Basic)	R440				

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	Network system to get information for doing research in Department of Biological Sciences is introduced. You will also learn the basics of large-scale sequencing data analysis, which has rapidly advanced in recent years. The exercise will take the form of a two-day intensive course. Day 1: Wednesday, April 13 2-4 periods: 8-287 Day 2: Wednesday, April 20 2-4 periods: 8-287 In the first session (Day 1), students will practice how to use our 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 doing 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	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 Biological Sciences I	R0431	—	—	1st Intensive	—	—	1
Doctoral program	Special Course in Biological Sciences I	R0432	Special Course in Biological Sciences I	R432				

Instructor(s)	Note
Rei Narikawa	Classes mainly targeted at students interested in high school education, such as high school teachers

(1) Course policies and topics	Practical learning of techniques to elucidate the molecular basis for sensing light by living organisms
(2) Knowledge/skills to be acquired and learning objectives/course goals	Practical learning of techniques to elucidate the molecular basis for sensing light by living organisms
(3) Course schedule, subject matter, and classroom activities	Day 1: Photobiology Lectures, Exercises, and Reporting ・Lectures and practical training on the relationship between light and color, spectroscopy, and the basics of photobiology Day 2: Optical lecture, lab, reporting, recap ・Lectures and practical training on how living things sense light
(4) Outside-class activities and assignments	Ask for review after practice and practice for high school classes.
(5) Textbooks and course materials	Lectures are given on slides. Distribute prints as appropriate.
(6) Assessment and grading	Evaluate by class participation attitudes and reports.
(7) Questions to the instructor (Office hours, etc.)	narikawa.rei@tmu.ac.jp Questions are always welcome, so please make an appointment in advance by email. narikawa.rei@tmu.ac.jp
(8) Special note	This course is offered in Japanese. The main purpose of this course is to re-educate high school biology teachers, but graduate students who want to become teachers can also take this course. In this case, consult with the Coordinating Teacher (Fukuda) kokko@tmu.ac.jp in advance.

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 Biological Sciences I	R0361	—	—	1st Intensive	—	—	1
Doctoral program	Special Course in Biological Sciences I	R0362	Special Course in Biological Sciences I	R362				

Instructor(s)	Note
Takahiro Yoshida	lasses mainly targeted at students interested in high school education, such as high school teachers

(1) Course policies and topics	Practical training will be conducted on terrestrial invertebrates, mainly insects, from sampling to species identification. The course also includes lectures on biodiversity and its research, aiming to deepen students' understanding of biodiversity and to provide them with the basic skills needed to elucidate biodiversity.
(2) Knowledge/skills to be acquired and learning objectives/course goals	Acquire basic knowledge and skills that are important in studying biodiversity. Through lectures and practical training on sampling, sampling, dissection, morphological observation, sketching, and species identification, the goal is to acquire the ability to conduct biodiversity research independently to some extent.
(3) Course schedule, subject matter, and classroom activities	In small groups, participants will work collaboratively on the following topics throughout the first and second days. Lectures on techniques related to this training and research on biodiversity and its elucidation will also be provided as appropriate. Practice of species identification of any taxon using specimens prepared by the instructor, morphological comparison with closely related species, and creation of a pictorial search combined with sketches. Practice of specimen preparation, morphological observation, and dissection using insects prepared by faculty members. Practical sampling and sorting of soil invertebrates at the Minami-Osawa campus (in case of rain, soil samples prepared by the faculty will be used).
(4) Outside-class activities and assignments	A report must be submitted after the class.
(5) Textbooks and course materials	Textbooks will be distributed as appropriate.
(6) Assessment and grading	Evaluate by class participation attitudes and reports.
(7) Questions to the instructor (Office hours, etc.)	E-mail me if you have any questions. yoshida_takahiro@tmu.ac.jp
(8) Special note	In this exercise, soil invertebrates will be sampled in the Minami Osawa Campus, unless it rains on the second day. You should prepare clothes and insect repellent that are good for getting dirty. This course is offered in Japanese. The main purpose of this course is to re-educate high school biology teachers, but graduate students who want to become teachers can also take this course. In this case, consult with the Coordinating Teacher (Fukuda) kokko@tmu.ac.jp in advance.

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 Planning and Management 1	R0443	—	—	1st	Tue	2	1
Doctoral program	Biology Course in Planning and Management 1	R0444	Biology Course in Planning and Management 1	R444				

Instructor(s)	Note
Haruta and All faculty member of Department of Biological Sciences	

(1) Course policies and topics	(Course description) Planning and Management Practicum 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	(Course objectives) 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. (1) Outreach activities, including visiting lectures/experiments and production of web content/brochures. (2) Research introduction and study guidance/consultation for undergraduate and graduate students (3) Organizing research meetings (4) 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	(Reference) Past reports can be available at https://www.biol.se.tmu.ac.jp/impgrad/outreach.html.
(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		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 Planning and Management 2	R0445	—	—	2nd	Tue	2	1
Doctoral program	Biology Course in Planning and Management 2	R0446	Biology Course in Planning and Management 2	R446				

Instructor(s)	Note
Haruta and All faculty member of Department of Biological Sciences	

(1) Course policies and topics	(Course description) Planning and Management Practicum 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	(Course objectives) 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. (1) Outreach activities, including visiting lectures/experiments and production of web content/brochures. (2) Research introduction and study guidance/consultation for undergraduate and graduate students (3) Organizing research meetings (4) 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	(Reference) Past reports can be available at https://www.biol.se.tmu.ac.jp/impgrad/outreach.html.
(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		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 1	R0447	—	—	1st	Tue	3	1
Doctoral program	Biology Course in International Research Experiences 1	R0448	Biology Course in International Research Experiences 1	R448				

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	Biology Course in Research Evaluation 1	R0451	—	—	1st	Wed	1	1
Doctoral program	Biology Course in Research Evaluation 1	R0452	Biology Course in Research Evaluation 1	R452				

Instructor(s)	Note
Suzuki and All faculty member of Department of Biological Sciences	

(1) Course policies and topics	Research Evaluation Exercise 1 - Evaluating Research Proposals and Applications through critical reading of multiple applications and reports written by others, students learn how to formulate better research plans and applications. Students will also learn from the exercise how to critique logically and how to communicate such critiques.
(2) Knowledge/skills to be acquired and learning objectives/course goals	Through this exercise, students will cultivate their ability to learn spontaneously, think logically, and communicate effectively.
(3) Course schedule, subject matter, and classroom activities	Using a research plan report, research report, or application form for a JSPS Postdoctoral Fellowship, students will prepare a research plan for their future tenure, present their plan, and mutually critique it. Afterwards, the students revise their applications, serve as referees for each other, and evaluate the applications of others. Furthermore, they will explain the results of their evaluation to the applicant along with the reasons for the evaluation. The results of the mutual evaluation are tabulated, discussed among the evaluators, and the applications are ranked. In some groups (see below), applications that are evaluated as meeting certain criteria will be granted travel expenses for research presentations after review and examination by the faculty. If you wish to receive a research travel grant, you must participate in all of the group's exercises. If you are going to be absent due to unavoidable circumstances, please contact Mr. Suzuki (associate) in advance. The format of the exercises may be subject to change depending on the status of the covid-19 epidemic. Furthermore, if the conference is held online, travel expenses will not be reimbursed.
(4) Outside-class activities and assignments	Each group will be required to prepare and revise a research plan report, a research report, or an application for a JSPS Postdoctoral Fellowship as out-of-class learning. Therefore, at least 1.5 hours of preparation (preparation) and review (revision) are required.
(5) Textbooks and course materials	『理科系の作文技術』木下是雄（1981)中央公論新社（中公新書 (624)）を事前に一読することを強く勧める。
(6) Assessment and grading	The evaluation will be based on the evaluation of applications mutually evaluated among the participants, taking attendance and comments into consideration.
(7) Questions to the instructor (Office hours, etc.)	If you have any questions, please email Suzuki at jsuzuki@tmu.ac.jp.
(8) Special note	Students can take this course in English. Those who wish to take the course in English should contact the class lecturers.

Program	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 Research Evaluation 2	R0453	—	—	2nd	Wed	1	1
Doctoral program	Biology Course in Research Evaluation 2	R0454	Biology Course in Research Evaluation 2	R454				

Instructor(s)	Note
Suzuki and All faculty member of Department of Biological Sciences	

(1) Course policies and topics	Research Evaluation Exercise 2 - Evaluation of Research Presentations To understand what is a more understandable presentation through evaluation of others' research presentations, and to improve one's own presentation skills..
(2) Knowledge/skills to be acquired and learning objectives/course goals	Through this exercise, students will cultivate their ability to learn spontaneously, think logically, and communicate effectively.
(3) Course schedule, subject matter, and classroom activities	Attend conferences and research presentations as an audience, listen to multiple presentations, and evaluate their content. The results will be summarized in a report along with the rationale for the evaluation. Guidance on the key points of the evaluation will be given at KIBACO before the presentations.
(4) Outside-class activities and assignments	Evaluation reports must be prepared and submitted outside of class.
(5) Textbooks and course materials	Materials required for class will be distributed through KIBACO.
(6) Assessment and grading	Grading will be based on evaluation reports from conferences and presentations.
(7) Questions to the instructor (Office hours, etc.)	f you have any questions, please email Suzuki at jsuzuki@tmu.ac.jp.
(8) Special note	Students can take this course in English. Those who wish to take the course in English should contact the class lecturers.

Program	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	Practice in Biological Sciences (Radioisotope Techniques)	R0455	—	—	1st Intensive	—	—	1
Doctoral program	Practice in Biological Sciences (Radioisotope Techniques)	R0456	Practice in Biological Sciences (Radioisotope Techniques)	R456				

Instructor(s)	Note
Okamoto, Saito and Asano	

(1) Course policies and topics	This course is designed for graduate students who intend to use unsealed radioisotopes in their research for the first time, and provides them with basic techniques for the safe handling of radioactively labeled compounds in biological experiments. Please note that only those who have been certified as radiation workers are eligible for this course.
(2) Knowledge/skills to be acquired and learning objectives/course goals	Acquire basic techniques for the safe handling of radiolabeled compounds (unsealed radioisotopes) in biological experiments.
(3) Course schedule, subject matter, and classroom activities	The following practical training will be conducted in late May or early June for three days (from 2nd period to 4th period) in an intensive format. The plan is to 1. basic techniques for safe handling of unsealed radioisotopes 2. basics of tracer experiments using radiolabeled compounds 3. analysis of protein biosynthesis using 35S (including analysis using an imaging analyzer) 4. analysis of protein phosphorylation reaction using 32P (including measurement by scintillation counter) (including) In the event that this training cannot be conducted as scheduled due to a disaster or other reasons, the date, time, place, and content of the training (materials and equipment used in the training, etc.) may be changed. In such a case, the date, time, place, and contents of the training (e.g., materials and equipment used in the training) may be changed.
(4) Outside-class activities and assignments	The following practical training will be conducted in late May or early June for three days (from 2nd period to 4th period) in an intensive format. The plan is to 1. basic techniques for safe handling of unsealed radioisotopes 2. basics of tracer experiments using radiolabeled compounds 3. analysis of protein biosynthesis using 35S (including analysis using an imaging analyzer) 4. analysis of protein phosphorylation reaction using 32P (including measurement by scintillation counter) (including) In the event that this training cannot be conducted as scheduled due to a disaster or other reasons, the date, time, place, and content of the training (materials and equipment used in the training, etc.) may be changed. In such a case, the date, time, place, and contents of the training (e.g., materials and equipment used in the training) may be changed.
(5) Textbooks and course materials	Textbooks and materials will be distributed.
(6) Assessment and grading	Evaluation will be based on class participation, experimental attitude, and reports.
(7) Questions to the instructor (Office hours, etc.)	Questions are always welcome via email. tasaito@tmu.ac.jp asano-tsunaki@tmu.ac.jp okamoto-takashi@tmu.ac.jp
(8) Special note	Only those who are certified as radiation workers are eligible for this course. The number of students may be limited to ensure safety. In such cases, priority will be given to first-timers who have a clear plan to use radioisotopes. Please follow the instructions posted on the bulletin board. Please apply for the course in advance. Those who wish to take the course in English should contact the lecturers.

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 in Biological Sciences 1, 2	—	—	—	As Needed	—	—	1 or 2
Doctoral program	Internship in Biological Sciences 1, 2	—	Internship in Biological Sciences 1, 2	—				

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

(1) Course policies and topics	Internships
(2) Knowledge/skills to be acquired and learning objectives/course goals	It corresponds to the internship. This course was newly established in 2001, and encourages voluntary work experience, activity experience, and practical training experience 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	Since the course will be offered as a new course at the request of the student, it is not possible to apply for the course at the beginning of the semester. Students must submit a preliminary application to the Academic Affairs Committee at least 6 weeks prior to the start of the course. After the preliminary application is approved, the course will be offered as a new course. There are no restrictions on the academic year in which the course is to be taken. Courses can be taken concurrently as long as the content of the courses are different.
(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.Fukuda (kokko@tmu.ac.jp), a member of the Graduate School Academic Affairs Committee.
(8) Special note	Students who wish to take courses in English 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	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)	Note
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 a large number 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		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 2	R0459	—	—	2nd	Fri	5	1
Doctoral program	Special Seminar in Biological Sciences 2	R0460	Special Seminar in Biological Sciences 2	R460				

Instructor(s)	Note
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 a large number 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	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	R0009	—	—	2nd I	Mon	1	1
Doctoral program	Special Lecture on Biological Sciences	R0010	Special Lecture on Biological Sciences	R010				

Instructor(s)	Note
Murakami and Eguchi	This course is a common course with the undergraduate program.

(1) Course policies and topics	Phylogenetic evolution, phylogeography This course will deepen students' understanding of animal and plant diversity, evolution, geographic distribution, and their causes, focusing on the research being conducted by the faculty members themselves.
(2) Knowledge/skills to be acquired and learning objectives/course goals	To deepen understanding of how researchers formulate a research theme, plan and conduct research, and to apply this understanding to the planning and execution of the participant's own research.
(3) Course schedule, subject matter, and classroom activities	（Murakami） Research on the origins of the geographical distribution of wild plants in the Japanese archipelago using DNA information (plant molecular phylogeography), research on the symbiosis and co-evolution of wild angiosperms and their pollinating insects in the Izu Islands, and ferns that grow only in the gametophyte generation will be introduced and discussed by the participants to further their understanding of these topics. （Eguchi）. We will present our findings on the discovery of cryptic species, classification, and geographic genetic structure of insects, arachnids, and polypods in Southeast Asia. We will also introduce our overseas field research sites, including how we conduct our research in the field and how we have established an international collaborative research system.
(4) Outside-class activities and assignments	(Murakami.) Review of the distributed handouts is mandatory. （Eguchi.) Ask students to read a short paper and express their opinions on the research orientation, issues, etc. to deepen their understanding of the research.
(5) Textbooks and course materials	Lectures will be given mainly by handouts, and references and papers will be introduced as necessary.
(6) Assessment and grading	Evaluation will be based on class participation and reports.
(7) Questions to the instructor (Office hours, etc.)	（Murakami) If you would like to ask questions, please make an appointment in advance by emailing nmurak@tmu.ac.jp （Eguchi.) If you wish to ask questions in person, please make an appointment in advance by e-mail (antist@tmu.ac.jp) as we accept questions at any time.
(8) Special note	This course is a graduate course for graduates of other universities (it is also a course for undergraduates of this university). Application for enrollment requires permission from Graduate School Academic Affairs (Fukuda). Students who wish to enroll in this course should consult with their advisor and the instructor in charge of the course in advance. The method and content of the course may change depending on the prevalence of COVID-19.

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	R0715	—	—	2nd I	Mon	2	1
Doctoral program	Special Lecture on Biological Sciences	R0716	Special Lecture on Biological Sciences	R716				

Instructor(s)	Note
Adam Cronin	This course is a common course with the undergraduate program.

(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
(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	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	R0705	—	—	2nd I	Tue	1	1
Doctoral program	Special Lecture on Biological Sciences	R0706	Special Lecture on Biological Sciences	R706				

Instructor(s)	Note
Kawahara and Narikawa	This course is a common course with the undergraduate program.

(1) Course policies and topics	Various biological phenomena are highly regulated by protein dynamics and extracellular signals such as light. In the first half of this class, we will discuss about the ubiquitin-dependent protein degradation system, which is critical for cell cycle progression. We will also focus on ubiquitin-related human diseases including carcinogenesis, neuro-degeneration, immune disorders, and diabetes. In the latter half, we will learn photobiology by reading scientific papers focused on light matters. We will focus on light responsive systems of various organisms.
(2) Knowledge/skills to be acquired and learning objectives/course goals	In the first half of the class, students will understand the roles of ubiquitin system in cell proliferation and its related diseases. In the later half, students will understand the scientific field of photobiology. In addition, students will learn how to read scientific papers especially focusing on interpretation of figures.
(3) Course schedule, subject matter, and classroom activities	First half：presented by Dr. Kawahara １：Roles of ubiquitin-dependent protein degradation system in cell cycle control. ２：Ubiquitination machinery in eukaryotic cells. ３：Ubiquitin-mediated protein quality control in viral immunity (antigen presentation). ４：Ubiquitin-dependent proteolysis and onset of diabetes. Second half：presented by Dr. Narikawa ５：Photobiology 1: Bacterial photoperception ６：Photobiology 2: Eel fluorescent protein I ７：Photobiology 3: Eel fluorescent protein II ８：Photobiology 4: Visual system of mantis shrimp
(4) Outside-class activities and assignments	Both in the first half and the second half, you should review the last lecture content.
(5) Textbooks and course materials	「Essential Cell Biology, 4th edition」, 「Molecular Biology of the Cell」 Document materials will be distributed.
(6) Assessment and grading	Judged from report, examination and/or class attitude.
(7) Questions to the instructor (Office hours, etc.)	Office hours: Particular office hours are not set. Please make an appointment via e mail if you want to visit my office for a query or concern. A query by email is also acceptable. Kawahara：hkawa@tmu.ac.jp（Room 9-488） Narikawa：narikawa.rei@tmu.ac.jp（Room 8-324）
(8) Special note	This lecture is for students who cannot speak Japanese and graduated from other university. Authorization from curriculum coordinator is required before taking this lecture. Consider your research area to choose this lecture.

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	R0707	—	—	2nd I	Tue	2	1
Doctoral program	Special Lecture on Biological Sciences	R0708	Special Lecture on Biological Sciences	R708				

Instructor(s)	Note
Kanae Ando	This course is a common course with the undergraduate program.

(1) Course policies and topics	Course title: Special Lecture in Biology Class number: R0707 Second semester, Tue 10:30-12:00 Instructor: Kanae Ando (k_ando@tmu.ac.jp) DESCRIPTION: Our society is quickly aging, and the number of patients with age-associated diseases are growing. Recent studies revealed that accumulation of misfolded proteins may underlie the pathogenesis of many age-related neurological diseases such as Alzheimer's disease. We will discuss current understanding of molecular mechanisms underlying these diseases and therapeutic strategies.
(2) Knowledge/skills to be acquired and learning objectives/course goals	OBJECTIVES: This course aims to introduce current knowledge underlying the pathogenesis of age-related neurodegenerative diseases, and encourage students to distill and synthesize the information you learn in cell biology, molecular biology and neuroscience. The format of this course is a combination of didactic lectures and student presentation. Lectures will introduce concepts, and student presentation followed by discussion will promote an understanding of analytical approaches to questions in neuroscience as well as critical scientific thinking.
(3) Course schedule, subject matter, and classroom activities	TENTATIVE COURSE SCHEDULE: 1. Introduction 2. Alzheimer's disease (lecture) 3. Alzheimer's disease (student presentation) 4. Parkinson's disease (lecture) 5. Parkinson's disease (student presentation) 6. Amyotrophic lateral sclerosis (lecture) 7. Amyotrophic lateral sclerosis (student presentation) 8. Review & discussion FORMAT: Didactic lecture and student presentation.
(4) Outside-class activities and assignments	OUT OF CLASS ACTIVITY REQUIREMENT : Students will be asked to read recent articles from scientific journals and prepare for presentation.
(5) Textbooks and course materials	TEXTBOOK: In terms of learning the facts about each specific topic, the textbook. 'Bear, Mark F., Barry W. Connors, and Michael A. Paradiso. Neuroscience: Exploring the Brain, 3rd ed. Lippincott Williams & Wilkins, 2006. ISBN: 9780781760034' should be your basic study guide. Reading materials including primary literature will be distributed in the class.
(6) Assessment and grading	GRADE: Class participation 30%, Presentation 30%, Final report 40%
(7) Questions to the instructor (Office hours, etc.)	HOW TO REACH OUT TO THE INSTRUCTOR: Office hour: Wednesday afternoon, 1-2:30pm. Or, e-mail to k_ando@tmu.ac.jp for an appointment.
(8) Special note	NOTE: This course is open to the students who completed an undergraduate program in the universities other than TMU and are not fluent in Japanese. Talk to your supervisors if this course is appropriate for you. To register, submit a course registration request form to the program organizer, Dr. Kimiko Fukuda

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	R0731	—	—	2nd I	Wed	1	1
Doctoral program	Special Lecture on Biological Sciences	R0732	Special Lecture on Biological Sciences	R732				

Instructor(s)	Note
Tamura and Takahashi	This course is a common course with the undergraduate program.

(1) Course policies and topics	This course covers some current research topics in evolutionary genetics.
(2) Knowledge/skills to be acquired and learning objectives/course goals	By the end of the class, students should understand how research proceeds in the field and learn how logical discussions are conducted. Also students should be able to develop their own ideas and opinions related to the topics.
(3) Course schedule, subject matter, and classroom activities	Following topics will be discussed in the class: 1. Genes involved in speciation (AT) 2. Evolution of adaptive traits (AT) 3. Genome-wide genetic mapping (AT) 4. Genes in conflict (AT) 5. Evolution of sex chromosomes (KT) 6. Evolution of physiological traits (KT) 7. Evolution of meiotic recombination (KT)
(4) Outside-class activities and assignments	Students are expected to review and conduct self-learning on materials related to the topics as out-of-classwork.
(5) Textbooks and course materials	Handouts will be provided before or during the class.
(6) Assessment and grading	Final grade will be determined by class attendance/participation.
(7) Questions to the instructor (Office hours, etc.)	Particular office hour is not allocated, but students can make appointments by email.
(8) Special note	This course is provided for students who have not graduated from Tokyo Metropolitan University. Permission of the curriculum coordinator (Dr. Fukuda) is necessary for the registration.

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	R0733	—	—	2nd I	Wed	2	1
Doctoral program	Special Lecture on Biological Sciences	R0734	Special Lecture on Biological Sciences	R734				

Instructor(s)	Note
Kanegae and Kurokawa	This course is a common course with the undergraduate program.

(1) Course policies and topics	One of the most significant functions of living organisms is to respond to surrounding environmental information. The purpose of this class is to understand the physiological phenomena exhibited by animals and plants, primarily to acquire knowledge about physiological changes in response to information on the external environment.
(2) Knowledge/skills to be acquired and learning objectives/course goals	Part 1: This course will provide opportunity to learn the physiology of nervous system and cellular basis of learning and memory. Students will be able to discusses and describe 'how animals learn' using not only English but also Japanese technical terms. Part 2: At the end of this course, students will be able to explain how light as environment information is accepted by plant photoreceptors and how information is expressed.
(3) Course schedule, subject matter, and classroom activities	[Part 1] Animal physiology 1. Physiology of neuron and synapse 2. Behavioral plasticity and synaptic plasticity 3. Cellular basis of learning and memory 4. Summary and final examination [Part 2] Plant physiology 5. Diversity of photoreceptors 6. Adaptation for environmental light condition 7. Transcriptional regulation of photomorphogenesis 8. Post-transcriptional regulation of photomorphogenesis
(4) Outside-class activities and assignments	Homework will be given after each class or you should review the last lecture every week.
(5) Textbooks and course materials	Text: Handouts will be provided. [Part 2] Lecture materials will be uploaded to kibaco '資料' by the day before. Please download it before class starts.
(6) Assessment and grading	Assessment: The mean score from Part 1 and Part 2 will be the final grade. Part 1: Presentation and discussion 20 %, Quiz or Report submission 30 %, Examination 50 %. Part 2: Quiz or Report submission 40 %, Examination 60 %.
(7) Questions to the instructor (Office hours, etc.)	Particular office hour is not set. For queries, please make an appointment via e-mail.
(8) Special note	This 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	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	R0735	—	—	2nd I	Thu	1	1
Doctoral program	Special Lecture on Biological Sciences	R0736	Special Lecture on Biological Sciences	R736				

Instructor(s)	Note
Haruta and Ehira	This course is a common course with the undergraduate program.

(1) Course policies and topics	(Course description) This special lecture is the classes for the students of department of biological sciences, dealing with basic knowledge in environmental microbiology and microbial genetics. Students will be strongly encouraged to ask questions and express opinions.
(2) Knowledge/skills to be acquired and learning objectives/course goals	(Course objectives) The aims of this course are to learn phylogenetic and physiological diversity of microorganisms. You will learn the role of microorganisms in natural environments and relationships between microbe-microbe, microbe-plant, microbe-animal, and microbe-human. You will also learn mechanisms of bacterial responses to environmental changes.
(3) Course schedule, subject matter, and classroom activities	(Class contents) First half: Shin HARUTA 1. Phylogeny of Bacteria and Archaea 2. Diversity of Bacteria and Archaea 3. Microbial ecology 4. Applied microbiology Second half: Shigeki EHIRA 5. Bacterial genome 6. Acclimation to environmental changes in bacteria 7. Cellular differentiation in bacteria 8. Synthetic biology Students are expected to prepare each lecture by reading texts or research articles.
(4) Outside-class activities and assignments	Students are expected to prepare each lecture by reading texts or research articles.
(5) Textbooks and course materials	(Text book) Hand-outs will be provided in the class. Books for reference: Brock: Biology of Microorganisms (Madigan et al., Pearson Edu.) Microbiology: An Evolving Science (Slonczewski & Foster, W. W. Norton & Company)
(6) Assessment and grading	(Evaluation) Evaluation will be based on a final report. Presentation and discussion in the class are also considered.
(7) Questions to the instructor (Office hours, etc.)	(Office hours) By appointment through e-mail
(8) Special note	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	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	R0669	—	—	2nd I	Thr	2	1
Doctoral program	Special Lecture on Biological Sciences	R0670	Special Lecture on Biological Sciences	R670				

Instructor(s)	Note
Adam Weitemier	This course is a common course with the undergraduate program.

(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. In this course, students will interact with scientific writing by observing the structure of scientific papers, analyzing English scientific writing styles, and generating writing samples. This course focuses primarily on the common IMRaD (Introduction Methods Results-and-analysis Discussion) structure of scientific reports.
(2) Knowledge/skills to be acquired and learning objectives/course goals	The aims of this one-term 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. Reading Practice 3. Introduction Section 4. Methods Section 5. Results Section 6. Discussion Section I 7. Discussion Section II 8. Title, Abstract, Keywords
(4) Outside-class activities and assignments	Online activities will be frequent. Some activities will require access to Google Docs. Holding a Google account is not necessary, but may help.
(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 found in the English Mini-Library, room 8-246.
(6) Assessment and grading	Participation 45%, Effort 40%, Improvement 15%
(7) Questions to the instructor (Office hours, etc.)	The instructor can be reached at aweitem@tmu.ac.jp or through the Kibaco class page messages.
(8) Special note	This course invites participation from all students and honors student diversity and different points of view. Active participation in the class is essential.

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 I	Fri	1	1
Doctoral program	Special Lecture on Biological Sciences	R0718	Special Lecture on Biological Sciences	R718				

Instructor(s)	Note
Adam Weitemier	This course is a common course with the undergraduate program.

(1) Course policies and topics	Special lecture in Neurobiology Category: Specialized Subjects Credit : 1 Instructor: Adam Weitemier Subtitle: Neurobiology of the locus coeruleus norepinephrine system [Course Description] 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.
(2) Knowledge/skills to be acquired and learning objectives/course goals	[Objectives] 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	[Out of class activity requirement] Students will be asked to read or search for articles from scientific journals and prepare for presentations.
(5) Textbooks and course materials	[Textbooks/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, room 8-246.
(6) Assessment and grading	[Assessment] Class participation 45%, Assigned Work 25%, Presentation 30%
(7) Questions to the instructor (Office hours, etc.)	[Office hour] Available for questions/comments via KIBAKO online system E-mail to aweitem@tmu.ac.jp for questions or an appointment.
(8) Special note	[Other information and comments if any] This class is for graduates universities other than TMU. The permission of curriculum coordinator (Dr. Fukuda) is required for the registration. Discuss with your supervisor and class teachers in advance. -Previous knowledge in basic neuroscience or physiology will be helpful. -This course is not a prerequisite to the Second Semester II course taught by Dr. Weitemier. They are independent. If you wish to take both courses, please register for them separately.

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	R0749	—	—	2nd II	Fri	1	1
Doctoral program	Special Lecture on Biological Sciences	R0750	Special Lecture on Biological Sciences	R750				

Instructor(s)	Note
Adam Weitemier	This course is a common course with the undergraduate program.

(1) Course policies and topics	Special lecture in Neurobiology Category: Specialized Subjects Credit : 1 Instructor: Adam Weitemier Subtitle: Neurobiology and the Environment [Course Description] 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.
(2) Knowledge/skills to be acquired and learning objectives/course goals	[Objectives] 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 Course Schedule] 1. Introduction 2. Study Perspectives; Course task 3. Brain Defenses; Discussion 4. Mechanisms of Damage; Discussion 5. Homeostasis; Discussion 6. Stress; Discussion 7. Management; Quiz 8. Solutions; Discussion
(4) Outside-class activities and assignments	[Out of class activity requirement] Students will be asked to search for articles and scientific papers to prepare for in-class discussion.
(5) Textbooks and course materials	[Textbooks/Materials] Research articles to be distributed throughout the course. General background on the nervous systerm 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'
(6) Assessment and grading	[Assessment] Class participation 50%, Quizzes 20%, Research Motivation 30%
(7) Questions to the instructor (Office hours, etc.)	[Office hour] Available for questions/comments via KIBAKO online system E-mail to aweitem@tmu.ac.jp for questions or an appointment.
(8) Special note	This class is for graduates of universities other than TMU. The permission of curriculum coordinator (Dr. Fukuda) is required for the registration. Discuss with your supervisor and class teachers in advance. -Previous knowledge of general neuroscience or physiology will be helpful. -This course is independent from the 2nd Semester I course taught by Dr. Weitemier. If you wish to take both courses, please register for them separately.

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	R0709	—	—	2nd I	Wed	1	1
Doctoral program	Special Lecture on Biological Sciences	R0710	Special Lecture on Biological Sciences	R710				

Instructor(s)	Note
Fukuda and Takatori	This course is a common course with the undergraduate program.

(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 (General ability of problem thinking, Active learning attitude). Students will be encouraged to logically discuss those questions in class (Logical thinking ability). 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 and final test
(4) Outside-class activities and assignments	Reading materials will be assigned every week.
(5) Textbooks and course materials	Text: Will 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	This course is offered in Japanese. A basic understanding of cell biology is required. Students will be required to participate in discussions during class. For questions regarding class contact the instructor before registration. This class is for graduates of universities other than TMU. The permission of curriculum coordinator (Dr. Fukuda) is required for the registration. Discuss with your supervisor and class teachers in advance.

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	R0721	—	—	2nd I	Wed	2	1
Doctoral program	Special Lecture on Biological Sciences	R0722	Special Lecture on Biological Sciences	R722				

Instructor(s)	Note
Jun-ichi Kato	This course is a common course with the undergraduate program.

(1) Course policies and topics	Lectures on microbial genome dynamics, cell growth mechanisms, and genome science.
(2) Knowledge/skills to be acquired and learning objectives/course goals	Students will gain an understanding of basic research methods in genetics, prokaryotic genome dynamics, cell growth mechanisms, and genome science.
(3) Course schedule, subject matter, and classroom activities	Part 1: Prokaryotic Genome Dynamics Part 2: Prokaryotic cell growth mechanisms (1) Part 3: Prokaryotic cell proliferation mechanisms (2) Part 4: Genome Science of Prokaryotes Part 5: Synthetic biology of prokaryotes Part 6: Summary and examination
(4) Outside-class activities and assignments	Review after class is important.
(5) Textbooks and course materials	No specific text is specified; materials will be provided via kibako.
(6) Assessment and grading	Grading will be based on examinations, attendance, and reports.
(7) Questions to the instructor (Office hours, etc.)	If you want to ask questions, please make an appointment in advance by e-mail.
(8) Special note	This course is offered in Japanese. Graduate students who graduated from universities other than Tokyo Metropolitan University may take this course. Permission to enroll must also be obtained from Graduate School Academic Affairs (Kimiko Fukuda, Associate Professor). Graduate students who wish to enroll in this course should consult with their advisor and the faculty member in charge of the course in advance.

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	R0711	—	—	2nd I	Thr	1	1
Doctoral program	Special Lecture on Biological Sciences	R0712	Special Lecture on Biological Sciences	R712				

Instructor(s)	Note
Suzuki and Okada	This course is a common course with the undergraduate program.

(1) Course policies and topics	Title Special lecture in Ecology 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. Yasukazu Okada (yasu_okada@tmu.ac.jp) and Dr. Jun-Ichirou Suzuki (jsuzuki@tmu.ac.jp)
(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. Evolution and diversity of life history (YO) 2. Sexual selection and sexual dimorphism (YO) 3. Behavior: innate or learned behavior ? (YO) 4. Intra- and inter-specific interactions (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) 9. exam
(4) Outside-class activities and assignments	Out-of-class activities Students will be given homework (ca. A4, 1page) after each class by JS.
(5) Textbooks and course materials	Textbook and required supplies supplies; handouts will be provided through kibaco. (for the course by JS) Referenced text books (YO): An Introduction to Behavioural Ecology, (Davies NB, Krebs JR & West SA, Wiley)[日本語版：デイビス・クレブス・ウェスト行動生態学 原著第4版（共立出版）], Ecological Developmental Biology (Gilbert S & Epel S, Oxford University Press)[日本語版：生態進化発生学（東海大学出版会）], シリーズ 現代の生態学(日本生態学会編，共立出版） 第5巻「行動生態学」，第7巻「エコゲノミクス」
(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 by activity and participation in lectures (40%), exams (30%), and reports (30%). The course by JS will be assessed based on in-class participation (25%), homework (25%) 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 (jsuzuki@tmu.ac.jp). You can contact YO any time by email (yasu_okada@tmu.ac.jp)
(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. This course is open to the students who completed an undergraduate program in the universities other than TMU and are not fluent in Japanese. Talk to your supervisors if this course is appropriate for you. To register, submit a course registration request form to the program organizer, Dr. Kimiko Fukuda. This course is offered in Japanese.

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	R0713	—	—	2nd I	Thu	2	1
Doctoral program	Special Lecture on Biological Sciences	R0714	Special Lecture on Biological Sciences	R714				

Instructor(s)	Note
Okamoto and Sakai	This course is a common course with the undergraduate program.

(1) Course policies and topics	First half (Sakai): Introduces various topics related to "memory" and explains the molecular mechanisms of memory, especially through the latest memory research using Drosophila. Second half (Okamoto): The latest research topics in development and physiology in angiosperms will be explained.
(2) Knowledge/skills to be acquired and learning objectives/course goals	First half (Sakai): To deepen understanding of molecular mechanisms of memory by introducing the history and state-of-the-art of memory research mainly in Drosophila. Second half (Okamoto): After understanding the molecular and cellular basis of developmental and physiological mechanisms in plants, they will be connected to applied plant sciences. Common to both the first and second halves: Students are required to actively participate in discussions, thereby developing their ability to learn spontaneously, to think logically, and to think about comprehensive problems.
(3) Course schedule, subject matter, and classroom activities	Part 1, Guidance, Model Animals and Memory Part 2, Odor learning in Drosophila Part 3, Courtship Learning in Drosophila Part 4, Molecular Mechanisms of Memory Part 5, Creating New Plants Part 6, Reproducting the fertilization and embryogenesis in plants under the microscope Part 7. Understanding the principles in plant development Part 8, Exploring the cell fate-determining machineries essential for the plastic developmental program of plants
(4) Outside-class activities and assignments	Review the contents of the previous session.
(5) Textbooks and course materials	Distribute materials using KIBACO.
(6) Assessment and grading	Grading will be based on a comprehensive evaluation, taking into consideration the student's active participation in class, examinations, and other factors.
(7) Questions to the instructor (Office hours, etc.)	If you would like to ask questions, please make an appointment in advance by e-mail (Sakai: sakai-takaomi@tmu.ac.jp; Okamoto: okamoto-takashi@tmu.ac.jp).
(8) Special note	Guidance will be given in the first class regarding classes starting the following week. It is recommended that students who wish to take the course contact the instructor in advance. When lectures are given online, they will be announced on kibaco's "Announcements" page. This course is offered in Japanese. Graduate students who graduated from universities other than Tokyo Metropolitan University may take this course. Permission to enroll must also be obtained from Graduate School Academic Affairs (Kimiko Fukuda, Associate Professor). Graduate students who wish to enroll in this course should consult with their advisor and the faculty member in charge of the course in advance.

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	R0723	—	—	2nd I	Fri.	1	1
Doctoral program	Special Lecture on Biological Sciences	R0724	Special Lecture on Biological Sciences	R724				

Instructor(s)	Note
Nozawa and Murakami	This course is a shared course with the undergraduate program.

(1) Course policies and topics	Species and speciation, evolution of sex and sex chromosomes
(2) Knowledge/skills to be acquired and learning objectives/course goals	First half: Masafumi Nozawa Mutation is the ultimate source of evolution. Therefore, it is important to understand the molecular and genetic bases of evolution. In this lecture, Nozawa introduces his research topic, "Evolution of Sex Chromosomes," to students. Students are expected to understand how evolution has occurred at the molecular level in the long run, how researchers have set up their problems, and how they have overcome difficulties during the way of their research. Second half: Noriaki Murakami While the species and speciation patterns in land plants share some similarities with animals such as *Drosophila*, they are also different and unique in some respects. Understanding the evolution of reproductive isolation in land plants, sympatric ecological speciation, and speciation through interspecific hybridization and doubling genomes is the goal of the second part of this lecture.
(3) Course schedule, subject matter, and classroom activities	First half: Masafumi Nozawa Class 1: Why sex chromosome evolution? Class 2: Y chromosome degeneration and dosage compensation Class 3: Histone modifications on sex chromosomes and loss of Y chromosome Class 4: Future research directions on sex chromosome evolution Second half: Noriaki Murakami Class 5: Evolution of reproductive isolation in ferns Class 6: Sympatric ecological speciation of angiosperms in the Ogasawara Islands Class 7: Reticulate speciation through interspecific hybridization and doubling genomes Class 8: Review and Discussion
(4) Outside-class activities and assignments	Students are required to review the content of each lecture.
(5) Textbooks and course materials	First half: Nozawa Textbooks will be distributed through kibaco. Second half: Murakami Handouts will be distributed each time. Reference books will be introduced in class if needed.
(6) Assessment and grading	First half: Nozawa Class participation, response to questions and discussion: 20%. Report (including quiz): 30%. Second half: Murakami Class participation: 10% Final report: 40%
(7) Questions to the instructor (Office hours, etc.)	If you want to ask questions, please make an appointment in advance by e-mail (Nozawa manozawa[at]tmu.ac.jp ; Murakami nmurak[at]tmu.ac.jp).
(8) Special note	This course is offered in Japanese. Graduate students who graduated from universities other than Tokyo Metropolitan University may take this course. Permission to enroll must also be obtained from Graduate School Academic Affairs (Kimiko Fukuda, Associate Professor) in advance. Graduate students who wish to enroll in this course also need to consult with their advisor and the faculty member in charge of the course in advance.

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	R0725	—	—	1st Intensive	—	—	1
Doctoral program	Special Lecture on Biological Sciences	R0726	Special Lecture on Biological Sciences	R726				

Instructor(s)	Note
Paul Load *	This course is a common course with the undergraduate program.

(1) Course policies and topics	Course title: Marine Biology Lecturer: Paul H. Lord Last updated: 29Dec21 Class Location: TBD Times: 8:50-10:20; 10:30-noon; 13:00-14:30; 14:40-16:10, Th-F-M-T
(2) Knowledge/skills to be acquired and learning objectives/course goals	Course Description & Goals: The ecology and general biology of the marine biota. Stresses life histories and trophic relationships, adaptations for marine life, and limitations imposed by marine environments. Notes on this TMU edition of Lord's Marine Biology Class: This is a class that I taught for the first time in 2013. I am still refining course content. This TMU edition of the class demands greater focus and conciseness. Some of what I envision as I write this syllabus will be more or less difficult than I envision it will be. Almost certainly, some assignments will not take place as scheduled. What I have presented here is my best estimate for the class. Be patient as we navigate through Marine Biology. HELP ME MAKE THIS CLASS BETTER FOR FELLOW SCHOLARS AND FOR STUDENTS WHO FOLLOW. Provide me input on how to make this class more valuable.
(3) Course schedule, subject matter, and classroom activities	Tentative schedule <Day 1, Thursday> 1. Science of Marine Biol 2. Ocean Floor 3. Ocean Chemistry & Physics & Biol Fundamentals 4. Ocean visits <Day 2, Friday> 5. Ocean microbes 6. Visible primary producers 7. Macroinvertebrates <Day 3, Monday> EXAM I 8. Fishes 9. Exam review & Fishes 10. Non Fish Vertebrates 11., Mammals & Ecology <Day 4, Tuesday> 12. Marine Ecology & Tidalzones 13. Coral Reefs & Epipelagic Life 14. Epipelagic Life & Deep Ocean 15. Ocean Resources & Human Impacts Final Exam (Openbook) Attendance Policy: You are responsible for attending all scheduled class meetings in the mode for which you are enrolled. If you have a legitimate excuse for missing a class, you are still responsible for the material covered. If you are absent for an exam due to illness, family trauma, or college athletic meets, you must contact me within 24 hours by email or telephone to receive the option of a make-up exam. In evaluating classroom responses, I excuse you for two classes assuming that you will, occasionally, have competing priorities. Additional days of incorrect classroom question grades or nonparticipation will result in a lower class participationgrade. Breaking News: I will share with you current news stories that relate to our knowledge of the oceans and man's use of its resources. These news stories will be addressed in exams and quizzes. The level of question detail will typically be minimal, but, if we invest more than a minute or two in class discussing the story, the questions may become more detailed. You can earn extra credit on quizzes by being the first to show me a news story worthy of the class' attention.
(4) Outside-class activities and assignments	Readings & Review: Textbook chapters should be reviewed before lectures to orient you to the type and scope of lecture material. Please feel free to read ahead and reread chapters previously covered. I am excited by this textbook and will follow the book closely. When I vary from assigned readings, class notes will be cross referenced with the page numbers from the textbook (or outside readings). After lectures, use your textbook to clarify any noted material that is not clear. Following the lecture, examine the photographs, illustrations, and graphs in the textbook and read their captions carefully. These are key to understanding material I will address in exams. If you have uncertainties concerning material covered in the readings or the lectures, I implore you to talk with me to address these questions or to identify problems that may arise as we progress through the semester. As each topic builds on those that precede it, do not wait to see me to have your questions answered.
(5) Textbooks and course materials	Required Textbooks: Marine biology. P. Castro & M. E. Huber, 11th edition ISBN: 978-1-259-88003-2. McGraw Hill, New York. The elements of style. Strunk, W. & E. B. White. 4th Edition ISBN: 0-205-30902-X. 2000. Longman. New York.
(6) Assessment and grading	Exams: We will have one unit exam on Monday and one take-home final exam. The unit exam requires the first hour of the 8:50 class period and will be held at on Monday unless I tell you otherwise. The final exam will cover material from the last two days of class (60%) plus material from the first two days of

	class (40%). All exams are based on lecture material as well as assigned readings and outside-of–classes assignments. Exams comprise 60% of your final grade. Assignments and Quizzes: Supplementing scheduled exams, there will be approximately two quizzes and three or four outside-of-class assignments. The lowest two scores will be dropped. Assignments and quizzes comprise 30% of your final grade. There are no make-up quizzes, nor are late assignments accepted. Grades: Your final grade is composed of two exam scores (30% each for 60%) plus top four quizzes & assignments (7.5% each for 30%) plus participation score (10%) equaling 100%.
(7) Questions to the instructor (Office hours, etc.)	Electronic course submissions will be made via email. Assignments submitted electronically must be provided as paper copies in the class immediately following the submission deadline. Because the lecturer is off-campus, email questions and submissions must be made to two email addresses: lordp@usa.net and paul.lord@oneonta.edu. To facilitate lecturer file management, kibaco submissions, email subject lines and the names of submitted files must be in a specific format: MB Your_last_name ASSIGNMENT_NAME ddMmmyy e.g., MB Smirk Jellyfish 22Aug22 where “MB” indicates “marine biology”, “dd” equals a two-digit representation of the date, “Mmm” equals a three-digit representation of the month, and “yy” equals a two-digit representation of the year. Any submissions not conforming to this convention will be penalized five (out of 100) points. For more information and date, 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/R0728. R0725/R0726 is the first half (day 1 and 2) and R0727/R0728 is the second half (day 3 and 4). Prerequisites: College level course completion in Biology or Oceanography. No-Lab Course Labs: This class has frustrated prior scholars and me because we have no lab time in which to delve into the details of the material presented in lecture. To partially offset this, I will scour local seafood establishments for algae, various invertebrates, fish heads, and other materials relating to the course. Some of this material we will eat. Some of it wewill examine and dissect. Sometimes, we will do both. Eating with Lord is not a requirement, but you should, at a minimum, use your senses, other than taste, to carefully examine what will be passed around the classroom. (I will provide paper towels.) You should expect quiz and exam questions on these materials. This course is given in English. For questions, please email to Dr. Kanae Ando (k_ando@tmu.ac.jp).

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	R0727	—	—	1st Intensive	—	—	1
Doctoral program	Special Lecture on Biological Sciences	R0728	Special Lecture on Biological Sciences	R728				

Instructor(s)	Note
Paul Load *	This course is a common course with the undergraduate program.

(1) Course policies and topics	Course title: Marine Biology Lecturer: Paul H. Lord Last updated: 29Dec21 Class Location: TBD Times: 8:50-10:20; 10:30-noon; 13:00-14:30; 14:40-16:10, Th-F-M-T
(2) Knowledge/skills to be acquired and learning objectives/course goals	Course Description & Goals: The ecology and general biology of the marine biota. Stresses life histories and trophic relationships, adaptations for marine life, and limitations imposed by marine environments. Notes on this TMU edition of Lord's Marine Biology Class: This is a class that I taught for the first time in 2013. I am still refining course content. This TMU edition of the class demands greater focus and conciseness. Some of what I envision as I write this syllabus will be more or less difficult than I envision it will be. Almost certainly, some assignments will not take place as scheduled. What I have presented here is my best estimate for the class. Be patient as we navigate through Marine Biology. HELP ME MAKE THIS CLASS BETTER FOR FELLOW SCHOLARS AND FOR STUDENTS WHO FOLLOW. Provide me input on how to make this class more valuable.
(3) Course schedule, subject matter, and classroom activities	Tentative schedule <Day 1, Thursday> 1. Science of Marine Biol 2. Ocean Floor 3. Ocean Chemistry & Physics & Biol Fundamentals 4. Ocean visits <Day 2, Friday> 5. Ocean microbes 6. Visible primary producers 7. Macroinvertebrates <Day 3, Monday> EXAM I 8. Fishes 9. Exam review & Fishes 10. Non Fish Vertebrates 11., Mammals & Ecology <Day 4, Tuesday> 12. Marine Ecology & Tidalzones 13. Coral Reefs & Epipelagic Life 14. Epipelagic Life & Deep Ocean 15. Ocean Resources & Human Impacts Final Exam (Openbook) Attendance Policy: You are responsible for attending all scheduled class meetings in the mode for which you are enrolled. If you have a legitimate excuse for missing a class, you are still responsible for the material covered. If you are absent for an exam due to illness, family trauma, or college athletic meets, you must contact me within 24 hours by email or telephone to receive the option of a make-up exam. In evaluating classroom responses, I excuse you for two classes assuming that you will, occasionally, have competing priorities. Additional days of incorrect classroom question grades or nonparticipation will result in a lower class participationgrade. Breaking News: I will share with you current news stories that relate to our knowledge of the oceans and man's use of its resources. These news stories will be addressed in exams and quizzes. The level of question detail will typically be minimal, but, if we invest more than a minute or two in class discussing the story, the questions may become more detailed. You can earn extra credit on quizzes by being the first to show me a news story worthy of the class' attention.
(4) Outside-class activities and assignments	Readings & Review: Textbook chapters should be reviewed before lectures to orient you to the type and scope of lecture material. Please feel free to read ahead and reread chapters previously covered. I am excited by this textbook and will follow the book closely. When I vary from assigned readings, class notes will be cross referenced with the page numbers from the textbook (or outside readings). After lectures, use your textbook to clarify any noted material that is not clear. Following the lecture, examine the photographs, illustrations, and graphs in the textbook and read their captions carefully. These are key to understanding material I will address in exams. If you have uncertainties concerning material covered in the readings or the lectures, I implore you to talk with me to address these questions or to identify problems that may arise as we progress through the semester. As each topic builds on those that precede it, do not wait to see me to have your questions answered.
(5) Textbooks and course materials	Required Textbooks: Marine biology. P. Castro & M. E. Huber, 11th edition ISBN: 978-1-259-88003-2. McGraw Hill, New York. The elements of style. Strunk, W. & E. B. White. 4th Edition ISBN: 0-205-30902-X. 2000. Longman. New York.
(6) Assessment and grading	Exams: We will have one unit exam on Monday and one take-home final exam. The unit exam requires the first hour of the 8:50 class period and will be held at on Monday unless I tell you otherwise. The final exam will cover material from the last two days of class (60%) plus material from the first two days of

	class (40%). All exams are based on lecture material as well as assigned readings and outside-of–classes assignments. Exams comprise 60% of your final grade. Assignments and Quizzes: Supplementing scheduled exams, there will be approximately two quizzes and three or four outside-of-class assignments. The lowest two scores will be dropped. Assignments and quizzes comprise 30% of your final grade. There are no make-up quizzes, nor are late assignments accepted. Grades: Your final grade is composed of two exam scores (30% each for 60%) plus top four quizzes & assignments (7.5% each for 30%) plus participation score (10%) equaling 100%.
(7) Questions to the instructor (Office hours, etc.)	Electronic course submissions will be made via email. Assignments submitted electronically must be provided as paper copies in the class immediately following the submission deadline. Because the lecturer is off-campus, email questions and submissions must be made to two email addresses: lordp@usa.net and paul.lord@oneonta.edu. To facilitate lecturer file management, kibaco submissions, email subject lines and the names of submitted files must be in a specific format: MB Your_last_name ASSIGNMENT_NAME ddMmmyy e.g., MB Smirk Jellyfish 22Aug22 where “MB” indicates “marine biology”, “dd” equals a two-digit representation of the date, “Mmm” equals a three-digit representation of the month, and “yy” equals a two-digit representation of the year. Any submissions not conforming to this convention will be penalized five (out of 100) points. For more information and date, please contact Dr. Kanae Ando (k_ando@tmu.ac.jp).
(8) Special note	Please note that this course MUST be taken in conjunction with R0725/R0726. R0725/R0726 is the first half (day 1 and 2) and R0727/R0728 is the second half (day 3 and 4). Prerequisites: College level course completion in Biology or Oceanography. No-Lab Course Labs: This class has frustrated prior scholars and me because we have no lab time in which to delve into the details of the material presented in lecture. To partially offset this, I will scour local seafood establishments for algae, various invertebrates, fish heads, and other materials relating to the course. Some of this material we will eat. Some of it wewill examine and dissect. Sometimes, we will do both. Eating with Lord is not a requirement, but you should, at a minimum, use your senses, other than taste, to carefully examine what will be passed around the classroom. (I will provide paper towels.) You should expect quiz and exam questions on these materials. This course is given in English. For questions, please email to Dr. Kanae Ando (k_ando@tmu.ac.jp). Please note that this course MUST be taken in conjunction with R0725/R0726. R0725/R0726 is the first half (day 1 and 2) and R0727/R0728 is the second half (day 3 and 4). Prerequisites: College level course completion in Biology or Oceanography. No-Lab Course Labs: This class has frustrated prior scholars and me because we have no lab time in which to delve into the details of the material presented in lecture. To partially offset this, I will scour local seafood establishments for algae, various invertebrates, fish heads, and other materials relating to the course. Some of this material we will eat. Some of it wewill examine and dissect. Sometimes, we will do both. Eating with Lord is not a requirement, but you should, at a minimum, use your senses, other than taste, to carefully examine what will be passed around the classroom. (I will provide paper towels.) You should expect quiz and exam questions on these materials. This course is given in English. For questions, please email to Dr. Kanae Ando (k_ando@tmu.ac.jp).

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	R0719	—	—	1st Intensive	—	—	1
Doctoral program	Special Lecture on Biological Sciences	R0720	Special Lecture on Biological Sciences	R720				

Instructor(s)	Note
Diego Tavares Vasques *	This course is a common course with the undergraduate program.

(1) Course policies and topics	Course Title: Introduction to Plants Systematics and Taxonomy Instructor: Diego Tavares Vasques Dates: TBA. Please email Dr. Kanae Ando (k_ando@tmu.ac.jp) for more information. Course Objectives/Overview Evolution is an intriguing phenomenon that rules all biological events. The mechanisms controlling evolution are many in nature and can be studied under different levels of complexity. In this course, theories of evolutionary genetics (such as natural selection, adaptation, speciation, and others) will be explored in the context of the evolutionary history of plants. Together, we will explore how changes in the life cycle have influenced the selective pressure plants have been exposed to, how adaptations on nutrition and body structure have emerged through time and how the reproduction of these eukaryotic organisms has had a deep influence on population genetics.
(2) Knowledge/skills to be acquired and learning objectives/course goals	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
(3) Course schedule, subject matter, and classroom activities	Schedule Day 1 Unit 1: Introductory class, The DNA molecule and its importance for evolution - Course explanation - Concept of evolution in Biology - Introduction to plants' diversity - Evidences of Evolution - History and definition of Taxonomy and Systematics Practice 1: International Biodiversity Databases and morphometrics 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 2: Plants Taxonomy and Systematics - Plants Life History – Alternate generations - Mosses and its allies' diversity - Ferns and its allies' diversity - Gymnosperms and Angiosperms diversity Practice 2: Reading and Drawing Phylogenies Groups presentation Teaching Methods Unit 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. At the end of the class, students will be divided in groups, and each group will be assigned with a land plant family for research. Following this unity, we will have a practice class on how to use data from international databases for morphometric analysis of plants. On the Unit 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. Unit 2 will be followed on 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.
(4) Outside-class activities and assignments	Students are asked to provide individual reports on this class after the course is finished.
(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	Method of Evaluation

grading	Class attendance/participation - 30% Final project (final presentation and report) - 70%
(7) Questions to the instructor (Office hours, etc.)	Dr. Diego Tavares Vasques The University of Tokyo – Center for Global Communication Strategies (CGCS) dtvasques@g.ecc.u-tokyo.ac.jp Dr. Kanae Ando k_ando@tmu.ac.jp
(8) Special note	This course is given in English. This is an intensive summer lecture. Dates to be announced. For questions, please email to Dr. Kanae Ando (k_ando@tmu.ac.jp).

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	R0729	—	—	1st Intensive	—	—	1
Doctoral program	Special Lecture on Biological Sciences	R0730	Special Lecture on Biological Sciences	R730				

Instructor(s)	Note
Ben Wallen *	This course is a common course with the undergraduate program.

(1) Course policies and topics	Course Title – Hearing Instructor: Dr. Ben Warren University of Leicester, Leicestershire, UK [Course Description] Our ability to enjoy music, converse with friends and interact with our environment depend on the function on delicate structures within our ears. The ears of humans and wider mammals is, however, based on a singularly-evolved ear design – the cochlea. Insects provide a wealth of starkly different ear designs, which have evolved on many different body parts. This intensive two-day course will understand auditory transduction by using a wide variety of ear types, across animal phyla. This comparative approach to understand hearing is particularly insightful and fascinating and brings a broad but deep appreciation of how animals hear. You will learn how ears operate from the mechanical elements that capture sound energy to the microscopic cells responsible to converting vibrations into electrical signals that we eventually interpret as sound. On Day 1 we will revise physical properties of sound before learning the basic operation of ears both in mammals and insects. On Day 2 we delve into theproperties arising from sensitive ears such as: phantom oscillations and echoes (so-called otoacoustic emissions), negative stiffness and the cochlear amplifier. We finish by reviewing the arms race between insects and bats and then how hearing loss effects all biological ears– especially our own. This intensive course will use a combination of live lectures, guided journal clubs and guided independent research. In addition to learning how auditory transduction operates you will be trained in other transferable skills such as: how to make engaging presentations, experimental design (power analysis) and how to critically interpret scientific presentations.
(2) Knowledge/skills to be acquired and learning objectives/course goals	You will learn how ears operate from the mechanical elements that capture sound energy to the microscopic cells responsible to converting vibrations into electrical signals that we□eventually interpret as sound.
(3) Course schedule, subject matter, and classroom activities	Day 1 An auditory feature detection circuit for sound pattern recognition, https://www.science.org/doi/10.1126/sciadv.1500325 Day 2 Physiological changes throughout the ear due to age and noise – a longitudinal study, Blockley et al., 2021, Journal of Neuroscience https://www.biorxiv.org/content/10.1101/2021.11.25.470017v1 Methods of Instruction: This course will consist of 10 lectures, 3 guided journal clubs, 2 interactive sessions on presentation skills and experimental design. This combination of learning approaches will allow students to test and refine their knowledge. Course Objectives Upon completion of the course, students are expected to: 1. Understand basic biophysical principles of sound waves and their reception in ears and how sound waves are converted into movements of sound receivers and then transduced into electrical signals. 2. To understand the biomechanical strategies that ears employ to increase their sensitivity to quiet sound, tune their ears to frequencies of interest and detect the amplitude of sound. 3. Understand the 'arms race' between insects and bats and the different strategies employed between them. 4. Understand the main types and causes of hearing loss and state-of-the-art research in hearing loss. 5. Understand the scientific process of discovery and to critically interpret scientific findings. 6. Presentation skills and power analysis. Course Topics 1. Physical principles of sound waves 2. Vertebrate Hearing 3. Insect Hearing 4. Auditory Receptors in Vertebrates 5. Auditory Receptors in Insects 6. Active Hearing 7. Hunt for the Mechanotransducer channel 8. Bat vs insects acoustic detection 9. Hearing loss (Part 1) 10. Hearing loss (Part 2) 11. Spot the mistakes - Presentation skills 12. Experimental design – Power analysis 13. Summary of Lectures
(4) Outside-class activities and assignments	[Basic Requirement of the Course] The course will include literature reading and report. Reading of the textbook is absolutely required to familiarize the students with the concepts and ideas. Reading of the journal articles is also required, although this is best nearer the start of the course. Although I am not expecting the students to understand all preliminary reading it will make absorbing and understanding the material in the course easier and will maximize the benefit students will get from the course. There is purposely plenty of active engagement with live lectures, guided journal clubs and interactive presentations. This type of active learning, using a range of different techniques and resources, will result in a deep and enjoyable learning experience and will allow the students to test their understanding as the course progresses.
(5) Textbooks and course materials	Text book and Required Supplies: Required textbook: 1. Textbook: An introduction to the physiology of hearing: Forth edition, James O. Pickles ISBN: 9004243771. Essential reading, chapters: 1,2,3 and 5 2. Journals (essential reading before the start of the course, or before each day):
(6) Assessment and grading	[Assessment] Class attendance and participation (40%); Participation in Discussion (40%); Report (20%).
(7) Questions to the instructor (Office hours, etc.)	[Office hour] Email to Dr. Kanae Ando (k_ando@tmu.ac.jp) for more information.
(8) Special note	Dates to be announced. For questions, please email to Dr. Kanae Ando (k_ando@tmu.ac.jp). If you took the summer course taught by Dr. Warren in 2020, please do not register for this course. The contents are similar.

Program	Graduate School of Science		Graduate School of Science and Engineering		Semester	Day	Time	Credit
	Course Name	Course Number	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	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	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. This course starts in the first semester.

Program	Graduate School of Science		Graduate School of Science and Engineering		Semester	Day	Time	Credit
	Course Name	Course Number	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	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. This course starts in the second semester.

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

Program	Graduate School of Science		Graduate School of Science and Engineering		Semester	Day	Time	Credit
	Course Name	Course Number	Course Name	Course Number				
Master's program	Special Practice in Biological Sciences II	Number assigned to each Research Techniques	—	—	As Needed	—	—	2
Doctoral program	Special Practice in Biological Sciences II	Number assigned to each Research Techniques	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. Fukuda (kokko@tmu.ac.jp).
(8) Special note	Students must obtain permission from their academic advisors and the Educational Affairs Committee.

Program	Graduate School of Science		Graduate School of Science and Engineering		Semester	Day	Time	Credit
	Course Name	Course Number	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	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	I This course starts in the first semester. 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		Graduate School of Science and Engineering		Semester	Day	Time	Credit
	Course Name	Course Number	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	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. This course starts in the first semester.

Mechanical Engineering
(Graduate School of Science and Engineering)

Notes on course enrollment

Doctoral program

1. The Mechanical Engineering major does not have mandatory courses. Students must take 20 or more credits from elective courses.
2. Students shall seek guidance from their doctoral advisors in selecting courses.
3. Students must take the following courses in respective years:

First year
- Advanced Laboratory IA, IB
- Advanced Graduate Seminar IA, IB

Second year
- Advanced Laboratory IIA, IIB
- Advanced Graduate Seminar IIA, IIB

Third year
- Advanced Laboratory IIIA, IIIB
- Advanced Graduate Seminar IIIA, IIIB

Doctoral Program Courses and Credits

Course name	School year	Credit Hours		
		Required	Electives	Discretionary
Thesis Research in Material and Mechanical Science IA	1		4	
Thesis Research in Material and Mechanical Science IB	1		4	
Thesis Research in Material and Mechanical Science IIA	2		4	
Thesis Research in Material and Mechanical Science IIB	2		4	
Thesis Research in Material and Mechanical Science IIIA	3		4	
Thesis Research in Material and Mechanical Science IIIB	3		4	
Advanced Graduate Seminar in Material and Mechanical Science IA	1		1	
Advanced Graduate Seminar in Material and Mechanical Science IB	1		1	
Advanced Graduate Seminar in Material and Mechanical Science IIA	2		1	
Advanced Graduate Seminar in Material and Mechanical Science IIB	2		1	
Advanced Graduate Seminar in Material and Mechanical Science IIIA	3		1	
Advanced Graduate Seminar in Material and Mechanical Science IIIB	3		1	
Thesis Research in Fluid and Thermal Engineering IA	1		4	
Thesis Research in Fluid and Thermal Engineering IB	1		4	
Thesis Research in Fluid and Thermal Engineering IIA	2		4	
Thesis Research in Fluid and Thermal Engineering IIB	2		4	
Thesis Research in Fluid and Thermal Engineering IIIA	3		4	
Thesis Research in Fluid and Thermal Engineering IIIB	3		4	
Advanced Graduate Seminar in Fluid and Thermal Engineering IA	1		1	
Advanced Graduate Seminar in Fluid and Thermal Engineering IB	1		1	
Advanced Graduate Seminar in Fluid and Thermal Engineering IIA	2		1	
Advanced Graduate Seminar in Fluid and Thermal Engineering IIB	2		1	
Advanced Graduate Seminar in Fluid and Thermal Engineering IIIA	3		1	
Advanced Graduate Seminar in Fluid and Thermal Engineering IIIB	3		1	
Thesis Research in Mechanical Systems IA	1		4	
Thesis Research in Mechanical Systems IB	1		4	
Thesis Research in Mechanical Systems IIA	2		4	
Thesis Research in Mechanical Systems IIB	2		4	
Thesis Research in Mechanical Systems IIIA	3		4	
Thesis Research in Mechanical Systems IIIB	3		4	
Advanced Graduate Seminar in Mechanical Systems IA	1		1	
Advanced Graduate Seminar in Mechanical Systems IB	1		1	
Advanced Graduate Seminar in Mechanical Systems IIA	2		1	
Advanced Graduate Seminar in Mechanical Systems IIB	2		1	
Advanced Graduate Seminar in Mechanical Systems IIIA	3		1	
Advanced Graduate Seminar in Mechanical Systems IIIB	3		1	
Internship I	1,2,3		1	
Internship II	1,2,3		2	

Note: As for Internship I and Internship II, students may retake the same course if respective courses provide different subject matter.

* D = Courses for the Doctoral Program
* NA 2022 = Courses not offered in the academic year 2022

Course outline	D	NA 2022	Semester	Day	Time	Course Number	Course Name	Credit Hours	Instructor(s)	Note (enrollment requirements, subject matter, etc.)
-	○		Intensive course			D (R898)	Internship Ⅰ	1	All instructors	
-	○		Intensive course			D (R900)	Internship Ⅱ	2	All instructors	
-	○		1st	Mon.	1-4	D (R861)	Thesis Research in Material and Mechanical Science IA	4	All instructors	
-	○		2nd	Mon.	1-4	D (R862)	Thesis Research in Material and Mechanical Science IB	4	All instructors	
-	○		1st	Wed.	1-4	D (R863)	Thesis Research in Material and Mechanical Science IIA	4	All instructors	
-	○		2nd	Wed.	1-4	D (R864)	Thesis Research in Material and Mechanical Science IIB	4	All instructors	
-	○		1st	Fri.	1-4	D (R865)	Thesis Research in Material and Mechanical Science IIIA	4	All instructors	
-	○		2nd	Fri.	1-4	D (R866)	Thesis Research in Material and Mechanical Science IIIB	4	All instructors	
-	○		1st	Mon.	1-4	D (R867)	Thesis Research in Fluid and Thermal Engineering IA	4	All instructors	
-	○		2nd	Mon.	1-4	D (R868)	Thesis Research in Fluid and Thermal Engineering IB	4	All instructors	
-	○		1st	Wed.	1-4	D (R869)	Thesis Research in Fluid and Thermal Engineering IIA	4	All instructors	
-	○		2nd	Wed.	1-4	D (R870)	Thesis Research in Fluid and Thermal Engineering IIB	4	All instructors	
-	○		1st	Fri.	1-4	D (R871)	Thesis Research in Fluid and Thermal Engineering IIIA	4	All instructors	
-	○		2nd	Fri.	1-4	D (R872)	Thesis Research in Fluid and Thermal Engineering IIIB	4	All instructors	
-	○		1st	Mon.	1-4	D (R873)	Thesis Research in Mechanical Systems IA	4	All instructors	
-	○		2nd	Mon.	1-4	D (R874)	Thesis Research in Mechanical Systems IB	4	All instructors	
-	○		1st	Wed.	1-4	D (R875)	Thesis Research in Mechanical Systems IIA	4	All instructors	
-	○		2nd	Wed.	1-4	D (R876)	Thesis Research in Mechanical Systems IIB	4	All instructors	
-	○		1st	Fri.	1-4	D (R877)	Thesis Research in Mechanical Systems IIIA	4	All instructors	
-	○		2nd	Fri.	1-4	D (R878)	Thesis Research in Mechanical Systems IIIB	4	All instructors	
-	○		1st	Mon.	5	D (R879)	Advanced Graduate Seminar in Material and Mechanical Science IA	1	All instructors	
-	○		2nd	Mon.	5	D (R880)	Advanced Graduate Seminar in Material and Mechanical Science IB	1	All instructors	
-	○		1st	Wed.	5	D (R881)	Advanced Graduate Seminar in Material and Mechanical Science IIA	1	All instructors	
-	○		2nd	Wed.	5	D (R882)	Advanced Graduate Seminar in Material and Mechanical Science IIB	1	All instructors	
-	○		1st	Fri.	5	D (R883)	Advanced Graduate Seminar in Material and Mechanical Science IIIA	1	All instructors	
-	○		2nd	Fri.	5	D (R884)	Advanced Graduate Seminar in Material and Mechanical Science IIIB	1	All instructors	
-	○		1st	Mon.	5	D (R885)	Advanced Graduate Seminar in Fluid and Thermal Engineering IA	1	All instructors	
-	○		2nd	Mon.	5	D (R886)	Advanced Graduate Seminar in Fluid and Thermal Engineering IB	1	All instructors	
-	○		1st	Wed.	5	D (R887)	Advanced Graduate Seminar in Fluid and Thermal Engineering IIA	1	All instructors	
-	○		2nd	Wed.	5	D (R888)	Advanced Graduate Seminar in Fluid and Thermal Engineering IIB	1	All instructors	
-	○		1st	Fri.	5	D (R889)	Advanced Graduate Seminar in Fluid and Thermal Engineering IIIA	1	All instructors	
-	○		2nd	Fri.	5	D (R890)	Advanced Graduate Seminar in Fluid and Thermal Engineering IIIB	1	All instructors	
-	○		1st	Mon.	5	D (R891)	Advanced Graduate Seminar in Mechanical Systems IA	1	All instructors	
-	○		2nd	Mon.	5	D (R892)	Advanced Graduate Seminar in Mechanical Systems IB	1	All instructors	
-	○		1st	Wed.	5	D (R893)	Advanced Graduate Seminar in Mechanical Systems IIA	1	All instructors	
-	○		2nd	Wed.	5	D (R894)	Advanced Graduate Seminar in Mechanical Systems IIB	1	All instructors	
-	○		1st	Fri.	5	D (R895)	Advanced Graduate Seminar in Mechanical Systems IIIA	1	All instructors	
-	○		2nd	Fri.	5	D (R896)	Advanced Graduate Seminar in Mechanical Systems IIIB	1	All instructors	

General Courses for All Graduate Programs

Master's Program | Doctoral Program

<Graduate School Career Courses>

Our Graduate Program offers courses for career development as general courses for master's and doctoral programs since 2019. Whether students work for private companies, universities or research institutes, or enroll in a doctoral program after completing the master's program, it is essential to connect the student's research objectives and future career. This makes the knowledge and skills gained in research activities meaningful for the student's next step.

Therefore, our program offers career courses for graduate students so that students will have the mindset and skills necessary for career development through these courses.

<Notes>

(1) The career courses are open for both master's and doctoral graduate students.

(2) The career courses offer credits, but they are not counted for credits required for completion of the master's program and doctoral program.

(3) In addition to the career courses offered at the University, students may take career courses at the Graduate School of Tokyo Institute of Technology, which has a credit transfer agreement with the University. If interested in taking the courses, the information is available on the university website and the bulletin board on the first floor of Building 8 at the beginning of each semester.

Course Catalog for 2022 General Courses for All Graduate Programs (Graduate School Career Courses)

Course Number	Course Name	Credit Hours	Instructor(s)	Semester	Day	Time	Classroom	Note
M:W0500 D:W0600	Career Development for Graduate Students in Science and Engineering	1	Yuji Hayashi, University Education Center	2nd A	Mon.	5	11-102 Minami Osawa	Course registration will be accepted in the first class meeting.
M:W0515 D: W0615	Intellectual Property Management in Companies	1	Mami Yoshikawa*, University Education Center	2nd B	Thu.	5	11-109 Minami Osawa	Course registration will be accepted in the first class meeting.
(2 units) M:W0510 D: W0610 (1 unit) M:W0511 D: W0611	Research Internships for Graduate Students	2 or 1	Naoki Kachi and others, University Education Center	Intensive course (at needed)			—	
M:W0520 D: W0620	Academic Communication for Graduate Students	1	Wakako Fushikida, Joel Metthews, Naoki Kachi, University Education Center	Intensive III			11-109 Minami Osawa	

Legend:
* Course Number: M = master's courses, D = doctoral courses
* Semester: 1st B=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. Intensive III will be explained elsewhere.

Course Name	Course Type	Course Number		Semester	Day	Time	Credit Hours	Classroom
		Master's Program	Doctoral Program					
Intellectual Property Management in Companies	General Courses for All Graduate Programs	W0500	W0600	2nd A	Mon.	5th	1	11-102 Minami Osawa
Instructor(s)								
Yuji Hayashi, University Education Center	- Course registration is accepted at Academic Affairs. If interested in enrolling in the course, students must attend the first class meeting.							

(1) Course policies and topics	In this class, we will discuss careers in the private sector for doctoral candidates in science and engineering.
(2) Knowledge/skills to be acquired and learning objectives/course goals	The purpose of the class is to learn how our seniors who have received their doctoral degrees in science and engineering are working in a number of private companies based on the skills they have developed in the doctoral program, so that they can have realistic expectations for their own future without being overly pessimistic or optimistic.
(3) Course schedule, subject matter, and classroom activities	[Course schedule] 1. Orientation (lecture on data related to job-hunting activities in the doctoral program) 2-5. Lectures by graduates of our doctoral course who are active in the private sector within 5 years of graduation (Four graduates will give the lectures). 6-7. Discussion based on transcribed recordings of lectures given in previous years 8. Summarize the class (you will be asked to submit an oral report of what you have written in your report on the spot) Lectures 2 through 7 are in no particular order. The speakers will be replaced according to their availability. The main topics of the lectures are as follows: 1. Research activities while in school and current work 2. Job hunting activities at first job, if any, and job hunting activities when changing jobs 3. How you are evaluated as a doctoral candidate in science and engineering 4. Are you making use of the knowledge, skills, and abilities you acquired while in school? 5. Differences between what I expected and what actually happened after I joined the company 6. Other things you would like to tell your juniors [Class method] The first and eighth sessions will be lectures by faculty members. Lectures by graduates will be given in the 2nd through 5th sessions. In the 6th and 7th sessions, transcripts of lectures from previous years will be read and discussed by students. In some cases, lectures may be given via Zoom depending on the circumstances of the speaker. The speakers will present a variety of ideas and experiences. There is no superiority or inferiority among them, and there is no right answer. When a speaker comes, please listen carefully to what he or she has to say, and if you have any questions, please ask the speaker. When studying from transcripts of past lectures, share your thoughts with the other students and listen to their thoughts. By doing so, you will be able to think about how to deal with your career, and you will be able to have your own ideas about your career according to your own circumstances.
(4) Outside-class activities and assignments	Transcriptions of lectures given in previous years will be distributed to students prior to the class for discussion. Please read the transcripts before class and organize the points of interest or importance.
(5) Textbooks and course materials	None
(6) Assessment and grading	You will be evaluated on your participation in the class and on your report. In your report, please write about any changes in your career-related ideas that you have made as a result of the class and any reaffirmation of your existing ideas.
(7) Questions to the instructor (Office hours, etc.)	We ask the speakers to give interactive lectures so that questions to the speakers can be asked well within the time of the lecture. Questions to the instructor should be asked after class.
(8) Special note (Course prerequisites)	Even if you do not register for the course, you are welcome to attend only the lectures given by those who have completed the course in your field. Also, post-doctoral fellows who have already completed their degrees and are thinking of moving into the private sector may also find it helpful, so please come and join us if you are interested. In either case, no special procedures are required. Please refer to the bulletin board on campus and come to the classroom on the day of your application. When considering one's career based on what one hears from others, it is just as important to have similar personalities, such as attitudes toward risk, as it is to have similar disciplines between the audience and the speaker. The fields of study are obvious from the departments in which the students have completed, but the personalities are not, so it is recommended that students make time to listen to as many lectures as possible. [Relevance to other courses] Nothing in particular. Please do your best in your own research.

Course Name	Course Type	Course Number		Semester	Day	Time	Credit Hours	Classroom
		Master's Program	Doctoral Program					
Intellectual Property Management in Companies	General Courses for All Graduate Programs	W0515	W0615	2nd B	Thu.	5th	1	11-109 Minami Osawa

Instructor(s)	
Mami Yoshikawa*, University Education Center	- Course registration is accepted at Academic Affairs. If interested in enrolling in the course, students must attend the first class meeting.

(1) Course policies and topics	In recent years, society has been shifting fundamentally from an industrial society to an information and knowledge society. Corporations are also shifting their focus on management from tangible assets (land, buildings, and equipment) to intangible assets (technology, know-how, and ideas). In R&D and technology development, companies are also incorporating intellectual property rights, such as patents, into their innovative technologies to enhance competitiveness and add value to their products and services. The management of intellectual property is one of the important matters for corporate strategy. This course will provide the basics of intellectual property management from the perspective of the function of intellectual property in R&D and technology development and its contribution to business activities.
(2) Knowledge/skills to be acquired and learning objectives/course goals	In this course, students will learn: - The basics of intellectual property rights such as patent rights, design rights, and trademark rights. Students should understand these fundamentals to be professionals in the R&D and engineering field. - To understand the role and strategic significance of intellectual property rights in R&D and technology development, which are value-creating activities in businesses. - To think from a management perspective using actual business models how to create barriers to entry for other companies while using competitive technologies and expanding their customer base.
(3) Course schedule, subject matter, and classroom activities	[Course schedule] 1. Overview of intellectual property rights, including patent rights, design rights, trademark rights, and copyrights and how each right is protected; instructions on the report 2. Significance of intellectual property in corporate business strategy, economic and social background, and patent search 3. Technology and intellectual property for improving competitiveness (1) Functional materials (e.g., light-emitting diodes, photocatalytic technology) 4. Technology and intellectual property for improving competitiveness (2) Food industry (e.g., Ajinomoto's aspartame) 5. Technology and intellectual property for improving competitiveness (3) IT industry (e.g., QR codes, Amazon's 1-Click ordering) 6. Intellectual property management of brands: Trademarks, designs, a combination of intellectual property rights (e.g., Yakult's containers, Shinkansen bullet trains) 7. Examples of open/closed strategies: CPU (Intel), semiconductors (Qualcomm), know-how protection (laws to prevent unfair competition), copyrights 8. Presentation based on the report, review (discussion) [Classroom activities] The activities include having discussions on intellectual property topics among students from different disciplines.
(4) Outside-class activities and assignments	As a report assignment, students will write a patent application on a topic from the patent contest and conduct a patent search.
(5) Textbooks and course materials	- "Industrial Property Rights Standard Textbook Comprehensive Edition" (in Japanese) by Japan Institute for Promoting Invention and Innovation (List price: 900 yen + tax) - Handouts will be provided.
(6) Assessment and grading	In-class participation and the report submitted after class will be counted toward the grade.
(7) Questions to the instructor (Office hours, etc.)	- Email the instruction clearly describing your questions or needs and make an appointment. - The email addresses will be provided in the first class meeting.
(8) Special note (Course prerequisites)	- There are no prerequisites for this course. This course is open to students of all disciplines. - The cases used in this course will be explained so that students of different disciplines will understand.

Course Name	Course Type	Course Number		Semester	Day	Time	Credit Hours
		Master's Program	Doctoral Program				
Research Internships for Graduate Students	General Courses for All Graduate Programs	W0510 (2 units) W0511 (1 unit)	W0610 (2 units) W0611 (1 unit)	Intensive course (at needed)	—	—	2 or 1
Instructor(s)							
Prof. Naoki Kachi (professor emeritus) and other instructors	The credit hours may be reduced to one, depending on the actual duration of the internship.						

(1) Course policies and topics	This course provides a mid- to long-term internship at private companies, mainly for current doctoral students or graduate students who plan to enroll in a doctoral program. The course aims to help students practice and apply the acquired research abilities and skills in actual R&D activities in companies. The cause also helps students develop general skills, such as management and communication skills, to succeed in various fields. These opportunities enable students to enhance their future research activities and realistically consider working for R&D projects at private companies. Please note that the internship provided in this course is not intended for landing a job at a company.
(2) Knowledge/skills to be acquired and learning objectives/course goals	Through this course, students will: - Understand how R&D methods, values, and behavior in companies are different from those in research activities in universities. - Gain new ideas, perspectives, and exploration in the student's research activities and think from a broader perspective on how research and society relate and how significant the research activities are. - Acquire various skills necessary for researchers, including communication skills, planning and management skills, proactive and collaborative approaches in diverse fields.
(3) Course schedule, subject matter, and classroom activities	Considering the internship purpose and conditions, we match each enrolling student with one of the 35 companies participating in the Industry-University Collaborative Innovation Human Resources Development Council (C-ENGINE), of which the University is a member. In general, the internship period is about two months. Companies do not have preferences for students' fields of study, whether liberal arts or science majors. Companies have hired students of the following majors in order of the number of hired: mechanical engineering, mathematical/physical sciences, electricity/electronic, chemistry, information technology, biology, engineering (others), pharmacology, environmental studies, and architecture (based on the FY 2020 results from the 17 member universities of this council). The internship training does not always need to be completely in line with the student's research topics. The internship details and the training period will be adjusted individually between the student and the preferred company with the help of our matching coordinator. (Many companies are flexible in adjusting various conditions.) Registration for this course will be done at Academic Affairs (1st floor of Building 1). 【Companies that accept internships in FY 2021 (as of 2/22/2021)】 Kawasaki Heavy Industries, Ltd., Canon Medical Systems Corporation, Kyocera Corporation, Konica Minolta, Inc., Sysmex Corporation, Shimadzu Corporation, Shimizu Corporation, Sumitomo Electric Industries, Ltd., Sumitomo Wiring Systems, Ltd., Sony Semiconductor Manufacturing Corporation, Daikin Industries, Ltd., Daicel Corporation, Dai Nippon Printing Co., Ltd., Takenaka Corporation, Tadano Ltd., Central Research Institute of Electric Power Industry, Toray Industries, Inc., Toppan Inc., Tomagawa Co., Ltd., Nitto Denko Corporation, Nippon Sheet Glass Co., Ltd., Nippon Shokubai Co., Ltd., Zeon Corporation, Nippon Telegraph and Telephone Corporation, Boehringer Ingelheim GmbH, Japan, Panasonic Corporation, Hitachi Metals Ltd., Fujifilm Corporation, Horiba, Ltd., Mitsubishi Heavy Industries, Ltd., Mitsubishi Electric Corporation, Murata Manufacturing Co., Ltd., Ricoh Co., Ltd., Rohto Pharmaceutical Co., Ltd., Rohm Co., Ltd.
(4) Outside-class activities and assignments	- Research the business profile of the company before your internship. In addition, students are expected to learn the concept and skills in the specialized field used in the internship in advance. - During the internship, students are expected to behave properly as working adults. If necessary, consult Student Affairs' Career Support.
(5) Textbooks and course materials	No textbooks required.
(6) Assessment and grading	- Students will be evaluated comprehensively based on the internship plan, performance report, and evaluation report from the company. - Pass/Fail grading will be used instead of letter grades.
(7) Questions to the instructor (Office hours, etc.)	The application for the internship is accepted at Career Support, and the course registration is processed at Academic Affairs. The internship objectives of companies are available on the "IDM system" (the system used to match companies and student applicants). If interested, students can create an IDM system account and browse the details. (For more information, visit Doctoral Program Career Support Information on the Career Support website. This site is also available for master's students.) Since internship objectives may be changed, we encourage students to contact the coordinating instructor (Prof. Kachi, the course instructor) immediately if interested in a specific company. Please reach out about two months before the start of the internship. (Students may also contact the instructor for guidance or questions.) After that, we will coordinate with the company. For contacting the coordinator or any questions, email at c-engine@tmu.ac.jp. This email address is used by the coordinator, Career Support, and Academic Affairs (all located in Minami Osawa C).
(8) Special note (Course prerequisites)	1. The approval of your graduate/doctoral advisor is required before participating in an internship. 2. Students are required to have an annual physical exam. 3. Students are required to have accident insurance such as student accident insurance and liability insurance. 4. Students need to submit an internship plan before the internship and a performance report after the internship. 5. Inform the instructor if a performance meeting is scheduled after completing the internship. 6. Credits earned from this course cannot be counted as required credits for program completion.

Course Name	Course Type	Course Number		Semester	Day	Time	Credit Hours	Classroom
		Master's Program	Doctoral Program					
Intellectual Property Management in Companies	General Courses for All Graduate Programs	W0520	W0620	Intensive III	-	-	1	-
Instructor(s)								
Wakako Fushikida, Joel Metthews, Naoki Kachi, University Education Center	Credits earned through this course may not be included in the course completion credits.							

(1) Course policies and topics

It is essential for graduate students to present their research process and results, and to receive feedback from others to enhance the content of their research. In addition, not only while in school, but especially after employment, it is essential to share ideas with people of different specialties and ages, and to have an attitude of collaboration while deepening mutual understanding.

In this class, students will practice giving presentations and writing research proposals based on their own daily research. Through these activities, students will acquire knowledge and skills in academic communication (logical and easy-to-understand presentations in both Japanese and English, mutual understanding including research in other fields, and an interdisciplinary perspective with an awareness of connections with society).

(2) Knowledge/skills to be acquired and learning objectives/course goals

(We also welcome the participation of master-course students who are interested in advancing to the doctoral program.)
-Acquire the ability to explain logically in Japanese and English about the expertise of one's own research
-Acquire the ability to consider the applicability of one's own research and to express it in an easy-to-understand manner.
-Deepen understanding of research in other fields through discussions with others, and to be able to reconsider one's own research from a cross-disciplinary viewpoint.
-Through practice of presentation and preparation of a draft research plan, be able to think about the connection between one's own research and society from an interdisciplinary viewpoint.

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

[Japanese Presentation] (May-June)

1st: Structure of presentation, creation of slides utilizing PowerPoint [individual work].

2nd: Group presentation, peer review using rubric [group work].

3rd: Whole group presentation and review [Whole group work] (June)

4th: Preparation for English presentation [individual work] (July - December)

[English presentation] (July-August)

5th: Whole class presentation, feedback from special lecturers (first half) [Whole class work] (July-August)

6th: Whole class presentation, feedback from special lecturers (second half) [Whole class work] (July-August)

[Preparation of draft research plan] (November - February)

*The application form for JSPS Postdoctoral Fellowships will be used as a teaching material.

7th: Outline and purpose of the special researcher (DC/PD) system, points for preparing application forms [lecture]

8th: Preparation of application draft, peer review [group work]

9th: Correction and critique by mentor faculty and URA [plenary work].

(4) Outside-class activities and assignments

-Students are expected to prepare presentations and draft research plans on their own outside of class time.

-When giving a presentation to a company, etc., students are expected to have an overview of the company's business in advance. They are also expected to observe basic rules and manners as a member of society.

(5) Textbooks and course materials

No English references

(6) Assessment and grading

Comprehensive evaluation will be made based on presentations, draft research proposals, and discussions among students.

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

Depending on the nature of the inquiry, contact the following e-mail address for face-to-face consultation, if necessary.

-Naoki Kachi, coordinator faculty member (Center for University Education) kachi-naoki@tmu.ac.jp

-URA in charge of Research Promotion Organization (related to application for special researcher) soutsui_f20@jmj.tmu.ac.jp

-Academic Affairs Planning Section, Academic Affairs Division (related to course registration procedures) kyomu-kikaku@jmj.tmu.ac.jp

(8) Special note (Course prerequisites)

In order to make use of the results of the presentations in this class, students are encouraged to participate outside of class in the following projects where they will actually have opportunities to introduce their own research.

Example:

-Research Pitch Contest (tentative name) (hosted by the University's Organization for Promotion of Integrated Research, time to be determined)

-SD Forum (organized by the Graduate School of System Design, TMU, around October)

-Overseas training program for graduate students in science (organized by the four graduate schools of science, TMU, around July to November)

-Exchange meeting between doctoral students and companies (hosted by Ochanomizu University, around September)

-Career Path Forum (hosted by Yokohama National University, around October)

-Research introductions at high school and university collaborative projects (hosted by the High School and University Collaboration Office, TMU), etc.

-For information on the various research presentation events, please refer to the Career Support Division's Career Support Information for Doctoral Students website (https://career.tmu.ac.jp/for_doctoral/) and postings on campus.

-The application for participation in each project should be made by the applicants themselves. Please note that some of the programs are limited to doctoral students, so please pay attention to the eligibility requirements for each program.

-The schedule of this class will be announced separately.

-The number of students may be limited if there are too many applicants for the class due to the format of presentations and exercises.

Graduate School of Science & Graduate School of Science and Engineering List of Course Instructors

[Mathematical Sciences / Mathematics and Information Sciences]

Instructor Name	Laboratory	Extension No.
Manabu Akaho	8-629	3136
Kensuke Ishitani	8-669	3167
Hokuto Uehara	8-623	3128
Yukihiro Uchida	8-667	3165
Shigenori Uchiyama	8-668	3166
Kazuhiro Kurata	8-632	3141
Shigeru Kuroda	8-672	3172
Masanori Kobayashi	8-670	3134
Takashi Sakai	8-631	3138
Masahiko Simojo	8-622	3135
Toshio Suzuki	8-675	3175
Shoichiro Takakuwa	8-663	3161
Asuka Takatsu	8-628	3127
Hirofumi Tsumura	8-674	3174
Hiro-o Tokunaga	8-673	3173
Kumiko Hattori	8-671	3171
Tomoyuki Hisamoto	8-666	3164
Tomohiro Fukaya	8-630	3137
Hiroshi Murakami	8-522	3096
Yoshiyuki Yokota	8-626	3133
Shun'ichi Yokoyama	8-665	3168
Kazushi Yoshitomi	8-624	3131
Takeshi Kawasaki	8-662	3158
Masaki Hirata	8-662	3158

[Physics]

Instructor Name	Laboratory	Extension No.
Yuji Aoki	8-531	3362
Emiko Arahata	8-580	3368
Yoshitaka Ishisaki	8-227	3244
Yuichiro Ezoe	8-229	3246
Hidekazu Kakuno	8-532	3363
Hiroaki Kadowaki	8-225	3242
Rei Kurita	8-496	3333
Akira Shudo	8-518	3351
Sergei Ketov	8-581	3371
Hajime Tanuma	8-526	3355
Kazumasa Hattori	8-519	3352
Tetsuo Hyodo	8-583	3373
Yutaka Fujita	8-517	3348
Takashi Hotta	8-578	3366
Tatsuma Matsuda	8-226	3243
Yoshikazu Mizuguchi	8-579	3367
Yasumitsu Miyata	8-528	3357
Hiroyuki Mori	8-577	3365
Osamu Yasuda	8-584	3374
Kazuhiro Yanagi	8-290	5667
Shimpei Iida	8-292	3255
Kumi Ishikawa	8-296	3257
Hiromi Otsuka	8-594	3383
Noriaki Kitazawa	8-588	3375
Tetsuro Kumita	8-488	3326
Yousuke Goto	8-125	3222
Shin Sasaki	8-515	3346
Atsushi Tanaka	8-510	3341
Marie Tani	8-483	3325
Yusuke Nakanishi	8-481	3324
Ryuji Higashinaka	8-122	3221
Youhei Yomogida	8-289a	3258

[Chemistry / Molecular Materials Chemistry]

Instructor Name	Laboratory	Extension No.
Masatoshi Ishida	8-566	3565
Teppei Ikeya	8-451	3525
Takashi Ito	8-469	3538
Akiko Inagaki	8-472	3541
Yasuji Oura	8-567	3576
Reika Kanya	8-367	3447
Koichi Kikuchi	8-372	3453
Shiro Kubuki	RI-201	3922
Shigeyuki Komura	8-374	3455
Toshio Shimizu	8-574	3585
Kenichi Sugiura	8-565	3574
Masato Taoka	8-467	3536
Nobuyuki Takegawa	8-366	3446
Naoki Nakatani	8-572	3543
Tohru Nishinaga	8-566	3565
Kotohiro Nomura	8-473	3542
Masahiko Hada	8-474	3583
Yasushi Hirose		
Kouji Hirota	8-466	3535
Mohammed Meharwed Abdel-Latif Soliman	8-472	3541
Seiji Yamazoe	8-568	3577
Kazuhiko Akiyama	8-576	3587
Takuya Abe	8-466	3535
Soichi Yoshikawa	8-546	3561
Kohei Shibamoto	8-365	3445
Daisuke Shimoyama		
Kazunori Hirabayashi	8-563	3573
Jun Matsumoto	8-369	3451
Kentaro Misawa	8-365	3445

[Biological Sciences]

Instructor Name	Laboratory	Extension No.
Adam Cronin	Makino-204	2751
Adam Witemeyer		
Kanae Ando	9-478	4443
Katsuyuki Eguchi	Makino-214	2754
Shigeki Ehira	8-334	3672
Yasukazu Okada	8-543	3766
Takashi Okamoto	8-320	3661
Yoko Kakugawa	Makino-107	2723
Jun-ichi Kato	8-329	3668
Takeshi Kanegae	8-312	3654
Hiroyuki Kawahara	8-492	4367
Makoto Kurokawa	8-429	3736
Takaomi Sakai	8-413	3724
Jun-Ichirou Suzuki	8-540	3764
Naohito Takatori	8-336	3673
Aya Takahashi	8-425	3733
Koichiro Tamura	8-415	3725
Masafumi Nozawa	8-417	3726
Rei Narikawa		
Fumio Hayashi	8-541	3765
Shin Haruta	8-434	3741
Kimiko Fukuda	8-339	3675
Noriaki Murakami	Makino-117	2727
Akiko Asada	9-493	4372
Tsunaki Asano	8-422	3731
Hidetoshi Kato	Makino-116	2726
Atsuko Kinoshita	8-318	3657
Taro Saito	9-493	4371
Satomi Takeo	8-412	3723
Yuuya Tachiki	8-338	3674
Toshiko Furukawa	8-322	3662
Naoto Yokota	9-481b	4370
Takahiro Yoshida	Makino-215	2755

[Mechanical Engineering]

Instructor Name	Laboratory	Extension No.
Satoshi Ogata	9-463	4143
Toshiki Koguchi	9-464	4277
Hiromichi Obara	9-457	4136
Naoto Kakuta	9-458	4137
Koji Kakehi	9-454	4145
Satoshi Kobayashi	9-465	4133
Toshio Shudo	9-455	4134
Satoru Takahashi	9-461	4254
Kazunori Hase	9-459	4135
Satoshi Honda	9-460	4141
Takuya Yoshimura	9-453	4131
Shuichi Wakayama	9-467	4147
Gen Tamaoki	10-227	4188
Yuichiro Hayashi	10-127	4183
Kazuhiko Murakami	9-354	4164
Makoto Yoshida	9-459	4135

Tokyo Metropolitan University Degree Rules (Excerpts)

Corporate Rules No. 54, 2005
Enacted on April 1, 2005

Purpose

Article 1

The purpose of these rules is to provide information concerning degrees at Tokyo Metropolitan University pursuant to the provisions of Article 13, Paragraph 1 of the Degree Regulations (Ordinance of the Ministry of Education No. 9 of 1953).

Type of degrees

Article 2

1. The following degree shall be conferred:
   (1) Bachelor's degree
   (2) Master's degree
   (3) Doctoral degree
   (4) Juris Doctor degree (professional)
2. In conferring a bachelor's, master's, or doctoral degree, disciplines shall be appended according to Appended Table 1.

(Appended table revisions of Rule 202 of 2005 and Rule 79 of 2007; partial revisions and appended table revisions of Rule 78 of 2008; appended table revisions of Rule 49 of 2009, Rule 27 of 2011, Rule 25 of 2013, Rule 38 of 2014, Rule 20 of 2015, and Rule 40 of 2017)

Requirements for conferring a master's degree

Article 4

Graduate School Rules of Tokyo Metropolitan University (Corporate Rules No. 49, 2005; hereinafter referred to as the "Graduate School Rules").

A master's degree shall be conferred to those who have completed the master's program pursuant to the provisions of Article 35, Paragraph 1.

(Partial revisions of Rule 31 of 2019)

Requirements for conferring a doctorate

Article 5

1. A doctorate shall be conferred on those who have completed the doctoral program pursuant to the provisions of Article 35, Paragraph 1 of the Graduate School Rules.
2. A doctorate shall be conferred on those who have passed the dissertation examination and examinations pursuant to the provisions of Article 35, Paragraph 2 of the Graduate School Rules and whose academic ability is confirmed by a test to be equivalent to or higher than those who have completed the doctoral program set forth in the preceding paragraph.

Method and timing of the degree application

Article 7

The method and timing of application for degrees shall be set forth in Appended Table 2.

(Appended table revision of Rule 5 of 2013)

Qualification for the master's degree application

Article 8

In order to be qualified to apply for the evaluation of the thesis examination (including research findings of a specific subject; hereinafter the same) to obtain a master's degree pursuant to the provision of Article 4, the student must have enrolled in the master's program and earned required credits or be approved to earn the required credits by the end of the evaluation of the thesis examination.

Qualification for the doctorate application

Article 9

In order to be qualified to apply for the evaluation of the dissertation examination to obtain a doctorate pursuant to the provision of Article 5, Paragraph 1, the student must have enrolled in the doctoral program and earned required credits or be approved to earn the required credits by the end of the evaluation of the dissertation examination. Provided, however, that this shall not apply where the student applies for a doctorate pursuant to the provisions of Article 5, Paragraph 2.

Application for a doctoral dissertation, etc.

Article 10

1. In order to apply for a doctorate pursuant to the provision of Article 5, Paragraph 2, the student shall submit the application form and related documents set forth in Article 7 with the discipline set forth in Article 2, Paragraph 2, along with the payment of the dissertation evaluation fee, to the Graduate School for the attention of the provost.

2. The dissertation evaluation fee, waiver, and other matters shall be as specified separately.

Acceptance of the degree application

Article 11.

1. Applications for a master's degree pursuant to the provisions of Article 4 and applications for a doctorate pursuant to the provisions of Article 5, Paragraph 1 shall be accepted by the relevant graduate school.

2. Under the provisions of Article 5, Paragraph 2, a dissertation along with a doctorate application shall be checked and determined by the Faculty Committee of the Graduate School (hereinafter "Graduate Faculty Committee") whether to accept it for evaluation.

3. If accepted according to the provision above, an application acceptance certificate shall be issued to the applicant.

4. After accepting a doctorate application pursuant to the provisions of the preceding two paragraphs, the provost shall request the Graduate Faculty Committee of the appropriate discipline to evaluate the dissertation.

Thesis/Dissertation

Article 12

1. One main thesis or dissertation shall be accepted. However, other papers may be attached as references.

2. The terminology used in the thesis/dissertation shall be determined by the Graduate Faculty Committee.

3. Received thesis/dissertation shall not be returned to the applicant under any circumstances.

Review Committee

Article 13

1. The thesis/dissertation shall be evaluated and determined based on the report prepared by the Review Committee, which is established in the Graduate Faculty Committee.

2. The Review Committee set forth in the preceding paragraph shall consist of as follows:

(1) The Review Committee for a thesis/dissertation set forth in Articles 8 and 9 shall consist of a graduate/doctoral advisor as the main evaluator and two or more faculty members who are members of and nominated by the Graduate Faculty Committee and appointed by the provost.

(2) The Review Committee for a dissertation set forth in Article 10 shall consist of one main evaluator and two or more faculty members who are members of and nominated by the Graduate Faculty Committee and appointed by the provost.

3. Notwithstanding the provision of the preceding paragraph, when the Graduate Faculty Committee deemed it necessary, the committee may nominate professors from other departments or other graduate schools or research institutes for the review committee members.

Review period

Article 14

1. The thesis and dissertation set forth in Articles 8 and 9 shall be accepted and the evaluation is completed while the applicant is enrolled in the graduate program.

2. The evaluation of the dissertation set forth in Article 10 must be completed within one year from the date that the doctorate application is received.

3. Notwithstanding the provisions of the preceding two paragraphs, the review period may be extended with the approval of the Graduate Faculty Committee.

Examinations

Article 15

1. While evaluating the dissertation, the Review Committee shall conduct the final examination or test for the subjects mainly related to the dissertation.
2. The final examination or test set forth in the preceding paragraph shall be conducted in an interview or written format.

Test

Article 16

1. The test set forth in Article 5, Paragraph 2 shall be conducted in an interview or written format.
2. For an individual who applies for a doctorate under Article 5, Paragraph 2, if the individual has withdrawn from the school but had enrolled in our doctoral program for one year or more and earned required credits, the test outlined in the preceding paragraph may be waived according to the rule prescribed by respective graduate programs.

Public presentation

Article 17

Under the rule prescribed by the Graduate Faculty Committee, the committee may request the doctorate applicant to give a public presentation of the dissertation (hereinafter "public presentation") as the final examination or test. The details of the public presentation shall be determined by the Review Committee.

Informing the Graduate Faculty Committee

Article 18

1. The Review Committee shall submit the evaluation report to the Graduate Faculty Committee immediately after completing the evaluation.
2. If necessary, the Graduate Faculty Committee may request the applicant to submit additional materials such as a copy, Japanese translation, prototype or sample of the dissertation. In some cases, the committee may request the applicant to elaborate on the dissertation.

Pass or fail decision

Article 19

1. The Graduate Faculty Committee shall decide whether to pass or fail the dissertation and final examinations, etc., by anonymous voting based on the evaluation report from the Review Committee.
2. The Graduate Faculty Committee meeting must consist of at least two-thirds of the committee members to qualify the meeting for the purpose in the preceding paragraph, and at least two-thirds favorable votes from attended members are required to pass. Note that those absent due to public duties shall not be counted in the aforementioned quorum.

Article 20

1. Upon the decision of the passing result, the Graduate Faculty Committee shall submit a report summarizing the dissertation evaluation and final examination or test result to the dean of the graduate program.
2. For the applicant of a doctorate pursuant to the provision of Article 5, Paragraph 2, the committee shall also submit the test result.
3. The same shall apply to the case where the committee determined the application failed. However, the evaluation summary shall not be required.

Granting a degree

Article 21-1

1. The provost shall confer a degree based on the report from the department or Graduate Faculty Committee, according to the attached format.
2. The bachelor's degree shall be granted in March. Provided, however, that the degree may be granted in September for those who have been enrolled for four years or more and for whom the Faculty Committee deems it particularly necessary.
3. The master's degree shall be awarded twice a year, in March and September.
4. The doctorate shall be awarded as needed.

(Partial revisions of Rule 31 of 2019)

Completion of the Collaborative International Research Program

Article 21-2If the master's or doctoral degree grantee has been recognized as passing the dissertation examination by the Collaborative International Research Program prescribed in Article 29, Paragraph 2 of the Graduate School Rules of Tokyo Metropolitan University (Corporate Rules No. 49 of 2005), the statement of the program completion shall be added to the diploma.

(Addition of Rule 49 of 2009; Partial revisions of Rule 31 of 2019)

Publication of the dissertation abstract

Article 22

After a doctorate is granted, the University shall publish the abstract of the dissertation and the summary of the dissertation examination result on the Internet within three months from the date of conferral of the doctorate. The method shall be prescribed separately.

(Partial revisions of Rule 5 of 2013)

Publication of the dissertation

Article 23

1. The individual who has been awarded a doctorate must publish the full text of his or her dissertation within one year of the date of conferral. Provided, however, that this shall not apply where the dissertation has already been published before the degree is conferred.
2. Notwithstanding the provision of the preceding paragraph, under certain circumstances, the doctorate grantee may publish the abstract of the dissertation instead of the full text upon approval of the Graduate Faculty Committee. In this case, the Graduate School shall make the full text of the dissertation available for viewing upon request.
3. The publication made by the doctorate grantee pursuant to the provisions of the preceding two paragraphs shall be on the Internet with the assistance of the school. The method shall be prescribed separately.
4. When publishing the dissertation after the conferral of the degree pursuant to the provisions of the preceding Paragraph 3, the dissertation must be published with the statement "Doctoral dissertation reviewed by Tokyo Metropolitan University."

(Partial revisions of Rule 5 of 2013 and Rule 31 of 2019)

Name of the degree

Article 24

When the individual who has been awarded a doctorate uses the name of the degree, the name of Tokyo Metropolitan University shall be added.

(Partial revisions of Rule 31 of 2019)

Revocation of a degree

Article 25

1. If the degree awarded was found to be made by fraudulent means, the provost may revoke the degree based on the deliberation of the Graduate Faculty Committee.
2. The decision of the Graduate Faculty Committee outlined in the preceding paragraph shall require the approval of three-quarters of the meeting participants. The provisions of Article 19 shall apply mutatis mutandis to matters such as the number of participants.

Supplementary provisions

1. These rules shall come into effect as of April 1, 2005.
2. Notwithstanding the provisions of Article 2, Paragraph 2, the discipline of those who transferred to the Graduate School from the following schools on April 1, 2011, the Degree Rules as of March 31, 2011 of those schools shall apply.

- Tokyo Metropolitan University
- Tokyo Metropolitan Institute of Technology
- Tokyo Metropolitan University of Health Sciences

(hereinafter referred to as the "undergraduate schools before transfer")

Appended Table 1 for Article 2

(Partial revisions of Rule 202 of 2005, Rule 79 of 2007, Rule 49 of 2009, Rule 27 of 2011, Rule of 2013, Rule 40 of 2017)

2. Master's degree

Graduate Program	Major (Field of Study)	Discipline
Graduate School of Science	Mathematical Sciences	Science
	Physics	Science
	Chemistry	Science
	Biological Sciences	Science

3. Doctorate

Graduate Program	Major (Field of Study)	Discipline
Graduate School of Science	Mathematical Sciences	Science
	Physics	Science
	Chemistry	Science
	Biological Sciences	Science

Supplementary provisions The examples under the previous prevision (Corporate Rules 29 No. 40 of February 22, 2018) are as follows:

2. Master's degree

Graduate Program	Major (Field of Study)	Discipline
Graduate School of Science and Engineering	Mathematics and Information Sciences	Science
	Physics	Science
	Molecular Materials Chemistry	Science
	Biological Sciences	Science
	Electrical and Electronic Engineering	Mechanical Engineering
	Mechanical Engineering	Engineering

3. Doctorate

Graduate Program	Major (Field of Study)	Discipline
Graduate School of Science and Engineering	Mathematics and Information Sciences	Science
	Physics	Science
	Molecular Materials Chemistry	Science
	Biological Sciences	Science
	Electrical and Electronic Engineering	Engineering
	Mechanical Engineering	Engineering

Appended Table 2 for Article 7 (Partial revisions of Rule 5 of 2013)

Classification	Application Date	Required Documents	Copies	Note
Degrees under the provisions of Article 4	In principle, January 10 or July 31 (Each Graduate Faculty Committee may set the date separately)	1. Degree application form 2. Thesis 3. Thesis abstract 4. Unofficial transcript	1 1	The required number of copies of the thesis/dissertation and the abstract is determined by each graduate school.
Degrees under the provisions of Article 5, Paragraph 1	In principle, April 10 or October 31 (Each Graduate Faculty Committee may set the date separately)	1. Degree application form 2. Dissertation 3. Dissertation abstract 4. Unofficial transcript 5. List of research achievements 6. CV	1 1 2 2	The required number of copies of the thesis/dissertation and the abstract is determined by each graduate school.
Degrees under the provisions of Article 5, Paragraph 2	Unspecified	1. Degree application form 2. Dissertations 3. Dissertation abstracts 4. List of dissertations 5. List of research achievements 6. CV 7. Certificate of the copy of the partial resident card	1 1 2 2 1	Specify the discipline prescribed in Appended Table 1 (Article 10) The required number of copies of the thesis/dissertation and the abstract is determined by each graduate school.

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* The application period for the master's degree is no later than January 10 or July 10, and the application period for the doctorate is no later than December 10 or June 10 pursuant to Article 2 of the "Detailed Rules of the Graduate School of Science concerning the Graduate School Rules and Degree Rules of Tokyo Metropolitan University."

Graduate School Rules of Tokyo Metropolitan University (Excerpts)

Corporate Rules No. 49, 2005

Enacted on April 1, 2005

Chapter 1 General Provisions

Purpose

Article 1

The Graduate School of Tokyo Metropolitan University (hereinafter referred to as the "Graduate School") aims to teach and research specialized academic theories and applications in technical fields of study from a broad perspective in order for students to gain deep knowledge and outstanding abilities to engage in professions that require a high level of expertise. It also aims to improve the lives of Tokyo citizens and develop the culture of Tokyo.

(Partial revisions of Regulation 11 of 2019)

Article 2

Structure of the Graduate School

Programs

Article 3

1. The Graduate School consists of graduate programs and the professional degree program set forth in Article 2, Paragraph 1 of the Standards for the Establishment of Professional Graduate Schools (Ordinance of the Ministry of Education, Culture, Sports, Science and Technology No. 16 of 2003; the same hereafter).
2. The graduate program is divided into two sections: the first two years (hereinafter referred to as the "master's program") and the next three years (hereinafter the "doctoral program"). The first part of the graduate program is considered to be a master's program.
3. The master's program aims to enable students to gain deep knowledge and advanced skills to engage in professions that require research skills or a high level of expertise in the fields of study from a broad perspective.
4. The doctoral program aims to enable students to acquire advanced research skills and profound academic knowledge that are the foundations for conducting independent research activities as researchers or engaging in other highly specialized work in the field of study.

Graduate programs and majors

Article 4

Graduate programs and majors shall be as shown in Appended Table 1.

Maximum number of students

Article 6

The maximum number of students shall be as shown in Appended Table 2.

(Appended table revisions of Rule 192 of 2005, Rule 65 of 2006, Rule 33 of 2010, Rule 16 of 2013, Rule 28 of 2017)

Administrative unit

Article 7

Administrative tasks related to the graduate program shall be handled by the relevant administrative departments.

Chapter 2-2. Educational and Research Objectives of Each Graduate Program

(Addition of Rule 24 of 2006)

Educational and research objectives of the Graduate School of Science and Engineering

Article 7-5

1. The master's program of Graduate School of Science aims to enable students to gain a wide range of knowledge, concepts, and methods in natural science as well as developing research skills and flexible problem-solving and presentation skills. It also aims to train students to become researchers, educators, and engineers with an international perspective, creativity, and applicable skills.
2. The doctoral program of the Graduate School of Science aims to enable students to gain advanced knowledge, concepts, and methods in natural science as well as developing independent research skills and the ability to explore and discover mid- to long-term projects and issues. It also aims to train students to become researchers, educators, and engineers with international leadership, outstanding creativity, and applicable skills.

(Addition of Rule 24 of 2006; partial revision of Rule 28 of 2017; moved down from Article 7-4)

Educational and research objectives of each major

Article 7-9

The objectives of each major on human resource development and other educational and research purposes shall be prescribed separately.

(Addition of Rule 24 of 2006; Rule 28 of 2017 moved down from Article 7-8)

Chapter 3. Faculty

Faculty Committee

Article 8

1. The Graduate School shall have a Faculty Committee.
2. The Faculty Committee shall consist of the professors of the relevant graduate programs.
3. Associate professors and other faculty members may be added to the Faculty Committee.
4. The Dean of the Graduate School shall convene and chair Faculty Committee meetings.
5. Based on the basic policy determined by the Education and Research Council, the Faculty Committee shall deliberate on the following matters related to:
   (1) Student admission, course completion, and other matters related to student enrollment and degree conferral
   (2) Curriculum organization
   (3) Self-inspection and evaluation of the status of education and research in the graduate school
   (4) Systematic training and research conducted by the graduate school to improve the subject matter and teaching methods of courses and research instructions
   (5) Other important matters related to education and research
6. In addition to the above-mentioned five matters, necessary matters concerning the Faculty Committee shall be prescribed separately.

(Partial revisions of Rule 24 of 2006, Rule 13 of 2009)

Course instructors

Article 9

1. Courses and instructions at the graduate school shall be conducted by professors of the University or other qualified individuals (hereinafter referred to as "course instructors").
2. The course instructors outlined above shall be designated by the provost based on the deliberation of the Faculty Committee of the relevant graduate school and the approval of the Faculty Committee to which the professor belongs.

Board of Delegates

Article 10

1. The Graduate Faculty Committee may establish a Board of Delegates.
2. The matters determined by the Faculty Committee prescribed in Article 8, Paragraph 5 may be delegated to the Board of Delegates in making decisions.
3. The Dean of the Graduate School shall convene and chair the meeting of the Board of Delegates.
4. Necessary matters such as the composition of the Board of Delegates shall be prescribed separately.

Chapter 4. Academic Year, Semester, Enrollment Period, etc.

Academic year

Article 11

1. The academic year shall be from April 1 to March 31 of the following year for those enrolled in the first semester and from October 1 to September 30 of the following year for those enrolled in the second semester.

2. Semesters and recesses shall be pursuant to the University Rules. However, the semesters and recesses of the law school shall be in accordance with the Rules of Tokyo Metropolitan University Graduate School of Law and Politics (hereinafter referred to as "Law School Rules").

(Partial revisions of Rule 65 of 2008)

Enrollment period

Article 12

The regular enrollment period for the master's program shall be two years, and the regular enrollment period for the doctoral program shall be three years.

Maximum enrollment period

Article 14

1. The enrollment period in the master's program shall not exceed four years, and the enrollment period in the doctoral program shall not exceed six years.
3. Notwithstanding the provisions of the preceding two paragraphs, when exceptionally approved by the Faculty Committee of the Graduate School under special circumstances, the student may stay enrolled beyond the regular enrollment period.

Long-term enrollment

Article 15

When a student wants to take courses systematically over a certain period of time beyond the regular period prescribed in Article 12, Paragraph 1, under certain circumstances such as full-time work, the Graduate School may allow the student to complete the program in a planned manner as prescribed separately.

(Partial revisions of Rule 39 of 2009)

Chapter 5. Admission, etc.

Admission, etc.

Article 17

1. Matters concerning student status, such as admission, withdrawal, expulsion, transfer, study abroad, and leave of absence, shall be pursuant to the University Rules, except for provisions prescribed in the Graduate School Rules.
2. After deliberate of the Faculty Committee, the provost shall request to withdraw from school if a student falls under any of the following:
   (1) Exceeded the maximum enrollment period set forth in Article 14
   (2) Unable to return to school after the period of absence set forth in Article 19

Leave of absence

Article 19

1. The leave of absence cannot exceed the three years in total for each program.
3. Notwithstanding the provisions of the preceding two paragraphs, when exceptionally approved by the Faculty Committee under special circumstances, the student may remain absent beyond the preceded period of absence.
4. The period of absence shall not be factored in the maximum enrollment period for master's program or doctoral program set forth in Article 14, Paragraph 1.
6. In addition to the provision of the preceding paragraphs, the provisions of the University Rules shall apply mutatis mutandis to leaves of absence.

(Partial revisions of Rule 65 of 2008)

Study abroad

Article 20

1. A student may be allowed to study at a graduate school or research institute, etc., in a foreign country, based on an agreement or discussion with the other graduate school, etc., if the provost finds that it is academically beneficial for the student.
2. The permission set forth in the preceding paragraph shall be granted based on the student's application to study abroad and after discussion of the Faculty Committee of the Graduate School to which the student belongs.
3. The period of study abroad may be counted as the enrollment period.

Chapter 6. Enrollment Requirements and Steps

Assignment of a graduate/doctoral advisor

Article 21

After admission to the graduate school, each student (except low school students) shall be assigned a professor (hereinafter referred to as a "graduate/doctoral advisor") who will provide guidance to the student.

Guidance from the graduate/doctoral advisor

Article 22

1. At the beginning of each academic year, students shall apply to attend courses for the academic year according to the instruction and need to be admitted for the course enrollment.
2. Students shall receive guidance from their graduate/doctoral advisors on selecting courses, writing theses, and conducting research.
3. When the graduate/doctoral advisor deems it necessary, the student may take specified courses.

Credits

Article 23

The standards used for course credits in the graduate school shall be pursuant to the standards for course credits of the department.

Credit requirements, etc.

Article 24

Credit requirements for courses set forth in the preceding article shall be as follows. The detailed rules shall be prescribed separately.

(1) Master's students must earn 30 or more credits during their enrollment.

(2) Doctoral students must earn 20 or more credits during their enrollment. However, doctoral students majored in Human Health Sciences in the Graduate School of Human Health Sciences must earn 14 or more credits during their enrollment.

(Partial revisions of Rule 192 of 2005, Rule 39 of 2009, Rule 30 of 2014, Rule 38 of 2015)

Curriculum organization policy

Article 24-2

1. The graduate school shall establish courses necessary to achieve its educational objectives and formulate a plan to provide guidance on thesis and dissertations writing, etc. (hereinafter referred to as "research guidance"). The school shall also systematically organize the curriculum.
2. The graduate school shall give appropriate consideration to the curriculum that helps students acquire highly specialized knowledge and skills in the field of study and develop basic knowledge in the related fields.

(Addition of Rule 65 of 2006)

Cross-disciplinary program of graduate school

Article 24-3

The TMU Graduate School Cross-Disciplinary Program (hereinafter referred to as the "Cross-Disciplinary Program") is explained with the aim of acquiring broad knowledge, a bird's-eye view, and applied skills that transcend graduate schools and departments, and enhancing cross-disciplinary research capabilities, in addition to the curriculum specified in the preceding Article, and the necessary matters are stipulated in the Program's regulations.

General courses for all graduate programs

Article 24-4

1. In addition to the courses according to the preceding two articles, general courses for students of multiple graduate programs (hereinafter referred to as "general courses for all graduate programs") shall be offered in the graduate school.
2. If the graduate program deems it suitable for education, the credits earned through the general courses for all graduate programs may be counted toward the required credits for program completion as prescribed in Articles 30, 31, and 34. Provided, however, that these courses shall not be counted as the courses prescribed in the provisions of Article 30-2.

(Addition of Rule 17 of 2018)

Systematic training to improve the curriculum, etc.

Article 24-5

The graduate school shall offer systematic training and research to improve the quality and process of the

course curriculum and research guidance.

(Addition to Rule 65 of 2006; Rule 28 of 2017 moved down from Article 24-3; Rule 17 of 2018 moved down from Article 24-4)

Courses and credits awarded

Article 25

1. The courses for each major in the graduate program and the number of credits to be awarded shall be as shown in Appended Table 3.
2. The courses for each major in Graduate School Interdisciplinary Programs and the number of credits to be awarded are set forth in the Graduate School Interdisciplinary Programs Rules.
3. The list of general courses for all graduate programs and the number of credits to be awarded shall be as shown in Appended Table 3-2.
4. In addition to the courses set forth in the preceding three paragraphs, the school may establish other courses with the approval of the Faculty Committee.

Appended table revisions of Rule 178 of 2005, Rule 192 of 2005, Rule 65 of 2006, Rule 71 of 2007, Rule 65 of 2008, Rule 39 of 2009, Rule 33 of 2010, Rule 17 of 2011, Rule 14 of 2012, Rule 16 of 2013, Rule 30 of 2014, Rule 19 of 2015; partial revisions and appended table revisions of Rule 28 of 2017, Rule 17 of 2018)

Recognition of credits

Article 26

Credit for courses shall be granted based on written or oral examinations or research reports and shall be awarded at the end of each semester or academic year.

Course assessment

Article 27

The provisions of Article 40 of the University Rules shall apply mutatis mutandis to course assessment of student performance.

Clear presentation of grading criteria, etc.

Article 27-2

1. The Graduate School shall present to students in advance the teaching method and details of the course and research as well as the class schedule and research guidance plan for the year.
2. In order to ensure objective and rigorous assessment, the Graduate School shall present to students in advance the grading criteria for evaluating the student's performance and thesis/dissertation and recognizing the program completion. In addition, the Graduate School shall adhere properly to said criteria.

(Addition of Rule 65 of 2006)

Taking courses at other graduate schools, etc.

Article 28

The acceptance of credits from courses taken at other graduate schools and previously attended institutions shall be pursuant to the provisions of Article 43, Paragraph 1 (also applies mutatis mutandis to Paragraph 2) and Article 45, Paragraphs 1 and 3 of the University Rules. In this case, the term "60 credits" in Article 43, Paragraph 1 of the University Rules shall be read as "10 credits." As to Article 45, Paragraph 3, the term "the previous two paragraphs" shall be read as "Paragraph 1," and the term "60 credits" shall be read as "10 credits."

(Partial revisions of Rule 192 of 2005, Rule 14 of 2012)

Research guidance at other graduate schools or research institutes, etc.

Article 29

If the provost finds that it is academically beneficial for the student, the student may be allowed to receive research guidance at another graduate school or research institute, etc., after having the Graduate Faculty Committee's approval and an agreement or discussion with the other graduate school or institution.

Joint Research Guidance Program

Article 29-2

1. If the President deems it educationally beneficial for a student to enroll in a graduate school of a foreign university under an agreement or consultation with the graduate school of the foreign university, and to undergo a program of research guidance and dissertation review jointly conducted by the graduate school of the University and the graduate school concerned (hereinafter referred to as "joint research guidance program") while maintaining his/her status as a student of the University, the President may permit the student to undergo the program after consultation with the faculty council of the graduate school to which the student belongs.
2. If there is a student from a graduate school of a foreign university who intends to take a joint research guidance program with the graduate school of TMU, the student may be admitted as an exchange student as stipulated in Article 67-2 of the TMU Academic Regulations, based on an agreement or consultation with the graduate school concerned.
3. When an exchange student accepted under the provisions of the preceding paragraph is recognized as having passed the thesis examination under the joint research guidance program with the graduate school of TMU, the President may, after discussion by the Faculty Council of the graduate school that accepted the exchange

student, award a certificate indicating that the student has completed the joint research guidance program.

Chapter 7. Completion Requirements

Completion requirements for the master's program

Article 30

1. In order to complete the master's program, students must complete the two-year enrollment period by attending regular classes, acquiring 30 or more credits of required courses in the master's program, submitting a thesis, and taking the final examination.
2. In the case of the preceding paragraph, if the graduate advisor considers it academically beneficial, up to 10 credits out of the 30 credits may be earned by taking the following courses as prescribed by each graduate school:
   - Non-major courses in the graduate program
   - Major courses in other graduate programs
   - Undergraduate courses
3. Of completion requirements set forth in Paragraph 1,
   as for the enrollment period for those who are recognized as delivering excellent research results, enrollment in the master's program for one year or more shall satisfy the requirement. In this case, if it is deemed appropriate for the purpose of the master's program, the evaluation of the research result on a certain topic may be substituted for the evaluation of a thesis.

(Partial revisions of Rule 65 of 2006, Rule 65 of 2008, Rule 28 of 2017)

Completion requirements for the doctoral program

Article 31

1. In order to complete the doctoral program, the students must complete the three-year enrollment period by attending regular classes, acquiring 20 or more credits in the required courses in the doctoral program, submitting a dissertation, and taking the final examination. However, as for the enrollment period for those who are recognized as delivering exceptional research results, enrollment in the doctoral program for one year or more satisfies the requirement, except for those who fall under the following paragraph.
2. As for the enrollment period for those who have completed the master's program with a period of one year of enrollment under the provision of Paragraph 3 of the previous article, if the Faculty Committee of the relevant graduate program recognized the student as delivering excellent research results, enrollment in the doctoral program for two years or more shall satisfy the requirement.

(Partial revisions of Rule 192 of 2005)

Final examination

Article 32

1. The thesis/dissertation and the final examination shall be evaluated by the graduate/doctoral advisor as the main evaluator and two or more course instructors as set forth in Article 9 nominated by the Graduate Faculty Committee and appointed by the provost.
2. The final examination shall be conducted for those who have acquired the required credits and submitted a thesis/dissertation.
3. The final examination set forth in the preceding paragraph shall be conducted primarily on the thesis/dissertation and written or oral examination of a course related to the thesis/dissertation.

Pass/fail of the thesis/dissertation and final examination

Article 33

The pass/fail result of the thesis/dissertation and final examination shall be determined based on the evaluation report submitted by the Review Committee established by the Faculty Committee.

Recognition of course completion and degree conferral

Article 35

1. For a student who has acquired the required credits set forth in Article 30 for the master's program and Article 31 for the doctoral program, and has passed the thesis/dissertation examination and the final examination, the provost shall authorize the program completion and confer a degree.

2. For an individual who has submitted a dissertation and doctorate application, the degree shall be conferred if the content of the dissertation is equivalent or higher quality than that is submitted under Article 31, Paragraph 1, and the examination result proves that the individual has broad academic knowledge and ability to guide research in the major field of study.
4. The degrees to be conferred under this article shall be prescribed separately.

Obtaining teacher certification

Article 36

1. In order to obtain teacher certification, the student must earn credits set forth in the School Teacher's License Act (Act No. 147 of 1949) and the Order for Enforcement of the School Teacher's License Act (Order of the Ministry of Education No. 26 of 1954).
2. The types and subjects offered in the graduate school to obtain teacher certification are listed in Appended Table 4.

(Appended table revisions of Rule 192 of 2005, Rule 65 of 2006, Rule 28 of 2017)

Chapter 8. Awards and Punishments

Awards and punishments

Article 37

Awards and punishments shall be pursuant to the University Rules.

Chapter 9. Tuition and Other Fees

Tuition and other fees

Article 38

1. Tuition fees, admission fees, entrance exam fees, certificate issuance fees, and thesis/dissertation examination fees, etc., shall be prescribed separately.
2. The provisions of Chapter 3 of the University Rules shall apply mutatis mutandis to the discount and waiver of admission fees and the payment method, installment payment, discount, waiver, etc. of tuition fees.

Chapter 10. Non-Degree Students

Non-degree students, etc.

Article 39

Non-degree students and international students shall be prescribed separately.

Supplementary provisions (29 Corporate Rules No. 28, February 22, 2018)

1. These rules shall come into effect as of April 1, 2018.
2. The provisions regarding the names of graduate programs, majors, academic domains, and completion requirements for students who were enrolled in the fields of study listed below as of March 31, 2018, and continue to be enrolled in the graduate program, etc. on or after April 1 of the same year, the previous provisions shall remain in effect.

- Graduate School of Social Sciences

- Graduate School of Science and Engineering

- Graduate School of Urban Environmental Sciences, Urban Environmental Sciences, Department of Geography and Environmental Sciences

- Graduate School of Urban Environmental Sciences, Urban Environmental Sciences, Department of Applied Chemistry

- Graduate School of Urban Environmental Sciences, Urban Environmental Sciences, Department of Urban System Science

- Graduate School of System Design, System Design, Department of Intelligent Mechanical Systems

- Graduate School of System Design, System Design, Department of Information and Communication Systems,

- Graduate School of System Design, System Design, Department of Management System Design

6. Notwithstanding the provisions of the revised Appended Table 4, the previous provisions shall remain in effect for
the types and subjects for teacher certifications for students who were enrolled as of March 31, 2018, and continue to be enrolled in the graduate program, etc., on or after April 1 of the same year.

Appended Table 1 for Article 4 (Partial revisions of Rule 192 of 2005, Rule 65 of 2006, Rule 28 of 2017)

1. Graduate programs

Master's program		Doctoral program	
Graduate Program	Major	Graduate Program	Major
Graduate School of Science	Mathematical Sciences Physics Chemistry Biological Sciences	Graduate School of Science	Mathematical Sciences Physics Chemistry Biological Sciences

Appended Table 2 for Article 6 (Partial revisions of Rule 192 of 2005, Rule 65 of 2006, Rule 39 of 2009, Rule 33 of 2010, Rule 16 of 2013, Rule 28 of 2017)

1. Graduate programs

Master's program				Doctoral program			
Graduate School	Major	Max. Adm.	Max. Enroll	Graduate School	Major	Max. Adm.	Max. Enroll
Graduate School of Science	Mathematical Sciences	25	50	Graduate School of Science	Mathematical Sciences	8	24
	Physics	35	70		Physics	10	30
	Chemistry	35	70		Chemistry	9	27
	Biological Sciences	40	80		Biological Sciences	16	28

Appended Table 4 for Article 36 (Partial revisions of Rule 192 of 2005, Rule 65 of 2006, Rule 28 of 2017)

Graduate School Master's Program	Major	Types and Subjects for Licenses	
		Junior High School Teacher's License	High School Teacher's License
Graduate School of Science	Mathematical Sciences	Mathematics	Mathematics
	Physics Chemistry Biological Sciences	Elementary Science	Elementary Science

Supplementary provisions The examples of Appended Table 1, Appended Table 2, and Appended Table 4 under the previous prevision (Corporate Rules 29 No. 28 of February 22, 2018) are as follows:

Appended Table 1 for Article 4 (Partial revisions of Rule 192 of 2005, Rule 65 of 2006)

1. Graduate programs

Master's program		Doctoral program	
Graduate School	Major	Graduate School	Major
Graduate School of Science and Engineering	Mathematics and Information Sciences Physics Molecular Materials Chemistry Biological Sciences Electrical and Electronic Engineering Mechanical Engineering	Graduate School of Science and Engineering	Mathematics and Information Sciences Physics Molecular Materials Chemistry Biological Sciences Electrical and Electronic Engineering Mechanical Engineering

Appended Table 2 for Article 6 (Partial revisions of Rule 192 of 2005, Rule 65 of 2006, Rule 39 of 2009, Rule 33 of 2010, Rule 16 of 2013)

1. Graduate programs

Master's program				Doctoral program			
Graduate School	Major	Max. Adm.	Max. Enroll	Graduate School	Major	Max. Adm.	Max. Enroll
Graduate School of Science and Engineering	Mathematics and Information Sciences	25	50	Graduate School of Science and Engineering	Mathematics and Information Sciences	8	24
	Physics	33	66		Physics	9	27
	Molecular Materials Chemistry	33	66		Molecular Materials Chemistry	9	27
	Biological Sciences	40	80		Biological Sciences	16	48
	Electrical and Electronic Engineering	32	64		Electrical and Electronic Engineering	6	18
	Mechanical Engineering	32	64		Mechanical Engineering	6	18

Appended Table 4 for Article 36 (Partial revisions of Rule 192 of 2005, Rule 65 of 2006)

Graduate School Master's Program	Major	Types and Subjects for Licenses	
		Junior High School Teacher's License	High School Teacher's License
Graduate School of Science and Engineering	Mathematics and Information Sciences	Mathematics	Mathematics
	Physics Molecular Materials Chemistry Biological Sciences	Elementary Science	Elementary Science
	Electrical and Electronic Engineering Mechanical Engineering		Engineering

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