2023

# Syllabi

Science
(Undergraduate Courses)

Rikkyo University

| Course Title | Linear Algebra 1 | | |
|---|---|---|---|
| Instructor | Nishino Takeo | | |
| Semester | Fall Semester | Credit | 2 Credits |
| Course Number | MAT1100 | Language | Japanese |

## Course Objectives

Students will learn the basics of linear algebra. Specifically, students should be able to accurately perform matrix addition, multiplication, and determinant calculations. In addition, students should understand applications of calculations using matrices, such as solving a system of linear equations. Finally, students will become familiar with abstract concepts such as the rank of matrices and linear mappings.

## Course Contents

Linear algebra is an indispensable tool in mathematics and physics. In ″Introduction to Linear Algebra″, we mainly studied matrices with two rows and two columns, and in this ″Linear Algebra 1″ and ″Linear Algebra 2″ in the spring semester of the second year, we will study general matrices.
In ″Linear Algebra 1″, we start with learning the basics of vectors and matrices, and learn how to compute fundamental objects such as determinants of square matrices and inverse matrices. The course also touches on applications of matrix calculations, such as solving linear equations and linear mapping. These applications will prepare us for more abstract discussions in ″Linear Algebra 2″.

## Others

※Please refer to the ″Syllabus & Class Schedule Search System″ for details including course schedule, evaluations, textbooks and others.
<URL>
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CA003

| Course Title | Exercises in Linear Algebra 1 | | |
|---|---|---|---|
| Instructor | Nishino Takeo/Koyama Tamio | | |
| Semester | Fall Semester | Credit | 1 Credit |
| Course Number | MAT1100 | Language | Japanese |

## Course Objectives

Through solving exercises, students will gain a solid understanding of the contents of ″Linear Algebra 1″.

## Course Contents

In this course, students will learn the basics of vectors and matrices, as well as basic objects such as determinants of square matrices and inverse matrices through exercises. In addition, we will practice solving linear equations, linear mappings, and other applications of matrix calculations.

## Others

※Please refer to the ″Syllabus & Class Schedule Search System″ for details including course schedule, evaluations, textbooks and others.
<URL>
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CA004

| Course Title | Introduction to Differential and Integral Calculus | | |
|---|---|---|---|
| Instructor | Kakei Saburou | | |
| Semester | Spring Semester | Credit | 2 Credits |
| Course Number | MAT1300 | Language | Japanese |

## Course Objectives

Learn the basic theory and calculation methods for real single-variable function, such as differentiation, and limits of sequences.

## Course Contents

We will start with a review of the calculus learned in high school, and you will learn how to handle it more precisely. In “Introduction to Differential and Integral Calculus” and “Exercises in Introduction to Differential and Integral Calculus” in the spring semester, we focus on differentiation. Mathematics taught at university places high emphasis on strictness and logic; the objective of this lecture is to touch on what it means to “treat strictly” through calculus.

## Others

※Please refer to the ″Syllabus & Class Schedule Search System″ for details including course schedule, evaluations, textbooks and others.
<URL>
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CA005

| Course Title | Exercises in Introduction to Differential and Integral Calculus | | |
|---|---|---|---|
| Instructor | Kakei Saburou | | |
| Semester | Spring Semester | Credit | 1 Credit |
| Course Number | MAT1300 | Language | Japanese |

## Course Objectives

Learn the basic theory and calculation methods for real single-variable function differentiation and limits of sequences.

## Course Contents

We will start with a review of the calculus learned in high school, and you will learn how to handle it more precisely. In “Introduction to Differential and Integral Calculus” and “Exercises in Introduction to Differential and Integral Calculus” in the spring semester, we focus on differentiation. Mathematics taught at university places high emphasis on strictness and logic; the objective of this lecture is to touch on what it means to “treat strictly” through calculus.

## Others

※Please refer to the ″Syllabus & Class Schedule Search System″ for details including course schedule, evaluations, textbooks and others.
<URL>
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CA006

| Course Title | Differential and Integral Calculus 1 | | |
|---|---|---|---|
| Instructor | Kakei Saburou | | |
| Semester | Fall Semester | Credit | 2 Credits |
| Course Number | MAT1300 | Language | Japanese |

## Course Objectives

Understand differentiation and integration theory for real single variable functions, and learn their practical use through application to concrete examples.

## Course Contents

Based on the contents of the “Introduction to Differential and Integral Calculus” lecture, the basic theory of differentiating and integrating single variable functions is studied. In “Differential and Integral Calculus 1” and “Exercises in Differential and Integral Calculus 1” in the fall semester, we focus on integration. In particular, the objective is to define the concept of definite integrals in the mathematically rigorous form of the “Riemann Integral” and to derive the basic properties based on that definition. The course also handles integration over infinite intervals, which has important applications. The basic properties of function series are studied by touching on specific functions.

## Others

※Please refer to the ″Syllabus & Class Schedule Search System″ for details including course schedule, evaluations, textbooks and others.
〈URL〉
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CA007

| Course Title | Exercises in Differential and Integral Calculus 1 | | |
|---|---|---|---|
| Instructor | Kakei Saburou/Koyama Tamio | | |
| Semester | Fall Semester | Credit | 1 Credit |
| Course Number | MAT1300 | Language | Japanese |

## Course Objectives

Understand differentiation and integration theory for real single variable functions, and learn their practical use through application to concrete examples.

## Course Contents

Based on the contents of the “Introduction to Differential and Integral Calculus” lecture, the basic theory of differentiating and integrating single variable functions is studied. In “Differential and Integral Calculus 1” and “Exercises in Differential and Integral Calculus 1” in the fall semester, we focus on integration. In particular, the objective is to define the concept of definite integrals in the mathematically rigorous form of the “Riemann Integral” and to derive the basic properties based on that definition. The course also handles integration over infinite intervals, which has important applications. The basic properties of function series are studied by touching on specific functions.

## Others

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〈URL〉
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CA008

| Course Title | Introduction to Computer Science 1 | | |
|---|---|---|---|
| Instructor | Mizusawa Yasushi | | |
| Semester | Spring Semester | Credit | 2 Credits |
| Course Number | MAT1400 | Language | Japanese |

## Course Objectives

The objective of this course is to learn the basics of computers, which are essential in modern life.

## Course Contents

This class is paired with "Exercises in Introduction to Computer Science 1". In "Introduction to Computer Science 1", students learn the fundamentals of computer science. Starting with numerical representation methods in data processing, the structure and operating principles of computer hardware and software are explained. "Exercises in Introduction to Computer Science 1" deals with the use of computers as stationary (what is known as "information literacy"). Students learn about uses of computer technology that are necessary for university life, such as preparing a report using a Japanese word processor and retrieving information with a web browser. Students also learn about how to transmit information using computers, such as by using presentation software.

## Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.
<URL>
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CA009

| Course Title | Exercises in Introduction to Computer Science 1 | | |
|---|---|---|---|
| Instructor | Mizusawa Yasushi/Suzuki Yuta | | |
| Semester | Spring Semester | Credit | 1 Credit |
| Course Number | MAT1400 | Language | Japanese |

## Course Objectives

The objective of this course is to learn the basics of computers, which are essential in modern life. Studies focus on word processing, spreadsheet and presentation software.

## Course Contents

This class is paired with "Introduction to Computer Science 1". In "Introduction to Computer Science 1", students learn the fundamentals of computer science. Starting with numerical representation methods in data processing, the structure and operating principles of computer hardware and software are explained. "Exercises in Introduction to Computer Science 1" deals with the use of computers as stationary (what is known as "information literacy"). Students learn about uses of computer technology that are necessary for university life, such as preparing a report using a Japanese word processor and retrieving information with a web browser. Students also learn about how to transmit information using computers, such as by using presentation software.

## Others

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<URL>
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CA010

| Course Title | Introduction to Computer Science 2 | | |
|---|---|---|---|
| Instructor | Noro Masayuki | | |
| Semester | Fall Semester | Credit | 2 Credits |
| Course Number | MAT1400 | Language | Japanese |

## Course Objectives

The objective is to learn the fundamentals of programming through learning the Python language, which is one of the programming languages.

## Course Contents

With the theme of learning and studying mathematics using computers, learn the fundamentals of computing such as programming in the Python language. First, students learn about programming fundamentals such as conditional judgments, loops and functions, and learn how to think like a computer to analyze and solve problems. Next, students aim to apply this computational approach to a variety of mathematical problems to deepen their studies.

## Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.
<URL>
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CA011

| Course Title | Exercises in Introduction to Computer Science 2 | | |
|---|---|---|---|
| Instructor | Noro Masayuki/Suzuki Yuta | | |
| Semester | Fall Semester | Credit | 1 Credit |
| Course Number | MAT1400 | Language | Japanese |

## Course Objectives

The objective is to learn the fundamentals of programming through learning the Python language, which is one of the programming languages.

## Course Contents

With the theme of learning and studying mathematics using computers, learn the fundamentals of computing such as programming in the Python language. First, students learn about programming fundamentals such as conditional judgments, loops and functions, and learn how to think like a computer to analyze and solve problems. Next, students aim to apply this computational approach to a variety of mathematical problems to deepen their studies.

## Others

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<URL>
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CA012

| Course Title | Linear Algebra 2 | | |
|---|---|---|---|
| Instructor | Abe Takuro | | |
| Semester | Spring Semester | Credit | 2 Credits |
| Course Number | MAT2100 | Language | Japanese |

## Course Objectives

To understand matrices and vector spaces from a general abstract point of view. We begin with learning basic concepts such as bases of vector spaces, linear independence, the dimension of a vector space and subspaces. After that, we will learn linear mappings, their matrix representations, and various related properties.

## Course Contents

In the course ″Linear Algebra 1″, we learned vectors and matrices. In ″Linear Algebra 2″, we learn vector spaces and linear maps, which are abstract generalization of vectors and matrices. The main difference between these points of view is whether we fix a basis of a vector space or not. This abstraction is very useful, since in many problems, a good choice of a basis will make the calculation simpler and give us a clearer perspective. In this lecture, after giving the basics of vector spaces, we will deal with linear maps between vector spaces and their matrix representations. An important point is to understand how the matrix representations change as one chooses different bases of vector spaces. We will also learn the diagonalization of matrices and Jordan normal forms as generalization of diagonalization.

## Others

※Please refer to the ″Syllabus & Class Schedule Search System″ for details including course schedule, evaluations, textbooks and others.
<URL>
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CA013

| Course Title | Exercises in Linear Algebra 2 | | |
|---|---|---|---|
| Instructor | Abe Takuro/Enokizono Makoto | | |
| Semester | Spring Semester | Credit | 1 Credit |
| Course Number | MAT2100 | Language | Japanese |

## Course Objectives

The goal is to better understand the abstract notions such as vector spaces and linear maps, which are the contents of the Linear Algebra 2 course, through solving exercises.

## Course Contents

An exercise course attached to the ″Linear Algebra 2″ course. The contents of the ″Linear Algebra 2″ course is more abstract than that of the Linear Algebra 1, and to have a better understanding of abstract concepts, it is important to see how they work in explicit problems. In this course, you are supposed to work out various exercises which will help you understand abstract concepts.

## Others

※Please refer to the ″Syllabus & Class Schedule Search System″ for details including course schedule, evaluations, textbooks and others.
〈URL〉
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CA014

| Course Title | Intoroduction to Theory of Groups | | |
|---|---|---|---|
| Instructor | Geisser, Thomas | | |
| Semester | Fall Semester | Credit | 2 Credits |
| Course Number | MAT2100 | Language | Japanese |

## Course Objectives

This is the first lecture in abstract algebra. Using the symmetric group as an example, group theory is introduced on a beginner level. The goal of this lecture is to become familiar with abstract algebraic thinking, and it is a prerequisit for the Algebra lecture in the 3rd year.

## Course Contents

Point symmetry, planar symmetry, rotation symmetry, and other symmetries are often encountered in nature. Group theory is a method of treating symmetries in a mathematical way, as groups are transformations which preserve symmetries. The aim of this lecture is to become familiar with abstract algebra, by learning how to formally deduce properties from axioms. Using many concrete examples the students will get familiar with the concept of groups, and will undestand the fundamental concepts of ″structure″ and ″homomorphism″ of algebra.

## Others

※Please refer to the ″Syllabus & Class Schedule Search System″ for details including course schedule, evaluations, textbooks and others.
〈URL〉
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CA015

| Course Title | Exercises in Intoroduction to Theory of Groups | | |
|---|---|---|---|
| Instructor | Geisser, Thomas/Enokizono Makoto | | |
| Semester | Fall Semester | Credit | 1 Credit |
| Course Number | MAT2100 | Language | Japanese |

## Course Objectives

This is the first lecture in abstract algebra. Using the symmetric group as an example, group theory is introduced on a beginner level. The goal of this lecture is to become familiar with abstract algebraic thinking, and it is a prerequisit for the Algebra lecture in the 3rd year.

## Course Contents

Point symmetry, planar symmetry, rotation symmetry, and other symmetries are often encountered in nature. Group theory is a method of treating symmetries in a mathematical way, as groups are transformations which preserve symmetries. The aim of this lecture is to become familiar with abstract algebra, by learning how to formally deduce properties from axioms. Using many concrete examples the students will get familiar with the concept of groups, and will undestand the fundamental concepts of ″structure″ and ″homomorphism″ of algebra.

## Others

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<URL>
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CA016

| Course Title | Differential and Integral Calculus 2 | | |
|---|---|---|---|
| Instructor | Sato Nobuya | | |
| Semester | Spring Semester | Credit | 2 Credits |
| Course Number | MAT2300 | Language | Japanese |

## Course Objectives

Students will deepen their understanding of differentiation of multivariable functions by applying it to various examples.
The objective is to attain mastery of the differentiation of multivariable functions. In particular, to acquire computational and applicational skills.

## Course Contents

This class builds upon the concepts learned in “Introduction to Differential and Integral Calculus” and “Differential and Integral Calculus 1” and teaches the concept of multivariable differentiation. Students learn how the various concepts that appear in the differentiation of single variable functions extend to cases with multiple variables. As application, students learn to solve extreme value problems. They also learn about the implicit function theorem and the inverse mapping theorem, which are important for applied calculus.

## Others

※Please refer to the ″Syllabus & Class Schedule Search System″ for details including course schedule, evaluations, textbooks and others.
〈URL〉
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CA017

| Course Title | Exercises in Differential and Integral Calculus 2 | | |
|---|---|---|---|
| Instructor | Sato Nobuya/Enokizono Makoto | | |
| Semester | Spring Semester | Credit | 1 Credit |
| Course Number | MAT2300 | Language | Japanese |

## Course Objectives

Students will deepen their understanding of differentiation of multivariable functions by applying it to various examples.
The objective is to attain mastery of the differentiation of multivariable functions. In particular, to acquire computational and applicational skills.

## Course Contents

This class builds upon the concepts learned in “Introduction to Differential and Integral Calculus” and “Differential and Integral Calculus 1” and teaches the concept of multivariable differentiation. Students learn how the various concepts that appear in the differentiation of single variable functions extend to cases with multiple variables. As application, students learn to solve extreme value problems. They also learn about the implicit function theorem and the inverse mapping theorem, which are important for applied calculus.

## Others

※Please refer to the ″Syllabus & Class Schedule Search System″ for details including course schedule, evaluations, textbooks and others.
〈URL〉
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CA018

| Course Title | Differential and Integral Calculus 3 | | |
|---|---|---|---|
| Instructor | Noumi Masatoshi | | |
| Semester | Fall Semester | Credit | 2 Credits |
| Course Number | MAT2300 | Language | Japanese |

## Course Objectives

Learn about differentiation and integration methods for multivariable functions. The fall semester focuses on integration methods.

## Course Contents

After reviewing the integration method of single variable functions, students learn the integration method of double and triple variable functions. Learn about the definition of integrals and the fundamental properties of integrals such as linearity and inequality. The basic theorems are studied because the actual integration calculations can be reduced to calculations for integrating single variable functions. Furthermore, since integration can be performed by skillfully transforming the integral variables, students learn the general formula for transforming variables for this. In addition, students learn about line integrals that are integrated along curves and surface integrals that are integrated over surfaces. Students also learn about integral theorems (Green's theorem, Gauss's theorem, Stokes' theorem) which apply for these integrals.

## Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.
<URL>
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CA019

| Course Title | Exercises in Differential and Integral Calculus 3 | | |
|---|---|---|---|
| Instructor | Noumi Masatoshi/Koyama Tamio | | |
| Semester | Fall Semester | Credit | 1 Credit |
| Course Number | MAT2300 | Language | Japanese |

## Course Objectives

Learn about differentiation and integration methods for multivariable functions. The fall semester focuses on integration methods.

## Course Contents

After reviewing the integration method of single variable functions, students learn the integration method of double and triple variable functions. Learn about the definition of integrals and the fundamental properties of integrals such as linearity and inequality. The basic theorems are studied because the actual integration calculations can be reduced to calculations for integrating single variable functions. Furthermore, since integration can be performed by skillfully transforming the integral variables, students learn the general formula for transforming variables for this. In addition, students learn about line integrals that are integrated along curves and surface integrals that are integrated over surfaces. Students also learn about integral theorems (Green's theorem, Gauss's theorem, Stokes' theorem) which apply for these integrals.

## Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.
<URL>
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CA020

| Course Title | Introduction to Linear Algebra | | |
|---|---|---|---|
| Instructor | Noro Masayuki | | |
| Semester | Spring Semester | Credit | 2 Credits |
| Course Number | MAT1000 | Language | Japanese |

## Course Objectives

As an itroduction to linear algebra, students will learn the basics of matrices, linear transformations and their diagonalizations.
The case of 2x2 matrices is mainly treated.

## Course Contents

In addition to the basic properties of matrices and matrix operations,
we also discuss determinants, inverses of 2x2 matrices and systems of linear equations.
We discuss the relation of linear transformations and matrices.
Then we introduce eigenvalues and eigenvectors of matrices and
we discuss matrix diagonalization and its applications.

## Others

※Please refer to the ″Syllabus & Class Schedule Search System″ for details including course schedule, evaluations, textbooks and others.
〈URL〉
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CA021

| Course Title | Exercises in Introduction to Linear Algebra | | |
|---|---|---|---|
| Instructor | Noro Masayuki/Enokizono Makoto | | |
| Semester | Spring Semester | Credit | 1 Credit |
| Course Number | MAT1000 | Language | Japanese |

## Course Objectives

As an itroduction to linear algebra, students will learn the basics of matrices, linear transformations and their diagonalizations.
The case of 2x2 matrices is mainly treated.

## Course Contents

In addition to the basic properties of matrices and matrix operations,
we also discuss determinants, inverses of 2x2 matrices and systems of linear equations.
We discuss the relation of linear transformations and matrices.
Then we introduce eigenvalues and eigenvectors of matrices and
we discuss matrix diagonalization and its applications.

## Others

※Please refer to the ″Syllabus & Class Schedule Search System″ for details including course schedule, evaluations, textbooks and others.
〈URL〉
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CA022

| Course Title | Sets and Mappings | | |
|---|---|---|---|
| Instructor | Aoki Noboru | | |
| Semester | Spring Semester | Credit | 2 Credits |
| Course Number | MAT1000 | Language | Japanese |

## Course Objectives

In this course we learn the basic ways of thinking and use of symbols needed to study mathematics.

## Course Contents

We learn the fundamentals of sets and mappings.

## Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.
<URL>
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CA023

| Course Title | General Topology A | | |
|---|---|---|---|
| Instructor | Komori Yasushi | | |
| Semester | Fall Semester | Credit | 2 Credits |
| Course Number | MAT2000 | Language | Japanese |

## Course Objectives

Learn the fundamentals of topological space and the topology of Euclidean space

## Course Contents

Sets are simply collections of elements, and there is no connection between these elements. Topological spaces make it possible to consider the convergence and mapping continuity of elements in a set by adding information such as their proximity and the connection between them. In first-year differentiation and integration lectures, students learned about continuous mapping according to the ( $\varepsilon$ , $\delta$ )-definition of limit, but here the idea of topology is used. In “General Topology A,” students learn about basic topology concepts.

## Others

※Please refer to the ″Syllabus & Class Schedule Search System″ for details including course schedule, evaluations, textbooks and others.
<URL>
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CA092

| Course Title | Electronic Computer 1 | | |
|---|---|---|---|
| Instructor | Oi Shu | | |
| Semester | Spring Semester | Credit | 2 Credits |
| Course Number | MAT2430 | Language | Japanese |

## Course Objectives

The first half teaches how to use the LaTeX document processing system. In the second half, students learn the basic usage of the Maxima formula processing system and apply it to numerical calculation.

## Course Contents

This lecture is conducted together with “Electronic Computer 2.” “Electronic Computer 1” is composed of lectures, while actual practice using computers is performed in “Electronic Computer 2.”

The first half deals with the document processing system LaTeX, which is particularly good at describing and expressing formulas, and is a de facto standard in the creation of mathematics documents. The objective is to learn its basic usage and to be able to actually create and present a mathematics report in LaTeX.

In the second half, students learn how to use the Maxima formula processing system to solve computational and mathematical problems with a computer. After that, students learn some basic methods for numerical calculation by using Maxima.

## Others

※Please refer to the ″Syllabus & Class Schedule Search System″ for details including course schedule, evaluations, textbooks and others.

<URL>

https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CA163

| Course Title | Electronic Computer 2 | | |
|---|---|---|---|
| Instructor | Oi Shu/Koyama Tamio | | |
| Semester | Spring Semester | Credit | 2 Credits |
| Course Number | MAT2430 | Language | Japanese |

## Course Objectives

The first half teaches how to use the LaTeX document processing system. In the second half, students learn the basic usage of the Maxima formula processing system and apply it to numerical calculation.

## Course Contents

This lecture is conducted together with “Electronic Computer 1.” “Electronic Computer 1” is composed of lectures, while actual practice using computers is performed in “Electronic Computer 2.”

The first half deals with the document processing system LaTeX, which is particularly good at describing and expressing formulas, and is a de facto standard in the creation of mathematics documents. The objective is to learn its basic usage and to be able to actually create and present a mathematics report in LaTeX.

In the second half, students learn how to use the Maxima formula processing system to solve computational and mathematical problems with a computer. After that, students learn some basic methods for numerical calculation.

## Others

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<URL>

https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CA164

| Course Title | Electronic Computer 3 | | |
|---|---|---|---|
| Instructor | Oi Shu | | |
| Semester | Fall Semester | Credit | 2 Credits |
| Course Number | MAT2430 | Language | Japanese |

## Course Objectives

In this lecture, students learn the introduction of the C Programming Language and study basic concept of programming.

## Course Contents

This lecture is conducted together with “Electronic Computer 4.” “Electronic Computer 3” is composed of lectures, while actual practice using computers is performed in “Electronic Computer 4.”

C is a very popular and classic programming language. By studying C, one can learn usage of computers itself. The C language is often used to high performance computing such as numerical calculations.
In this lecture, students learn the basic usage of C and the generic concept of programming.

## Others

※Please refer to the ″Syllabus & Class Schedule Search System″ for details including course schedule, evaluations, textbooks and others.
〈URL〉
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CA165

| Course Title | Electronic Computer 4 | | |
|---|---|---|---|
| Instructor | Oi Shu/Koyama Tamio | | |
| Semester | Fall Semester | Credit | 2 Credits |
| Course Number | MAT2430 | Language | Japanese |

## Course Objectives

In this lecture, students learn the introduction of the C Programming Language and study basic concept of programming.

## Course Contents

This lecture is conducted together with “Electronic Computer 3.” “Electronic Computer 3” is composed of lectures, while actual practice using computers is performed in “Electronic Computer 4.”

C is a very popular and classic programming language. By studying C, one can learn usage of computers itself. The C language is often used to high performance computing such as numerical calculations.

In this lecture, students learn the basic usage of C and the generic concept of programming.

## Others

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〈URL〉

https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CA166

| Course Title | Information Science 1 | | |
|---|---|---|---|
| Instructor | Suzuki Yuta/Ishihara Yuki | | |
| Semester | Spring Semester | Credit | 2 Credits |
| Course Number | MAT2430 | Language | Japanese |

## Course Objectives

In this course, we learn the foundational theory of database system and the basic usage of SQL (Structured Query Language), the language used for managing database system.

## Course Contents

Information systems are indispensable in our lives today. In information systems, we need to store various data electronically and use them systematically. This essential role is played by database systems. In this course, we learn the foundational theory of database systems mainly focused on relational database systems. Also, we make and manage small databases as examples of foundational theory and learn the usage of SQL, the language for managing database systems.

## Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.
<URL>
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CA168

| Course Title | Information Science 2 | | |
|---|---|---|---|
| Instructor | Suzuki Yuta/Ishihara Yuki | | |
| Semester | Fall Semester | Credit | 2 Credits |
| Course Number | MAT2430 | Language | Japanese |

## Course Objectives

In this course, we learn "object-oriented", the paradigm for developing information systems efficiently, mainly focused on object-oriented programming.

## Course Contents

In the course "Introduction to Computer Science 2", we have learned programming based on the procedural or structured programming paradigm. In these paradigms, we write down the flow of the process. On the other hand, in object-oriented programming, we analyze the required functionality based on "objects" and write down their communications and relations. This paradigm gives us a way for efficient development and flexible maintenance. Also, this paradigm is used now in general information system development itself. In this course, we learn object-oriented programming using the python language, which we learned in "Introduction to Computer Science 2", and focusing on object-oriented programming.

## Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.
<URL>
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CA169

| Course Title | Information Science 3 | | |
|---|---|---|---|
| Instructor | Suzuki Yuta/Ishihara Yuki | | |
| Semester | Spring Semester | Credit | 2 Credits |
| Course Number | MAT2430 | Language | Japanese |

## Course Objectives

In this course, we learn the basics of TCP/IP, the standard protocol suite for computer networks mainly focused on the lower layers: the physical, network interface (data link) and internet (network) layers.

## Course Contents

We are surrounded by computer networks today so much that it is hard to imagine a life without computer networks. However, even though we use network everyday, we are mostly unconscious of the background process of network. TCP/IP is a standard protocol suite for such network infrastructures. In this course, we learn the lower layers of TCP/IP, the physical, network interface (data link), internet (network) layers by analyzing and sending actual packets.

## Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.
<URL>
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CA170

| Course Title | Information Science 4 | | |
|---|---|---|---|
| Instructor | Suzuki Yuta/Ishihara Yuki | | |
| Semester | Fall Semester | Credit | 2 Credits |
| Course Number | MAT2430 | Language | Japanese |

## Course Objectives

In this course, we learn the basics of TCP/IP, the standard protocol suite for computer networks mainly focused on the upper layers: the transport and application layers.

## Course Contents

We are surrounded by computer networks today so much that it is hard to imagine a life without computer networks. However, even though we use network everyday, we are mostly unconscious of the background process of network. TCP/IP is a standard protocol suite for such network infrastructures. In this course, we continue our study in the course ″Information Science 3″ to learn the upper layers of TCP/IP, the transport and application layers by analyzing and sending actual packets and sending various protocol messages.

## Others

※Please refer to the ″Syllabus & Class Schedule Search System″ for details including course schedule, evaluations, textbooks and others.
〈URL〉
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CA171

| Course Title | Information Science 6 | | |
|---|---|---|---|
| Instructor | Komori Yasushi/Yasuda Masaya/Mizusawa Yasushi | | |
| Semester | Spring Others | Credit | 2 Credits |
| Course Number | MAT2430 | Language | Japanese |

## Course Objectives

Students learn about the mathematical theories computers use to process various types of data such as images, sound and video through practical exercises using computers.

## Course Contents

Sounds, images and videos are frequently used on the network. In addition, videos are easily viewed with mobile phones and dedicated broadcasts are also arranged. The important point here is how to represent high-quality audio and images using a small amount of data. This is based on Fourier transforms, which is one of the splendid applications of mathematics to be experienced.
On the final day, students investigate how to mathematically create 3D images and confirm this through practical exercises.

## Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.
<URL>
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CA173

| Course Title | Special Topics in Electronic Computer 2 | | |
|---|---|---|---|
| Instructor | Izu Tetsuya | | |
| Semester | Spring Semester | Credit | 2 Credits |
| Course Number | MAT3430 | Language | Japanese |

## Course Objectives

Mastering integer factorization algorithms and elementary number theory via lecture and programming

## Course Contents

In this lecture, we study various factorization algorithms in elementary number theory on not only procedure, complexity and theory but also effectiveness by using Python programming language. Also an application of factorization to cryptograpy is introduced. In addition, we also study factorization algorithms by using next-generation computer architecture such as an annealing computer and a quantum computer.

## Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.
<URL>
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CA177

| Course Title | Special Topics in Information Science 1 | | |
|---|---|---|---|
| Instructor | Shinohara Naoyuki | | |
| Semester | Spring Semester | Credit | 2 Credits |
| Course Number | MAT3430 | Language | Japanese |

## Course Objectives

Cultivate a better understanding of RSA cryptography, which is commonly used in TLS, to learn about the safety value of public key encryption.

## Course Contents

TLS is a protocol that encrypts and transmits information over the Internet, which uses public key encryption and secret key cryptography. In particular, RSA cryptography is widely used for public key encryption with security based upon the difficulty of calculating prime factorization, and research institutes in each country are conducting research on its safety value.
This lecture explains various algorithms related to implementing and deciphering RSA cryptography. Students learn the efficiency of them by either implementing them on the free software Risa/Asir and performing numerical experiments or hand calculation based on those algorithms.

## Others

※Please refer to the ″Syllabus & Class Schedule Search System″ for details including course schedule, evaluations, textbooks and others.
<URL>
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CA179

| Course Title | Special Topics in Information Science 3 | | |
|---|---|---|---|
| Instructor | Yasuda Masaya | | |
| Semester | Fall Semester | Credit | 2 Credits |
| Course Number | MAT3430 | Language | Japanese |

## Course Objectives

We introduce a basic part of algebraic geometry. Specifically, we aim to have a geometric image of curves in the projective plane and to understand the correspondence between commutative algebra and algebraic varieties. Furthermore, while learning a basic theory on algebraic curves, we will finally aim to understand the group structure of elliptic curves. In addition, we introduce several methods for point-counting on an elliptic curve over a finite field.

## Course Contents

We introduce a basic part of algebraic geometry and several methods for point-counting on an elliptic curve over a finite field with the following four chapters:
Chapter 1: Projective plane and plane curves (3 lectures)
Chapter 2: Commutative rings and algebraic varieties (5 lectures)
Chapter 3: Algebraic curve Theory and elliptic curves (4 lectures)
Chapter 4: Point-counting on an elliptic curve over finite fields (2 lectures)

## Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.
<URL>
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CA181

| Course Title | Special Topics in Algebra 1 | | |
|---|---|---|---|
| Instructor | Kumakawa Naoki | | |
| Semester | Spring Semester | Credit | 2 Credits |
| Course Number | MAT3130 | Language | Japanese |

## Course Objectives

The main purpose of this lecture is to study arithmetic properties of integers from the viewpoint of complex analysis.

## Course Contents

In most cases, problems in elementary number theory are easy to understand their statements.
However, their solutions often require deep knowledge of other areas of mathematics.
For example, the theory of special functions such as the Riemann zeta function and the gamma function is connected to the theory of numbers. In this lecture, we will study some fundamental properties of these functions and give the proofs of some theorems such as the quadratic reciprocity law and Dirichlet's theorem on arithmetic progressions.

## Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.
<URL>
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CA191

| Course Title | Special Topics in Algebra 6 | | |
|---|---|---|---|
| Instructor | Shibata Kazuki | | |
| Semester | Fall Semester | Credit | 2 Credits |
| Course Number | MAT3130 | Language | Japanese |

## Course Objectives

The purpose of this course is for students to learn the basics of commutative algebra. After students learn the definition and basic properties of commutative rings, the course explains specific examples of graded rings to facilitate students' deeper understanding of commutative algebra.

## Course Contents

Commutative algebra has a deep relationship with other fields such as manifolds and combinatorics. The field is actively researched and has produced many recent findings. In its first half, this course aims to lecture on the definition and properties of commutative rings. In its latter half, the course aims to cover combinatorial commutative rings, and their properties are described through concrete examples.

## Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.
<URL>
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CA196

| Course Title | Special Topics in Geometry 2 | | |
|---|---|---|---|
| Instructor | Sugiyama Kenichi | | |
| Semester | Fall Semester | Credit | 2 Credits |
| Course Number | MAT3230 | Language | Japanese |

## Course Objectives

In this course, we will discuss a theory of minimal surfaces, harmonic maps and surfaces of constant mean curvature in Euclid space of three dimension, after a brief review of fundamental invariants of a surfece.

## Course Contents

Minimal surfaces and surfaces of a constant mean curvature (which will be denoted by CMC for brevity) are related to holomorphic function via the Weierstrass representation theorem. In this lecture, after a brief review of fundamental theorems of minimal surfaces and CMC, we will explain the Hopf 's theorem which says that an immersed CMC in *[¥mathbb R]^3* is a round sphere and a notion of conjugacy of CMC.

## Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.
<URL>
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CA198

| Course Title | Special Topics in Analysis 1 | | |
|---|---|---|---|
| Instructor | Yamada Yuji | | |
| Semester | Spring Semester | Credit | 2 Credits |
| Course Number | MAT3330 | Language | Japanese |

## Course Objectives

Using the knowledge of the undergraduate course of analysis, we study more advanced mathematics courses.

## Course Contents

There are rich theorems and conjectures in number theory, especially in prime numbers.
Though it is known since the era of Euclid that there is an infinite number of primes, the theorem of arithmetic progressions of Dirichlet was proved recently in the 19th century. The proof is done using the Dirichlet series and L−functions.

## Others

※Please refer to the ″Syllabus & Class Schedule Search System″ for details including course schedule, evaluations, textbooks and others.
<URL>
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CA203

| Course Title | Special Topics in Analysis 4 | | |
|---|---|---|---|
| Instructor | Yamada Yuji | | |
| Semester | Fall Semester | Credit | 2 Credits |
| Course Number | MAT3330 | Language | Japanese |

## Course Objectives

We study theta functions as typical examples of meromorphic functions and learn their quasi-periodicities and infinite product expressions. As an application of theta functions, we give some solutions to the Yang-Bater equation. We also study the commutative sets of transfer matrices in solvable statistical mechanics.

## Course Contents

We study theta functions as typical examples of meromorphic functions and learn their quasi-periodicities and infinite product expressions. As an application of theta functions, we give some solutions to the Yang-Bater equation. We also study the commutative sets of transfer matrices in solvable statistical mechanics.

## Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.
<URL>
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CA206

| Course Title | Special Topics in Analysis 5 | | |
|---|---|---|---|
| Instructor | Kakei Saburou | | |
| Semester | Spring Semester | Credit | 2 Credits |
| Course Number | MAT3330 | Language | Japanese |

Course Objectives

Course Contents

Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.
<URL>
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CA207

| Course Title | Special Topics in Statistics 1 | | |
|---|---|---|---|
| Instructor | Mano Shuhei | | |
| Semester | Spring Semester | Credit | 2 Credits |
| Course Number | MAT3530 | Language | Japanese |

## Course Objectives

Studying discrete and stochastic mathematics in quantum computation.

## Course Contents

Fundermentals of quantum computation are explained, and algorithms with applied mathematical interests are introduced.
Knowledges of physics, nor information science, nor statistics, are not assumed.

## Others

※Please refer to the ″Syllabus & Class Schedule Search System″ for details including course schedule, evaluations, textbooks and others.
〈URL〉
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CA219

| Course Title | Introdubtion to Theory of numbers | | |
|---|---|---|---|
| Instructor | Enokizono Makoto | | |
| Semester | Spring Semester | Credit | 2 Credits |
| Course Number | MAT1130 | Language | Japanese |

## Course Objectives

Learn the fundamentals of the Elementary Theory of numbers and become able to use it.

## Course Contents

Since Euclid's "Elementa," number theory has been treated as a discipline with a body of theory. Within it, the contents up to the era of Euler is called the Elementary Theory of numbers. This lecture begins with a careful review of the knowledge of integers that students learned up until the end of high school, and accumulates knowledge of the Elementary Theory of numbers. As further applications, several very interesting subjects are dealt with. This lecture provides as many examples as possible.

## Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.
<URL>
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CA224

| Course Title | Intoroduction to Differential Equations | | |
|---|---|---|---|
| Instructor | Koyama Tamio | | |
| Semester | Spring Semester | Credit | 2 Credits |
| Course Number | MAT2330 | Language | Japanese |

## Course Objectives

The objective of this class is for students to learn the basic solutions of differential equations and to understand fundamental mathematical theories (such as the existence of solutions and uniqueness). Learn the basic ways of thinking to apply them to the natural sciences and social sciences.

## Course Contents

In the natural sciences and social sciences, the most commonly used method of mathematically modeling any kind of phenomena is differential equations. This class starts with methods of solving specific differential equations and explains the mathematical fundamentals of differential equations, including theoretical topics such as the existence of solutions and uniqueness. A typical model will be featured in order to explain the concept of making a mathematical model with differential equations.

## Others

※Please refer to the ″Syllabus & Class Schedule Search System″ for details including course schedule, evaluations, textbooks and others.
〈URL〉
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CA225

| Course Title | Seminar on Mathematics 1 | | |
|---|---|---|---|
| Instructor | Yasuda Masaya | | |
| Semester | Fall Semester | Credit | 2 Credits |
| Course Number | MAT3030 | Language | Japanese |

## Course Objectives

The goal of this seminar is to deepen knowledge as well as to increase the ability to scientifially communicate by reading mathematial books and discussing the material in the seminar.

## Course Contents

In this seminar a text is read in a group of about 5 students. The knowledge aquired in the first year will be deepened and expanded. Each class one of the students will prepare and explain in detail a part of the text while the other students will participate with questions and comments about the material.

## Others

※Please refer to the ″Syllabus & Class Schedule Search System″ for details including course schedule, evaluations, textbooks and others.
〈URL〉
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CA226

| Course Title | Seminar on Mathematics 2 | | |
|---|---|---|---|
| Instructor | Enokizono Makotoi | | |
| Semester | Fall Semester | Credit | 2 Credits |
| Course Number | MAT3030 | Language | Japanese |

## Course Objectives

This course aims for students to acquire the ability to read, understand, and explain contents of technical books, making full use of materials (e.g., calculus, linear algebra) students have previously learned.

## Course Contents

Approximately five students read and understand the text and, present the contents, thereby deepening knowledge they acquired during first-year courses. Each week, one or two students present in their own language and in an understandable manner the subject material they have been assigned. The other students are expected to participate actively by posing questions and making comments.

## Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.
<URL>
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CA227

| Course Title | Probability Theory and Statistics 1 | | |
|---|---|---|---|
| Instructor | Ueno Takahiko | | |
| Semester | Spring Semester | Credit | 2 Credits |
| Course Number | MAT2530 | Language | Japanese |

## Course Objectives

Learn about various statistics in your daily life. Most of the information in the world is unreliable and incomplete. If we collect and examine factors that fluctuate by chance, and are able to detect factors that have regularity, it is possible to make an estimate of the overall situation. The methodology for this is Statistics, which is widely applied throughout society. Real examples include election exit surveys, audience ratings surveys, investment decisions, new drug efficacy evaluations and various questionnaire surveys. The objective is for students to learn how those are conducted and used.

## Course Contents

In this lecture, the types of data and their summarization methods as well as probability distributions, the concept of statistical hypotheses and multivariate analysis is introduced.
At the beginning of the lecture, students are divided into several parallel groups. They are asked to investigate examples that are applied in reality and present them to the groups. Each time, there will be time provided for discussion.

## Others

※Please refer to the ″Syllabus & Class Schedule Search System″ for details including course schedule, evaluations, textbooks and others.
<URL>
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CA228

| Course Title | Probability Theory and Statistics 2 | | |
|---|---|---|---|
| Instructor | Ueno Takahiko | | |
| Semester | Fall Semester | Credit | 2 Credits |
| Course Number | MAT2530 | Language | Japanese |

## Course Objectives

Learn about the concept of probability. Further objectives include learning about stochastic variables, probability distributions, moment-gathering functions and central limit theorem.

## Course Contents

Probability, stochastic variables and probability distributions are mainly introduced. The probabilities defined in Laplace's method and their properties are introduced. In addition, Bayes theorem is introduced, which is the basis of Bayesian statistics which has become popular in recent years. Stochastic variables, probability distributions, moment-gathering functions and the central limit theorem will also be introduced. The second half of the lecture may use multivariate differentials and integrals.

## Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.
<URL>
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CA229

| Course Title | Advanced Linear Algebra | | |
|---|---|---|---|
| Instructor | Abe Takuro | | |
| Semester | Fall Semester | Credit | 2 Credits |
| Course Number | MAT2130 | Language | Japanese |

## Course Objectives

We discuss some advanced topics in linear algebra. In particular, we get familiar with operations on vector spaces. Through this, we aim to be able to use linear algebra without any difficulty when we come across their application in various mathematical context.

## Course Contents

In the first half of this course, we discuss the Jordan normal form in more detail than ″Linear Algebra 2″ and study endomorphisms of vector spaces. In ″Linear Algebra 1″, we learned vectors in real coordinate spaces and matrices, and in ″Linear Algebra 2″, we introduced abstract vector spaces and linear maps. In the latter half of this course, we take one step further and study operations on vector spaces and relations between vector spaces. Specifically, we introduce direct sum, dual space, quotient space, tensor product and exterior power of vector spaces. Topics might change depending on the time constraint.

## Others

※Please refer to the ″Syllabus & Class Schedule Search System″ for details including course schedule, evaluations, textbooks and others.
<URL>
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CA232

| Course Title | Introduction to Probability Theory 2 | | |
|---|---|---|---|
| Instructor | Suda Hayate | | |
| Semester | Fall Semester | Credit | 2 Credits |
| Course Number | MAT3530 | Language | Japanese |

## Course Objectives

This course will provide the fundamentals of finite Markov chains. Through this theory, participants will become familiar with the basic concepts of probability theory.

## Course Contents

A Markov chain is a stochastic process whose state space is discrete and has ″Markov property″, which is an important generalization of ″independence″. In this lecture, we focus on Markov chains, especially when the state space is finite, and learn the basics of Markov chains. The lecture will begin with a review of basic terminology, followed by definitions and properties of Markov chains, and then explain mixing time, one of the important topics in Markov chains. The prerequisites for attending this lecture are basic knowledge of analysis and linear algebra, and no prior knowledge of measure theory and measure-theoretic probability theory is required.

## Others

※Please refer to the ″Syllabus & Class Schedule Search System″ for details including course schedule, evaluations, textbooks and others.
<URL>
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CA234

| Course Title | Introduction to Mathematical Statistics 1 | | |
|---|---|---|---|
| Instructor | Konno Yoshihiko | | |
| Semester | Fall Semester | Credit | 2 Credits |
| Course Number | MAT3530 | Language | Japanese |

## Course Objectives

It is important in the modern society how to draw information from data generated by phenomenon with randomness. In this lecture we learn mathematical foundation on statistical inference. This method consists of ingredients such as probability models which generate random data and inference of the models.

## Course Contents

We start by the definition of probability space, random variables, their expectations, and mode of convergence of variables. Next we discuss popular statistical modelling and sampling distributions theory(mainly normal distribution theory). Based on these knowledge, we learn statistical inference such as point estimation, interval estimation, and hypothesis testing. Finally we learn how to evaluate the accuracy of these methods.

## Others

※Please refer to the ″Syllabus & Class Schedule Search System″ for details including course schedule, evaluations, textbooks and others.
〈URL〉
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CA236

| Course Title | English for Mathematics 1 | | |
|---|---|---|---|
| Instructor | Willox,ralph | | |
| Semester | Spring Semester | Credit | 2 Credits |
| Course Number | MAT3033 | Language | Others |

## Course Objectives

The objective of this course is to give an introduction to mathematical writing in English and to help College of Science students and especially mathematics students acquire sufficient proficiency in written English.

## Course Contents

Students study English terminology and idiomatic expressions used in mathematical science papers, by reading textbook excerpts and essays.
The objective is for students to be able to understand mathematical theses in English and to be able to write brief mathematical essays by themselves.

## Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.
<URL>
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CA310

CA311

| Course Title | English for Mathematics 2 | | |
|---|---|---|---|
| Instructor | Willox,ralph | | |
| Semester | Fall Semester | Credit | 2 Credits |
| Course Number | MAT3033 | Language | Others |

## Course Objectives

The objective of this course is for College of Science students to acquire sufficient oral skills in English in relation to mathematical science.

## Course Contents

Students study English idioms used in oral presentations related to mathematics, using videos of seminars and lectures. The objective is for students to become accustomed to various presentation styles and to improve their listening abilities and presentation skills in English. Students will be asked to create a brief presentation in the second half of the semester.

## Others

※Please refer to the ″Syllabus & Class Schedule Search System″ for details including course schedule, evaluations, textbooks and others.
〈URL〉
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CA311

CA321

| Course Title | Physics for Mathematics Students | | |
|---|---|---|---|
| Instructor | Murata Mikio | | |
| Semester | Spring Semester | Credit | 2 Credits |
| Course Number | MAT2630 | Language | Japanese |

## Course Objectives

Learn the ability to consider the basic laws of classical mechanics and their applications using mathematical methods such as differentiation and integration.

Through curriculum planning policies that “Cultivate ‘Educated people with scientific specializations,’” students will have general knowledge about fields of science that are adjacent to their specialty, and will be able to see things from a broad perspective. The objective of this course is to cultivate expertise and education in science during its formative years.

This course is part of the “elective 3” subject group.

## Course Contents

Consider the basic laws of classical mechanics and their applications using mathematical methods such as calculus and analysis. Lectures are on the fundamentals of physics for a logical and systematic understanding of nature. Keywords include the “Laws of Motion,” “Conservation of Momentum,” “Two-body Problem,” “Rigid Body Motion,” “Lagrange equation” and “Canonical Form.” The material is considered to be understandable even for those who have not studied physics in high school.

## Others

※Please refer to the ″Syllabus & Class Schedule Search System″ for details including course schedule, evaluations, textbooks and others.

<URL>

https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CA321

| Course Title | IT Industry | | |
|---|---|---|---|
| Instructor | Hamaya Satoshi | | |
| Semester | Fall Semester | Credit | 2 Credits |
| Course Number | MAT2440 | Language | Japanese |

## Course Objectives

Objective is to understand the recent situation of the information industry while touching on historical trends and influences of the ICT.　Target students are subscribers of a Teacher Training Course or those who are interested in employment in the information industry (SE, etc.) or starting a business. Students will be able to understand the relationship between the information industry and society, the economy and industry.　Changes of value creation process in industries and relationship between AI and jobs and skills will be also discussed.

## Course Contents

The information industry is widely understood as the industry related to the hardware, software, services and content to collect and process information.　Lectures are on the structure of this industry and its recent situation. Students will learn about new trends such as IoT and AI as well as relationships of information industry and other industries. Programming and the study of programming languages is outside the scope of this class. Depending on the number of participants, lectures by guest lecturers and workshop-style classes may be held. The syllabus may also be partially changed.

## Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.
<URL>
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CA322

| Course Title | Algebra 1 | | |
|---|---|---|---|
| Instructor | Geisser, Thomas | | |
| Semester | Spring Semester | Credit | 2 Credits |
| Course Number | MAT3110 | Language | Japanese |

## Course Objectives

In this course we study ring and module theory. Rings can be viewed of as a generalization of the integers and among others we study factorization into primes. One of the main theorems is the structure of finitely generated abelian groups and the Jordan normal form of matrices.

## Course Contents

In the first half of this class, the basic concepts of ring theory are explained and module theory are explained together with examples. An important class of rings are principal ideal domains, and we explain
the Structure Theorem for finitely generated abelian groups and the Jordan normal form of matrices. Students are expected to obtain a textbook as soon as possible and prepare for lessons, as the lectures basically follow the textbook. Knowledge of linear algebra and group theory is assumed; review as necessary as the lecture advances.

## Others

※Please refer to the ″Syllabus & Class Schedule Search System″ for details including course schedule, evaluations, textbooks and others.
〈URL〉
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CA401

| Course Title | Exercises in Algebra 1 | | |
|---|---|---|---|
| Instructor | Geisser, Thomas | | |
| Semester | Spring Semester | Credit | 1 Credit |
| Course Number | MAT3110 | Language | Japanese |

## Course Objectives

In this course we study ring and module theory. Rings can be viewed of as a generalization of the integers and among others we study factorization into primes. One of the main theorems is the structure of finitely generated abelian groups and the Jordan normal form of matrices.

## Course Contents

In the first half of this class, the basic concepts of ring theory are explained and module theory are explained together with examples. An important class of rings are principal ideal domains, and we explain
the Structure Theorem for finitely generated abelian groups and the Jordan normal form of matrices. Students are expected to obtain a textbook as soon as possible and prepare for lessons, as the lectures basically follow the textbook. Knowledge of linear algebra and group theory is assumed; review as necessary as the lecture advances.

## Others

※Please refer to the ″Syllabus & Class Schedule Search System″ for details including course schedule, evaluations, textbooks and others.
〈URL〉
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CA402

| Course Title | Algebra 2 | | |
|---|---|---|---|
| Instructor | Abe Takuro | | |
| Semester | Fall Semester | Credit | 2 Credits |
| Course Number | MAT3110 | Language | Japanese |

## Course Objectives

In this course we discuss the basics of field theory and Galois theory. If time permits we give application to coding theory and solutions of polynomial equations.

## Course Contents

The subject of this lecture is the theory of field extensions culminating in the main theorem of Galois theory, which translates problems in field theory into problems of group theory. We will give many examples and if time permits we will study finite fields and give applications to solutions of polynomial equations

## Others

※Please refer to the ″Syllabus & Class Schedule Search System″ for details including course schedule, evaluations, textbooks and others.
〈URL〉
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CA403

| Course Title | Exercises in Algebra 2 | | |
|---|---|---|---|
| Instructor | Abe Takuro | | |
| Semester | Fall Semester | Credit | 1 Credit |
| Course Number | MAT3110 | Language | Japanese |

## Course Objectives

In this course we discuss the basics of field theory and Galois theory. If time permits we give application to coding theory and solutions of polynomial equations.

## Course Contents

The subject of this lecture is the theory of field extensions culminating in the main theorem of Galois theory, which translates problems in field theory into problems of group theory. We will give many examples and if time permits we will study finite fields and give applications to solutions of polynomial equations
Students are expected to obtain a textbook as soon as possible and prepare for lectures by reviewing group theory and ring theory if necessary. The lectures mostly follow the textbook.

## Others

※Please refer to the ″Syllabus & Class Schedule Search System″ for details including course schedule, evaluations, textbooks and others.
〈URL〉
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CA404

| Course Title | Geometry 1 | | |
|---|---|---|---|
| Instructor | Nishino Takeo | | |
| Semester | Spring Semester | Credit | 2 Credits |
| Course Number | MAT3210 | Language | Japanese |

## Course Objectives

Students will learn how to handle curves and surfaces accurately. In addition, we will learn about the curvature, which is an important invariant of these objects.

## Course Contents

Curves and surfaces are common concepts in our daily lives, and we will use our knowledge of calculus to investigate them in detail. In the first part of the course, we will discuss curves, and learn what it means to treat them mathematically and rigorously. In addition, we will introduce the curvature, a basic invariant, and explain its geometric meaning.
Next, we deal with smooth surfaces (regular surfaces) and define the quantities called the first and second fundamental forms. After introducing principal curvature by geometric considerations, and thereby defining Gaussian and mean curvatures, we will see that these can be expressed in terms of the first and second fundamental forms. Then the relation between curvature and local shape of a surface is discussed, and an introductory exposition of minimal surfaces is given as an important example of surfaces. Finally, we will prove Gauss's fundamental theorem, which states that Gaussian curvature is actually determined only by the first fundamental form.

## Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.
<URL>
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CA405

| Course Title | Exercises in Geometry 1 | | |
|---|---|---|---|
| Instructor | Nishino Takeo | | |
| Semester | Spring Semester | Credit | 1 Credit |
| Course Number | MAT3210 | Language | Japanese |

## Course Objectives

Students will learn how to handle curves and surfaces accurately through exercises. In addition, we will learn about the curvature, which is an important invariant of figures.

## Course Contents

In this course, students will be asked to solve exercises related to the contents of Geometry 1. After reviewing the necessary preliminary knowledge, students are asked to calculate the quantities that characterize curves and surfaces using various examples. Specifically, we will calculate the curvature and torsion of plane and space curves, the parameter representation and the first and second basic forms of surfaces, and the associated curvature. Through these calculations, students will learn how the shape of a figure is determined from its curvature.

## Others

※Please refer to the ″Syllabus & Class Schedule Search System″ for details including course schedule, evaluations, textbooks and others.
〈URL〉
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CA406

| Course Title | Geometry 2 | | |
|---|---|---|---|
| Instructor | Sugiyama Kenichi | | |
| Semester | Fall Semester | Credit | 2 Credits |
| Course Number | MAT3210 | Language | Japanese |

## Course Objectives

Study cellular decomposition and homology groups of topological spaces as a means of perceiving the overall image of figures such as surfaces. Learn the Gauss–Bonnet theorem, which combines curvature, which is a local quantity with the Euler characteristic, which is a global quantity.

## Course Contents

Geometry 1 used calculus to deal with the local theory of curves and surfaces, and studied curvature in detail. In Geometry 2, geodesic lines on surfaces are defined as a generalization of straight lines on a plane, and their properties are examined. Next we introduce the space form, which is characterized by the constant Gaussian curvature, and look at how Euclidean geometry is generalized. Then, after explaining the necessary facts about topological spaces, homology groups are defined and it is explained how they reflect a global aspect of shapes. After defining the Betti number and Euler's characteristic using homology groups, the Gauss–Bonnet theorem is proven, which gives a relation between the curvature, a local quantity, with the Euler characteristic, a quantity defined from a global information.

## Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.
<URL>
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CA407

| Course Title | Exercises in Geometry 2 | | |
|---|---|---|---|
| Instructor | Sugiyama Kenichi | | |
| Semester | Fall Semester | Credit | 1 Credit |
| Course Number | MAT3210 | Language | Japanese |

## Course Objectives

Study cellular decomposition and homology groups of topological spaces as a means of perceiving the overall image of figures such as surfaces. Learn the Gauss–Bonnet theorem, which combines curvature, which is a local quantity with the Euler characteristic, which is a global quantity.

## Course Contents

Geometry 1 used calculus to deal with the local theory of curves and surfaces, and studied curvature in detail. In Geometry 2, geodesic lines on surfaces are defined as a generalization of straight lines on a plane, and their properties are examined. Next we introduce the space form, which is characterized by the constant Gaussian curvature, and look at how Euclidean geometry is generalized. Then, after explaining the necessary facts about topological spaces, homology groups are defined and it is explained how they reflect a global aspect of shapes. After defining the Betti number and Euler's characteristic using homology groups, the Gauss–Bonnet theorem is proven, which gives a relation between the curvature, a local quantity, with the Euler characteristic, a quantity defined from a global information.

## Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.
<URL>
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CA408

| Course Title | Analysis 1 | | |
|---|---|---|---|
| Instructor | Noumi Masatoshi | | |
| Semester | Spring Semester | Credit | 2 Credits |
| Course Number | MAT3310 | Language | Japanese |

## Course Objectives

The objectives are to learn the basics of the theory of functions of a complex variable and deepen its understanding through applications.

## Course Contents

Most of the functions one encounters in mathematics and natural science fall into the category of ``analytic functions''. Their true nature is revealed when we treat them in the complex domain. The theory of analytic functions has beauty on its own, and it often provides a powerful means for solving various problems. Getting familiar with complex numbers, students learn basic properties of complex functions and their representation by power series. Another goal of the course is to learn various concrete examples of analytic functions.

## Others

※Please refer to the ″Syllabus & Class Schedule Search System″ for details including course schedule, evaluations, textbooks and others.
〈URL〉
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CA409

| Course Title | Exercises in Analysis 1 | | |
|---|---|---|---|
| Instructor | Noumi Masatoshi | | |
| Semester | Spring Semester | Credit | 1 Credit |
| Course Number | MAT3310 | Language | Japanese |

## Course Objectives

The objectives are to learn the basics of the theory of functions of a complex variable and deepen its understanding through applications.

## Course Contents

Most of the functions one encounters in mathematics and natural science fall into the category of ``analytic functions''. Their true nature is revealed when we treat them in the complex domain. The theory of analytic functions has beauty on its own, and it often provides a powerful means for solving various problems. Getting familiar with complex numbers, students learn basic properties of complex functions and their representation by power series. Another goal of the course is to learn various concrete examples of analytic functions.

## Others

※Please refer to the ″Syllabus & Class Schedule Search System″ for details including course schedule, evaluations, textbooks and others.
〈URL〉
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CA410

| Course Title | Analysis 2 | | |
|---|---|---|---|
| Instructor | Sato Nobuya | | |
| Semester | Fall Semester | Credit | 2 Credits |
| Course Number | MAT3310 | Language | Japanese |

## Course Objectives

We study the theory of complex analytic functions, and deepen your understanding through several applications.

## Course Contents

Following Analysis 1, we study the basic theory of complex analytic functions and their applications. The main theorems are Cauchy's Theorem, Cauchy's integral formula, from which many facts are derived. The goal is to realize the strength of the theory of analytic functions through applications such as calculations of real definite integrals.

## Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.
<URL>
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CA411

| Course Title | Exercises in Analysis 2 | | |
|---|---|---|---|
| Instructor | Sato Nobuya | | |
| Semester | Fall Semester | Credit | 1 Credit |
| Course Number | MAT3310 | Language | Japanese |

## Course Objectives

We study the theory of complex analytic functions, and deepen your understanding through several applications.

## Course Contents

Following Analysis 1, we study the basic theory of complex analytic functions and their applications. The main theorems are Cauchy's Theorem, Cauchy's integral formula, from which many facts are derived. The goal is to realize the strength of the theory of analytic functions through applications such as calculations of real definite integrals.

## Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.
<URL>
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CA412

| Course Title | Mathematical Information Theory 1 | | |
|---|---|---|---|
| Instructor | Yasuda Masaya | | |
| Semester | Spring Semester | Credit | 2 Credits |
| Course Number | MAT3410 | Language | Japanese |

## Course Objectives

Following “Introduction to Computer Science 2 and Exercises” and “Electronic Computer 3 and 4,” students learn somewhat more applicable algorithms and numerical calculation methods through programming in C or Python language.

## Course Contents

This class is paired with “Exercises in Mathematical Information Theory 1.” “Mathematical Information Theory 1” contains lectures focused on theory, and in “Exercises in Mathematical Information Theory 1” students conduct practice exercises related to the lecture contents, from programming to report creation. It is assumed that students have just about finished learning the syntax of C or Python language. Use programming and mathematical theory to learn more sophisticated algorithms and create more advanced programs. Contents include linear algebra, interpolation, numerical integration and mathematical cryptography. Software used in “Exercises in Mathematical Information Theory 1” centers on C or Python language, but depending on the problem, other languages or formula manipulation software are used.

## Others

※Please refer to the ″Syllabus & Class Schedule Search System″ for details including course schedule, evaluations, textbooks and others.
〈URL〉
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CA413

| Course Title | Exercises in Mathematical Information Theory 1 | | |
|---|---|---|---|
| Instructor | Yasuda Masaya | | |
| Semester | Spring Semester | Credit | 1 Credit |
| Course Number | MAT3410 | Language | Japanese |

## Course Objectives

Following “Introduction to Computer Science 2 and Exercises” and “Electronic Computer 3 and 4,” students learn somewhat more applicable algorithms and numerical calculation methods through programming in C or Python language.

## Course Contents

This class is paired with “Exercises in Mathematical Information Theory 1.” “Mathematical Information Theory 1” contains lectures focused on theory, and in “Exercises in Mathematical Information Theory 1” students conduct practice exercises related to the lecture contents, from programming to report creation. It is assumed that students have just about finished learning the syntax of C or Python language. Use programming and mathematical theory to learn more sophisticated algorithms and create more advanced programs. Contents include linear algebra, interpolation, numerical integration and mathematical cryptography. Software used in “Exercises in Mathematical Information Theory 1” centers on C or Python language, but depending on the problem, other languages or formula manipulation software are used.

## Others

※Please refer to the ″Syllabus & Class Schedule Search System″ for details including course schedule, evaluations, textbooks and others.
〈URL〉
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CA414

| Course Title | Mathematical Information Theory 2 | | |
|---|---|---|---|
| Instructor | Mizusawa Yasushi | | |
| Semester | Fall Semester | Credit | 2 Credits |
| Course Number | MAT3410 | Language | Japanese |

## Course Objectives

Following "Mathematical Information Theory 1 and Exercises", students learn algorithms about somewhat more applicable numerical calculation and algebraic calculation, and how to implement their algorithms through programming language and mathematical software.

## Course Contents

This class is paired with "Exercises in Mathematical Information Theory 2". "Mathematical Information Theory 2" contains lectures focused on theory, and "Exercises in Mathematical Information Theory 2" contains exercises of programming and report creation. Contents include the basics of discrete Fourier transforms, solving algebraic equations, calculation of eigenvalues, and applications of algebraic calculation. By studying mathematical theory and by programming concretely using suitable languages and software (C, Python, SageMath, ...), students learn more sophisticated algorithms and more advanced programming.

## Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.
<URL>
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CA415

| Course Title | Exercises in Mathematical Information Theory 2 | | |
|---|---|---|---|
| Instructor | Mizusawa Yasushi | | |
| Semester | Fall Semester | Credit | 1 Credit |
| Course Number | MAT3410 | Language | Japanese |

## Course Objectives

Following "Mathematical Information Theory 1 and Exercises", students learn algorithms about somewhat more applicable numerical calculation and algebraic calculation, and how to implement their algorithms through programming language and mathematical software.

## Course Contents

This class is paired with "Mathematical Information Theory 2". "Mathematical Information Theory 2" contains lectures focused on theory, and "Exercises in Mathematical Information Theory 2" contains exercises of programming and report creation. Contents include the basics of discrete Fourier transforms, solving algebraic equations, calculation of eigenvalues, and applications of algebraic calculation. By studying mathematical theory and by programming concretely using suitable languages and software (C, Python, SageMath, ...), students learn more sophisticated algorithms and more advanced programming.

## Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.
<URL>
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CA416

| Course Title | Analysis 3 | | |
|---|---|---|---|
| Instructor | Yamada Yuji | | |
| Semester | Spring Semester | Credit | 2 Credits |
| Course Number | MAT3320 | Language | Japanese |

## Course Objectives

Use your knowledge of calculus and linear algebra to learn about the Fourier series as a basic tool of analysis.

## Course Contents

We study the definition of the Fourier series and basic theorems about the convergencies about them. Applying these theorems, we study the values of some infinite series, the equidistribution theorem of Weyl, Weierstrass polynomial approximation theorem. We also study the L2 theory of the Fourier series and the introductory course on solving some partial differential equations.

## Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.
<URL>
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CA453

| Course Title | Mathematical Information Theory 3 | | |
|---|---|---|---|
| Instructor | Mizusawa Yasushi | | |
| Semester | Fall Semester | Credit | 2 Credits |
| Course Number | MAT3420 | Language | Japanese |

## Course Objectives

Students learn the basics of algebraic number theory, and understand the basic theory of finite fields, from a viewpoint of application to information theory (error-correcting codes).

## Course Contents

In the first half, aiming to understand the error-correcting codes (Reed-Solomon codes, ...) as an application of finite field theory, students learn linear codes and finite fields, and review a part of basic algebra as a preparation for the latter half. In the latter half, students learn the basics of algebraic number theory, aiming to survey the error-correcting codes constructed from number fields (by Lenstra, Guruswami, ...). Students are encouraged to use software on algebra and number theory for exercises.

## Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.
<URL>
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CA454

| Course Title | Introduction to Modern Mathematics | | |
|---|---|---|---|
| Instructor | Nishino Takeo/Yamada Yuji/Abe Takuro | | |
| Semester | Fall Semester | Credit | 2 Credits |
| Course Number | MAT3020 | Language | Japanese |

## Course Objectives

Understand the current status of modern mathematical theory and its applications. Learn how mathematical theory develops and is applied to three themes chosen from cutting-edge fields of modern mathematics.

## Course Contents

The aim of this course is to explain three selected topics from modern mathematics theory and its applications. This time, the three selected themes are “graphs and their zeta functions”, “graph coloring and tree problems”, and “analytic functions and natural numbers”.

## Others

※Please refer to the ″Syllabus & Class Schedule Search System″ for details including course schedule, evaluations, textbooks and others.
<URL>
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CA455

| Course Title | Algebra 4 | | |
|---|---|---|---|
| Instructor | Geisser, Thomas | | |
| Semester | Fall Semester | Credit | 2 Credits |
| Course Number | MAT3120 | Language | Japanese |

## Course Objectives

In ″Algebra 3″, the goal is (1) to understand field theory and Galois theory in arbitrary characteristic, (2) to understand the relationship between solutions of polynomial equations and Galois theory, and understand infinite Galois extensions.

## Course Contents

There are formulas to express solutions of polynomials in degrees at most four. However, it was proved in the 19th century by Abel that there is no algebraic formula for the solutions of a general polynomials in degrees at least five. In this lecture we discuss the solutions of polynomials in degree 3 and 4, and explain the proof of Abel's theorem. After this, the notaion of separable and inseparable extensions will be introduced to develop Galois theory in arbitrary characteristic. Using Galois theory, it will be explained how one can give a criterion for the solutions of polynomial equations in terms of the Galois group.

## Others

※Please refer to the ″Syllabus & Class Schedule Search System″ for details including course schedule, evaluations, textbooks and others.
<URL>
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CA456

| Course Title | Geometry 4 | | |
|---|---|---|---|
| Instructor | Sugiyama Kenichi | | |
| Semester | Spring Semester | Credit | 2 Credits |
| Course Number | MAT3220 | Language | Japanese |

## Course Objectives

Number theory, which study various properties of numbers, is intimately related to analytic functions. In this course, we will study a relationship between number theory and analysis by continued fractions,

## Course Contents

In this lecture we will explain the theory of continued fraction. After an explanation of the continued fraction of the Golden number, certain properties of a continued fraction of a quadratic irrational number. Finally using contiguous relation of hypergeometric series, we will show a continued fraction of *¥pi*.

## Others

※Please refer to the ″Syllabus & Class Schedule Search System″ for details including course schedule, evaluations, textbooks and others.
〈URL〉
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CA457

| Course Title | Special Seminar on Mathematics | | |
|---|---|---|---|
| Instructor | ※ | | |
| Semester | Full Year Others | Credit | 8 Credits |
| Course Number | MAT4000 | Language | Japanese |

## Course Objectives

As the culmination of their studies at the Department of Mathematics, students concentrate on a single topic and delve deep into investigation. Learn the ability to deal with, solve and explain the subject to others. Special emphasis is placed on theoretical mathematics research.

## Course Contents

Classes are divided into small groups with one faculty member each and held in a seminar format. By making good use of the specialized knowledge acquired over three years, students read and understand advanced specialized books, explain their contents to other members, ask questions and provide answers.
Introduction Phase:
Review and replenish the fundamental knowledge necessary for research. Since the textbook still has relatively easy parts, emphasis is placed on learning how to decipher and explain them.
Development Phase:
As the textbook enters the subject, the explanations are often met with difficulties. Cultivate an attitude of working hard to find solutions with the cooperation of other members and advice from the instructors.
Results Phase:
The objective is to delve deeper into what the student finds particularly interesting from the research and form an independent opinion.

## Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.
<URL>
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CA601

| Course Title | Seminar on Applied Mathematics | | |
|---|---|---|---|
| Instructor | ※ | | |
| Semester | Full Year Others | Credit | 8 Credits |
| Course Number | MAT4000 | Language | Japanese |

## Course Objectives

As the culmination of their studies at the Department of Mathematics, students concentrate on a single topic and delve deep into investigation. Learn the ability to deal with, solve and explain the subject to others. Special emphasis is placed on theoretical mathematics research.

## Course Contents

Classes are divided into small groups with one faculty member each and held in a seminar format. By making good use of the specialized knowledge acquired over three years, students read and understand advanced specialized books, explain their contents to other members, ask questions and provide answers.
Introduction Phase:
Review and replenish the fundamental knowledge necessary for research. Since the textbook still has relatively easy parts, emphasis is placed on learning how to decipher and explain them.
Development Phase:
As the textbook enters the subject, the explanations are often met with difficulties. Cultivate an attitude of working hard to find solutions with the cooperation of other members and advice from the instructors.
Results Phase:
The objective is to delve deeper into what the student finds particularly interesting from the research and form an independent opinion.

## Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.
<URL>
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CA624

| Course Title | Basic Laboratory Experiments on Physics | | |
|---|---|---|---|
| Instructor | Taguchi Makoto | | |
| Semester | Spring Semester | Credit | 2 Credits |
| Course Number | PHY2700 | Language | Japanese |

## Course Objectives

This course provides an opportunity for physics students to have an intensive laboratory experience of physics experiments. Each student will learn basic knowledge and techniques of experiments and understand the underlying physics via the experiments.

## Course Contents

Students will finish ten experiments over this course. Students will write a lab report for each experiment. Supervisors will review the report and will provide critical comments to students. The contents of the experiments are subject to slightly change depending on situation of the COVID-19 infection. The experiments are as follows:

(1) Oscilloscope,
(2) Data analysis techniques with a computer,
(3) Measurement of Young's modulus,
(4) Joule's heating effect of current,
(5) Newton's ring,
(6) Transistor characteristics,
(7) Interaction of gamma-rays with matter,
(8) Measurement of the Planck constant,
(9) The Franck-Hertz experiment, and
(10) Measurement of impedance.

An emergency training is also scheduled.

## Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.

<URL>
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CB035

| Course Title | Classical Mechanics 1 | | |
|---|---|---|---|
| Instructor | Kurita Kazuyoshi | | |
| Semester | Spring Semester | Credit | 2 Credits |
| Course Number | PHY2100 | Language | Japanese |

## Course Objectives

Classical mechanics is one of the most fundamental subjects in physics. The methods of extracting the laws from phenomena in nature are typically displayed. The fundamental concepts in classical mechanics are often applicable to other fields of physics. The purpose of the class is to understand the meaning of the basic concepts and physical quantities and to apply them to solve problems.

## Course Contents

″Classical Mechanics 1″ mainly deals with the particle mechanics. Starting from the description of the particle motion, the meaning of Newton's second laws of motion is to be understood. The importance of the new concept of potential energy is emphasized and new conservation laws are introduced. The physical setups are basically the same as those learned in high school. However, differential equations are introduced and the analytical solutions will be obtained. Students need to prepare for the classes by reading and understanding the subjects in the textbook for the week. Homework problems are to be solved as well before coming to the class. Students are required to obtain the physics point of view in discussing and having dialogs on key physics concepts, examples in daily life and the new mathematical methods.

## Others

※Please refer to the ″Syllabus & Class Schedule Search System″ for details including course schedule, evaluations, textbooks and others.
<URL>
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CB038

| Course Title | Classical Mechanics 2 | | |
|---|---|---|---|
| Instructor | Hirasawa Masaki | | |
| Semester | Fall Semester | Credit | 2 Credits |
| Course Number | PHY2100 | Language | Japanese |

## Course Objectives

An introduction to classical mechanics, including fundamental concepts and applications of Newton's law of motion.Topics include non-inertial frames of reference,two-body problems and rigid bodies. Designed for students with previous experience in Classical Mechanics 1.

## Course Contents

Relative motion of frames(translational and rotating motion),inertial frames of reference,non-inertial frames and inertial forces; two-body problems including motion of planets;motion of rigid bodies,moment of inertia,moment of force and equation of motion of rigid bodies.

## Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.
<URL>
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CB040

| Course Title | Classical Electromagnetism 1 | | |
|---|---|---|---|
| Instructor | Kitamoto Shunji | | |
| Semester | Spring Semester | Credit | 2 Credits |
| Course Number | PHY2100 | Language | Japanese |

## Course Objectives

In this course, students will learn about laws that govern static electricity and magnetism. Students will understand an example of the physics framework by studying the theory of the electromagnetism.

## Course Contents

Students will learn Coulomb's law and Biot–Savar's law as start. Then they study electric and magnetic fields. Students will understand Gauss's law and Ampere's law and then apply them to some exercises. Students will understand divergence and rotation of electric and magnetic fields and learn Maxwell's equations in static conditions.

## Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.
<URL>
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CB041

| Course Title | Classical Electromagnetism 2 | | |
|---|---|---|---|
| Instructor | Taguchi Makoto | | |
| Semester | Fall Semester | Credit | 2 Credits |
| Course Number | PHY2100 | Language | Japanese |

## Course Objectives

In this course, as a continuance of Electromagnetism I, students will learn about Maxwell's equations and some basic solutions including the electromagnetic waves. Students will also learn a brief overview of the electronic circuit theory and electro-magnetic field in materials.

## Course Contents

Students will learn Faraday's law as an induced electric field and displacement current. Then students will understand the complete Maxwell's equations. Students will deduce the electromagnetic waves. Students will then study the energy in electric and magnetic fields and will learn pointing flux. Students will also understand the electric circuit theory and electro-magnetic field in materials.

## Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.
<URL>
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CB042

| Course Title | Mathematics for Physics 1 | | |
|---|---|---|---|
| Instructor | Ishii Takaaki | | |
| Semester | Spring Semester | Credit | 2 Credits |
| Course Number | PHY2600 | Language | Japanese |

## Course Objectives

In Mathematics for Physics, students learn mathematical methods used in physics. This course is an introduction to vector analysis in three-dimensional space. It is important to be familiar with vector analysis because of its wide use in many fields in physics including electromagnetism and fluid mechanics.

## Course Contents

After reviewing the basics of vectors, we will learn differential operations on vectors including gradient, divergence, and rotation. We will be familiarized with the Einstein notation also. We will then introduce line and surface integrals. Finally, we will learn integral theorems including Gauss's Theorem and Stokes' Theorem. Applications of vector analysis to physics will also be introduced.

## Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.
<URL>
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CB043

CB044

| Course Title | Mathematics for Physics 2 | | |
|---|---|---|---|
| Instructor | Suzuki Kenta | | |
| Semester | Fall Semester | Credit | 2 Credits |
| Course Number | PHY2600 | Language | Japanese |

## Course Objectives

This course introduces the basics of solving differential equations.

## Course Contents

Because most natural phenomena are described by differential equations, solving and understanding differential equations is very important. In this course, we learn various approaches to differential equations.

## Others

※Please refer to the ″Syllabus & Class Schedule Search System″ for details including course schedule, evaluations, textbooks and others.
<URL>
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CB044

| Course Title | Exercises in Physics 1 | | |
|---|---|---|---|
| Instructor | Suzuki Kenta | | |
| Semester | Spring Semester | Credit | 1 Credit |
| Course Number | PHY2800 | Language | Japanese |

## Course Objectives

The aim of this course is to understand and solve problems of physics.

## Course Contents

We solve problems of analytical mechanics, electromagnetism 1 and mathematical physics 1.

## Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.
<URL>
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CB045

| Course Title | Exercises in Physics 2 | | |
|---|---|---|---|
| Instructor | Ishii Takaaki | | |
| Semester | Fall Semester | Credit | 1 Credit |
| Course Number | PHY2800 | Language | Japanese |

## Course Objectives

This course is for exercises on "Electromagnetism II" and "Mathematics for Physics II".

## Course Contents

Students solve problems on "Electromagnetism II" and "Mathematics for Physics II". Students also present their solutions to the problems and develop their understanding.

## Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.
<URL>
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CB046

| Course Title | Exercises in Physics 3 | | |
|---|---|---|---|
| Instructor | Hiramatsu Takashi | | |
| Semester | Spring Semester | Credit | 1 Credit |
| Course Number | PHY2800 | Language | Japanese |

## Course Objectives

This course provides exercises in "Statistical Mechanics I" and "Quantum Mechanics I".

## Course Contents

Students solve problems on "Statistical Mechanics I" and on "Quantum Mechanics I", alternatively.

## Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.
<URL>
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CB047

| Course Title | Differential and Integral Calculus 1 | | |
|---|---|---|---|
| Instructor | Ueno Takahiko | | |
| Semester | Spring Semester | Credit | 2 Credits |
| Course Number | PHY2600 | Language | Japanese |

## Course Objectives

The aim of this course is to acquire the basic knowledge and practical computation of differential and integral calculus with a single variable. We develop differential and integral of high school mathematics and acquire the knowledge of series, Taylor expansion, improper integral, etc.

## Course Contents

We learn chapter 6, 1, 2 and 3 from the textbook. We develop differential and integral of high school mathematics and acquire new knowledge and ideas of series, Taylor expansion, improper integral, since this knowledge is necessary for learning specialized subjects.

## Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.
<URL>
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CB049

| Course Title | Differential and Integral Calculus 2 | | |
|---|---|---|---|
| Instructor | Ueno Takahiko | | |
| Semester | Fall Semester | Credit | 2 Credits |
| Course Number | PHY2600 | Language | Japanese |

## Course Objectives

The aim of this course is to acquire the basic knowledge and practical computation of differential and integral calculus with several variables. We acquire the knowledge of limitation, partial and total derivative of a function, extremum, constrained extremum, multiple integral and surface area, etc.

## Course Contents

We learn chapter 4 and 5 from the textbook. Basically we treat in two variables. We acquire the basic knowledge and ideas of differential and integral calculus with several variables of limitation, partial and total derivative of a function, Taylor expansion, extremum, constrained extremum, the method of Laglange multiplier, multiple integral, surface area and the relation between the gamma and the beta function, since this knowledge is necessary for learning specialized subjects.

## Others

※Please refer to the ″Syllabus & Class Schedule Search System″ for details including course schedule, evaluations, textbooks and others.
〈URL〉
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CB050

| Course Title | Linear Algebra 1 | | |
|---|---|---|---|
| Instructor | Kouno Takafumi | | |
| Semester | Spring Semester | Credit | 2 Credits |
| Course Number | PHY2600 | Language | Japanese |

## Course Objectives

We learn basic operations of matrices and determinants. In addition, we learn how to write mathematical sentences through proofs of theorems that we explain in this course.

## Course Contents

First, we introduce matrices through linear transformations on a plane and define operations of matrices, called addition, scalar multiplication, and multiplication. Next, we introduce elementary operations of matrices and learn how to solve simultaneous linear equations and how to classify solutions of simultaneous linear equations. In the second half of this course, we define determinants. Then, we explain the way to calculate explicit determinants and applications of determinants.

## Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.
<URL>
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CB055

| Course Title | Linear Algebra 2 | | |
|---|---|---|---|
| Instructor | Kouno Takafumi | | |
| Semester | Fall Semester | Credit | 2 Credits |
| Course Number | PHY2600 | Language | Japanese |

## Course Objectives

We study abstract vector spaces and linear maps and understand its relationship with the theory of matrices and simultaneous linear equations. In addition, we learn how to write mathematical sentences through proofs of theorems that we explain in this course.

## Course Contents

First, we define abstract vector spaces and explain subspaces and bases. Next, we define linear maps between vector spaces and study its properties including its images and kernels. In addition, we introduce matrix representations of linear maps and understand linear maps through the theory of matrices. In the second half of the course, we define inner products of vector spaces and study unitary transformations. Then, we introduce eigenvalues and eigenvectors of square matrices and explain its applications including matrix diagonalization.

## Others

※Please refer to the ″Syllabus & Class Schedule Search System″ for details including course schedule, evaluations, textbooks and others.
〈URL〉
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CB056

| Course Title | Exercises in Basic Physics 1 | | |
|---|---|---|---|
| Instructor | Kurita Kazuyoshi | | |
| Semester | Spring Semester | Credit | 1 Credit |
| Course Number | PHY2800 | Language | Japanese |

## Course Objectives

Problem sets on ″Classical Mechanics 1″, ″Introduction of Physics″, ″Differential and Integral Calculus 1″ and ″Linear Algebra 1″ are given in each class. Students work through them and answer the questions. The purpose of this problem session is to understand the basic concepts fully and to acquire the skills of problem solving.

## Course Contents

In each problem sessions, 2~4 problems are given individually. The answer sheets are collected at the end of the sessions. They are marked and returned in the following week. The questions are asked based on the topics being discussed in the recent lectures. Students are divided into three rooms where one teacher and TA are in charge for the support. Basic problems are given and each students need to solve them by themselves. It is encouraged to share ideas how to approach the problems but copying other students' answers may be even harmful and therefore it is prohibited. Students should feel free to ask questions to the teacher and the TAs. Contents discussed in ″Classical Mechanics 1″, ″Introduction of Physics″, ″Differential and Integral Calculus 1″ and ″Linear Algebra 1″ are covered.

## Others

※Please refer to the ″Syllabus & Class Schedule Search System″ for details including course schedule, evaluations, textbooks and others.
<URL>
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CB057

| Course Title | Exercises in Basic Physics 2 | | |
|---|---|---|---|
| Instructor | Murata Jiro | | |
| Semester | Fall Semester | Credit | 1 Credit |
| Course Number | PHY2800 | Language | Japanese |

## Course Objectives

The goal of this course is to gain deeper understandings about Classical Mechanics 2, Thermodynamics, Linear Algebra 2, Differential and Integral Calculus 2 through solving physics problems.

## Course Contents

The class will be separated into several groups. Attendance at the first day of the class is mandatory. Every week students will be given a set of assignments due the next week.

## Others

※Please refer to the ″Syllabus & Class Schedule Search System″ for details including course schedule, evaluations, textbooks and others.
<URL>
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CB058

| Course Title | Computer Experiments 1 | | |
|---|---|---|---|
| Instructor | Murata Jiro | | |
| Semester | Spring Semester | Credit | 1 Credit |
| Course Number | PHY2700 | Language | Japanese |

## Course Objectives

To learn techniques of the numerical calculation using C-language, after being trained on the basic usage of the computers.

## Course Contents

A classroom training to become familiar with standard usage of personal computers as a stational tool, numerical calculation techniques using spreadsheet software, and numerical solutions to solve the problems of mathematics and physics.
This course is designed to train the basics of programming technique using C-language and numerical calculation methods.
The teaching materials will be distributed via the Blackboard system. Students will be required to submit reports after solving the exercise shown in there.

## Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.
<URL>
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CB059

| Course Title | Computer Experiments 2 | | |
|---|---|---|---|
| Instructor | Murata Jiro | | |
| Semester | Fall Semester | Credit | 1 Credit |
| Course Number | PHY2700 | Language | Japanese |

## Course Objectives

To learn how to perform numerical simulations and statistical analysis of experimental data.

## Course Contents

Numerical treatments of the differential equations, Monte-Carlo technique using random number generation,
Programming for statistical analysis based on the least-square method, which is necessary for experimental data analysis.

The basic knowledge of how to apply C-language for numerical simulation covered in “Computer Experiments 1” is required.

The teaching materials will be distributed via the Blackboard system. Students will be required to submit reports after solving the exercise shown in there.

## Others

※Please refer to the ″Syllabus & Class Schedule Search System″ for details including course schedule, evaluations, textbooks and others.
<URL>
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CB060

| Course Title | Exercises in Basic Mathematics | | |
|---|---|---|---|
| Instructor | Hiramatsu Takashi/Ishii Takaaki/Jinno Ryusuke | | |
| Semester | Fall Semester | Credit | 1 Credit |
| Course Number | PHY2800 | Language | Japanese |

## Course Objectives

This course provides exercises in linear algebra and differential and integral calculus.

## Course Contents

Students solve problems in linear algebra and differential and integral calculus.

## Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.
<URL>
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CB061

| Course Title | Wave Motion and Quantum | | |
|---|---|---|---|
| Instructor | Hatsuda Yasuyuki | | |
| Semester | Fall Semester | Credit | 2 Credits |
| Course Number | PHY2200 | Language | Japanese |

## Course Objectives

This course covers oscillations, waves, the old quantum theory and Schroedinger's wave mechanics.

## Course Contents

In the first part of the course, we learn basics on various oscillations. It is shown that waves can be regarded as an infinie number of coupled harmonic oscillators. In the secound part, we briefly see histrical developments on the old quantum theory, and learn Schroedinger's wave mechanics.

## Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.
<URL>
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CB063

| Course Title | Quantum Mechanics 1 | | |
|---|---|---|---|
| Instructor | Hatsuda Yasuyuki | | |
| Semester | Spring Semester | Credit | 2 Credits |
| Course Number | PHY2200 | Language | Japanese |

## Course Objectives

This course is an introduction to modern quantum mechanics. The goal is to understand basic concepts of quantum mechanics. It is significant to recognize differences from classical mechanics.

## Course Contents

I start with a brief review on linear algebra for quantum mechanics. Then I proceed to basic spirit and rules of quantum mechanics, based on the operator formalism. After introducing Schroedinger's equation, I explain how to solve it for some simple situations. Finally it is shown that quantum mechanics really describes microscopic physics.

## Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.
<URL>
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CB064

| Course Title | Quantum Mechanics 2 | | |
|---|---|---|---|
| Instructor | Hatsuda Yasuyuki | | |
| Semester | Fall Semester | Credit | 2 Credits |
| Course Number | PHY3230 | Language | Japanese |

## Course Objectives

This course deals with a little bit advanced topics in quantum mechanics.

## Course Contents

The course is planned to cover angular momentum, variational methods, perturbation theory, the WKB method and scattering problems.

## Others

※Please refer to the ″Syllabus & Class Schedule Search System″ for details including course schedule, evaluations, textbooks and others.
〈URL〉
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CB065

| Course Title | Exercises in Physics 4 | | |
|---|---|---|---|
| Instructor | Suzuki Kenta/Tanaka Tomo/Yokokura Ryo | | |
| Semester | Fall Semester | Credit | 1 Credit |
| Course Number | PHY3830 | Language | Japanese |

## Course Objectives

The aim of this course is to understand and solve problems of physics.

## Course Contents

We solve problems of quantum mechanics 2 and statistical mechanics 2.

## Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.
<URL>
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CB066

| Course Title | Statistical Mechanics 1 | | |
|---|---|---|---|
| Instructor | Kobayashi Tsutomu | | |
| Semester | Spring Semester | Credit | 2 Credits |
| Course Number | PHY2200 | Language | Japanese |

## Course Objectives

The aim of this course is to understand an introductory part of statistical mechanics.

## Course Contents

Students learn an introductory part of statistical mechanics.

## Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.
<URL>
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CB068

| Course Title | Statistical Mechanics 2 | | |
|---|---|---|---|
| Instructor | Kobayashi Tsutomu | | |
| Semester | Fall Semester | Credit | 2 Credits |
| Course Number | PHY3230 | Language | Japanese |

## Course Objectives

The aim of this course is to understand a slightly advanced part of statistical mechanics.

## Course Contents

Students learn a slightly advanced part of statistical mechanics.

## Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.
<URL>
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CB069

| Course Title | Experiments in Physics 1 | | |
|---|---|---|---|
| Instructor | Hirayama Takato | | |
| Semester | Spring Semester | Credit | 4 Credits |
| Course Number | PHY2700 | Language | Japanese |

## Course Objectives

Students learn techniques and methods used in experimental physics through practice of more advanced experiments than those learned in Basic Laboratory Experiments on Physics in the second grade, and apply the acquired techniques and methods to Experiments in Physics 2 in the fall semester and Thesis 1 and 2 in the fourth grade.

## Course Contents

Students study the following six experiment themes:
Computer
Electronic Circuit
Radiation
Semiconductor
Vacuum Technique
Light

## Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.
<URL>
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CB070

| Course Title | Experiments in Physics 2 | | |
|---|---|---|---|
| Instructor | Hirayama Takato | | |
| Semester | Fall Semester | Credit | 4 Credits |
| Course Number | PHY2730 | Language | Japanese |

## Course Objectives

Students perform more advanced experiments using the basic techniques and methods learned in Experiments in Physics 1 or before, and aim to cultivate attitude of finding a subject and working to solve it on their own initiative and communication and presentation skills for Thesis 1 and 2 in the fourth grade.

## Course Contents

Students choose one from the following six experiment themes and perform it throughout the fall semester:
Computer
Electronic Circuit
Radiation
Semiconductor
Vacuum Technique
Light
Students are encouraged to propose an original theme other than examples proposed by lecturers. Experiments should be scheduled and conducted to be finished within the term.

## Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.
<URL>
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CB071

CB072

| Course Title | Introduction to Physics | | |
|---|---|---|---|
| Instructor | Yamada Shinya | | |
| Semester | Spring Semester | Credit | 2 Credits |
| Course Number | PHY1000 | Language | Japanese |

## Course Objectives

This course introduces the “physics in university “ through learning “special relativity” which is good introduction on learning modern physics.

## Course Contents

An establishment process of classical mechanics, which is the basis of physics, is reviewed. The preparation for mathematics is explained. The special relativity, which is the foundation of modern physics, is introduced.

## Others

※Please refer to the ″Syllabus & Class Schedule Search System″ for details including course schedule, evaluations, textbooks and others.
〈URL〉
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CB072

| Course Title | Thermodynamics | | |
|---|---|---|---|
| Instructor | Hirayama Takato | | |
| Semester | Fall Semester | Credit | 2 Credits |
| Course Number | PHY2100 | Language | Japanese |

## Course Objectives

We aim to achieve understanding of thermal phenomena through laws of thermodynamics and thermodynamic potentials.

## Course Contents

Macroscopic material consists of a tremendous number of atoms or molecules. Nonetheless, the state of the material can be described with a small number of state variables, such as temperature, pressure, density, energy, and entropy. Only a few fundamental thermodynamics laws can explain surprisingly various phenomena. Basic concepts of thermodynamics are introduced with necessary mathematical tools.

## Others

※Please refer to the ″Syllabus & Class Schedule Search System″ for details including course schedule, evaluations, textbooks and others.
〈URL〉
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CB073

| Course Title | Analytical Mechanics | | |
|---|---|---|---|
| Instructor | Harada Tomohiro | | |
| Semester | Spring Semester | Credit | 2 Credits |
| Course Number | PHY2100 | Language | Japanese |

## Course Objectives

Analytical mechanics is an essential tool to describe modern physics. Students will learn standard formulations in analytical mechanics and how to apply them to solve concrete problems in mechanics.

## Course Contents

This course introduces analytical mechanics from its elementary level. In particular, students will learn the Lagrangian and Hamiltonian formulations and how to apply them to problems in mechanics and study that conservation laws follow from the symmetries of the system. Finally, they will learn canonical transformations and the Hamilton–Jacobi formulation.

## Others

※Please refer to the ″Syllabus & Class Schedule Search System″ for details including course schedule, evaluations, textbooks and others.
〈URL〉
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CB074

| Course Title | Experiments in Chemistry for Physics Students | | |
|---|---|---|---|
| Instructor | Tabuchi Mari/Watanabe Eiji/Nishimura Ryo | | |
| Semester | Fall Semester 2 | Credit | 1 Credit |
| Course Number | PHY2700 | Language | Japanese |

## Course Objectives

This course aims to enable students to learn the fundamental knowledge and experimental methods for overall chemical experimentation and to provide students with experimental sophistication.

## Course Contents

In the first class, students will receive initial guidance. In the guidance, experimental guidelines and schedules will be distributed. Important notices and safety information before starting experiments, as well as how to take notes and write reports, will be explained. Class attendance for the guidance is a must. Bring a lab notebook to be used solely for experiments. One must read the experimental guidelines thoroughly and comprehend both its goals and contents before starting the experiment. In order to prevent accidents, it is crucial for students to obey the instructions of the instructor in charge whilst conducting an experiment. A scientific calculator will be necessary to conduct experiments in this course. Each individual is required to bring their own calculator.

## Others

※Please refer to the ″Syllabus & Class Schedule Search System″ for details including course schedule, evaluations, textbooks and others.
<URL>
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CB075

| Course Title | Experiments in Biology for Physics Students | | |
|---|---|---|---|
| Instructor | Yoro Emiko/Kurihara Emiko/Maruyama Ryuto | | |
| Semester | Fall Semester 1 | Credit | 1 Credit |
| Course Number | PHY2700 | Language | Japanese |

## Course Objectives

This course aims to enable students to learn the fundamental knowledge and experimental methods for overall biological experimentation and to provide students with experimental sophistication in biology.

## Course Contents

In the beginning of the course, students will receive initial guidance. The Guidelines of Biological Experimentation, which will be the main text book used in this course, will be handed out along with a schedule, lab coats, and name tags. The guidelines for writing reports will also be explained. The class attendance for the guidance is a must.

After the guidance, “Biological Experiments” will be conducted in accordance with the experimental guidelines.

In “Microscope Observations,” students will observe the chromosomes of onion cells undergoing division while learning about somatic cell division.

In “Quantitative Analysis of Proteins,” the protein content in egg whites will be measured while students learn about various methods of quantitative analysis of proteins.

In “PCR/Electrophoresis,” students will assess a person’s genotype while gaining a better understanding of the big picture.

In “The Physiological Adaptations of Cells,” students will learn about lac operons while gaining an understanding of the physiological adaptation mechanisms of E. Coli.

## Others

※Please refer to the ″Syllabus & Class Schedule Search System″ for details including course schedule, evaluations, textbooks and others.

〈URL〉

https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CB076

| Course Title | Classical Electromagnetism 3 | | |
|---|---|---|---|
| Instructor | Mutou Tomomi | | |
| Semester | Fall Semester | Credit | 2 Credits |
| Course Number | PHY3110 | Language | Japanese |

## Course Objectives

The aim of this course is to learn phenomenological and theoretical aspects of Maxwell's equations.

## Course Contents

Based on Maxewell's equations, we discuss propagation, reflection, refraction, radiation and scattering of electromagnetic waves. We also discuss the relativistic formulation of Maxwell's equations.

## Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.
<URL>
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CB102

| Course Title | Hydrodynamics | | |
|---|---|---|---|
| Instructor | Hiramatsu Takashi | | |
| Semester | Fall Semester | Credit | 2 Credits |
| Course Number | PHY2510 | Language | Japanese |

## Course Objectives

The aim of this course is to understand basic ideas of continuum mechanics and fluid mechanics.

## Course Contents

Liquid or gas are treated as 'fluid'. We learn the fundamentals of fluid mechanics using the perfect fluid and some applications in more realistic cases.

## Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.
<URL>
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CB106

| Course Title | Introductory Nuclear Physics | | |
|---|---|---|---|
| Instructor | Kurita Kazuyoshi/Murata Jiro | | |
| Semester | Fall Semester | Credit | 2 Credits |
| Course Number | PHY2410 | Language | Japanese |

## Course Objectives

To understand the basic properties of nuclei as the fundamental constitutes of matter and four fundamental interactions.

## Course Contents

Nuclei are located at the center of the atom, where electromagnetic, strong and weak interactions play important roles. Together with gravitational interaction, these four interactions have been understood during investigating nuclear properties. In this class, concrete properties of nuclei, together with the general treatment of the fundamental interactions will be introduced, including the unified theories. Also, problems should be solved during the class to improve better understandings.

## Others

※Please refer to the ″Syllabus & Class Schedule Search System″ for details including course schedule, evaluations, textbooks and others.
〈URL〉
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CB107

| Course Title | Solid State Physics | | |
|---|---|---|---|
| Instructor | Hiraki Ko-ichi | | |
| Semester | Spring Semester | Credit | 2 Credits |
| Course Number | PHY2510 | Language | Japanese |

## Course Objectives

The aim of this course is to understand the characteristic behaviours of the electrons in the crystalline solids.

## Course Contents

To understand the properties of a material, it is necessary to understand the state of electrons in that material. The starting point is to understand phenomenologically the properties of electrons in metals. After that, we will understand the properties of electrons in metals from a quantum mechanical point of view, and be convinced that the basic properties can be explained by the free electron model.
After the phenomenological/quantum mechanical understanding of the properties of metals, the importance of atoms or groups of atoms, molecules, being regularly arranged to form crystalline solids in metals will be understood together with the concepts of bonding mechanisms and reciprocal lattices.
Finally, superconductivity, will be introduced.
To understand states in matter from a microscopic point of view, knowledge of quantum mechanics and thermodynamics is necessary. The basics of these subjects will be outlined in class as needed.
Quizzes will be given to verify the level of understanding, and reports will be requested.

## Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.
<URL>
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CB108

| Course Title | Introductory Astrophysics | | |
|---|---|---|---|
| Instructor | Hiramatsu Takashi | | |
| Semester | Fall Semester | Credit | 2 Credits |
| Course Number | PHY2310 | Language | Japanese |

## Course Objectives

This course introduces the physical foundations of astrophysics.

## Course Contents

This course deals with gravity, fluid mechanics, and other basic physical processes that underlie various astrophysical phenomena.

## Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.
<URL>
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CB109

| Course Title | Data Processing | | |
|---|---|---|---|
| Instructor | Yoshino Kazuyoshi | | |
| Semester | Fall Semester | Credit | 2 Credits |
| Course Number | PHY2710 | Language | Japanese |

## Course Objectives

The goal of this class is to be able to explain the principle of data analysis used in machine learning and to realize them by computer programs.

## Course Contents

This class will explain the basic principles of data analysis methods used in machine learning and how to implement those analysis methods using C language programs.

## Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.
<URL>
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CB112

| Course Title | Methods of Measurement in Physics | | |
|---|---|---|---|
| Instructor | Murata Jiro | | |
| Semester | Fall Semester | Credit | 2 Credits |
| Course Number | PHY2910 | Language | Japanese |

## Course Objectives

To learn essential knowledge about the treatment of experimental data and the analytical techniques for students studying physics.

## Course Contents

Physics is known as the representative natural science as an empirical science. Correct data treatment is essential to compare data and theoretical models. In this course, treatment of experimental data, especially the technique of how to obtain reliable data considering their error and uncertainties, are focused on. Typical exercises will be shown, to train real data analysis.

## Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.
<URL>
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CB113

| Course Title | Special Lecture in Physics 1 | | |
|---|---|---|---|
| Instructor | Yamanaka Masanori | | |
| Semester | Fall Semester | Credit | 2 Credits |
| Course Number | PHY3910 | Language | Japanese |

## Course Objectives

We can calculate a partition function and the expectation, which is a foundation of statistical mechanics, as a case with a concrete model (two-level system, harmonic oscillator system, ideal gas) using statistical ensemble.

## Course Contents

Statistical mechanics is the study of calculating macroscopic physical quantities from microscopic laws and explaining experiments by using the concept of probability and statistics. In the first half, the basics of this methodology are explained, focusing on canonical ensemble, and in particular for two-level systems, harmonic oscillators, and ideal gases, without omitting the calculations of partition functions and expected values from the basics. We will explain from the extremely basic contents so that those who re-take statistical mechanics 1 and 2 will understand. In the second half, we will systematically explain basics to applications by analytically and numerically treating them using Ising model and gauge model. Though the concept of statistical mechanics can be applied to various fields, we explain how the methodology of statistical mechanics is used in these applications. For example, in applications to biophysics, principal component analysis of DNA molecular computing algorithms and molecular dynamics of proteins, and in applications to graph theory, solutions of staining problems such as four-color problems and condition satisfaction problems are taken as eigenstates We explain about the statistical dynamics system we have. In addition, we will explain the problems that will actually be encountered when actually performing calculations such as computational complexity, NP difficulty, and main memory size of a PC.

## Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.
<URL>
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CB114

| Course Title | Special Lecture in Physics 2 | | |
|---|---|---|---|
| Instructor | Machida Yo | | |
| Semester | Fall Semester | Credit | 2 Credits |
| Course Number | PHY3910 | Language | Japanese |

## Course Objectives

The aim of this course is to understand transport phenomena in solids including electrical, heat, and thermoelectric transport.

## Course Contents

Transport phenomena have been a central subject of solid state physic.　We study electron and phonon transport on the basis of classical and quantum theory of solids. Finally, some intriguing transport properties of solids will be introduced.

## Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.
<URL>
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CB115

| Course Title | Special Topic in Theoretical Physics 1(General Relativity) | | |
|---|---|---|---|
| Instructor | Harada Tomohiro | | |
| Semester | Spring Semester | Credit | 2 Credits |
| Course Number | PHY3210 | Language | Japanese |

## Course Objectives

This course introduces the basics of general relativity.

## Course Contents

This course is a lecture on general relativity, a theory of spacetime and gravity. General relativity has passed many experimental tests with high accuracy. Its basic ideas are now essential for theoretical physicists in all fields and experimental physicists in gravitational physics. This course is designed for beginning students.

## Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.
<URL>
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CB116

| Course Title | Special Topic in Theoretical Physics 2(Particle Physics) | | |
|---|---|---|---|
| Instructor | Kinoshita Shunichiro | | |
| Semester | Spring Semester 1 | Credit | 2 Credits |
| Course Number | PHY3410 | Language | Japanese |

## Course Objectives

The aim of this course is to learn the basics of quantum field theory, which is the foundation of modern physics.

## Course Contents

Quantum field theory plays important roles in modern physics. In this course, we attempt to understand basic properties of scalar fields, Maxwell fields, and Dirac fields, and quantization of their fields.

## Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.
<URL>
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CB117

| Course Title | Special Topic in Theoretical Physics 3(Cosmology) | | |
|---|---|---|---|
| Instructor | Tanahashi Norihiro | | |
| Semester | Spring Semester | Credit | 2 Credits |
| Course Number | PHY3310 | Language | Japanese |

## Course Objectives

The aim of this course is to help students understand the basic concepts of physical cosmology by reading a textbook written in English.

## Course Contents

This course deals with the basic concepts of physical cosmology.

## Others

※Please refer to the ″Syllabus & Class Schedule Search System″ for details including course schedule, evaluations, textbooks and others.
〈URL〉
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CB118

| Course Title | Special Topic in Theoretical Physics 5(Mathematical Physics) | | |
|---|---|---|---|
| Instructor | Kinoshita Shunichiro | | |
| Semester | Spring Semester 2 | Credit | 2 Credits |
| Course Number | PHY3210 | Language | Japanese |

## Course Objectives

The aim of this course is to learn perturbation theory of interacting quantum fields in quantum field theory.

## Course Contents

Quantum field theory plays important roles in modern physics. In this course, we learn perturbation theory, path integral quantizations, Feynman rules, renormalizations, in order to deal with interacting quantum fields.

## Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.
<URL>
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CB120

| Course Title | Special Topic in Theoretical Physics 6(Statistical Physics) | | |
|---|---|---|---|
| Instructor | Okubo Tsuyoshi | | |
| Semester | Spring Others | Credit | 2 Credits |
| Course Number | PHY3210 | Language | Japanese |

## Course Objectives

This course aims to understand the basics of tensor network representation in statistical physics and quantum many-body problems and to master approximation and computation techniques in tensor networks.

## Course Contents

As examples of tensor networks in statistical physics and quantum many-body problems, we will introduce approximate computation by tensor renormalization group and tensor network representation of quantum many-body states. Starting with a review of low-rank approximation of matrices, the lecture will cover the basics and recent developments of tensor networks and their applications.

## Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.
<URL>
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CB121

| Course Title | Special Topic in Nuclear and Radiation Physics 1(Nuclear Physics) | | |
|---|---|---|---|
| Instructor | Murata Jiro | | |
| Semester | Spring Semester | Credit | 2 Credits |
| Course Number | PHY3410 | Language | Japanese |

## Course Objectives

To learn basic knowledge of particle and nuclear physics for the accelerator experiments, including training of the numerical calculation required for experiments.

## Course Contents

The 20th century's physics has succeeded in establishing the knowledge and understanding of the fundamental origin of matter and force, by using microscopic and chemical techniques.
In this course, basic knowledge of what was known when radioactivity was discovered, properties of particle and nuclei from atomic nuclei to hadrons, quarks, and leptons investigated using natural radioactivity and accelerators will be lectured to understand the underlying common concepts.
The students will be trained to start experimental research, by applying concrete examples together with the lectures.

## Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.
<URL>
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CB122

| Course Title | Special Topic in Nuclear and Radiation Physics 3(Atomic and Molecular Phys.) | | |
|---|---|---|---|
| Instructor | Mitei | | |
| Semester | Spring Others | Credit | 2 Credits |
| Course Number | PHY3210 | Language | Japanese |

Course Objectives

Course Contents

Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.
<URL>
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CB124

| Course Title | Special Topic in Nuclear and Radiation Physics 5(Hadron Physics) | | |
|---|---|---|---|
| Instructor | Yamaguchi Hidetoshi | | |
| Semester | Spring Semester | Credit | 2 Credits |
| Course Number | PHY3410 | Language | Japanese |

## Course Objectives

Hadrons are fundamental particles that constitute the ″matter″ in the universe. The hadrons that are most familiar to us are the proton and the neutron, which are the basis of the synthesis of the various elements in the universe. This lecture focuses on the the role of atomic nuclei in the universe, including cutting-edge topics, such as nucleosynthesis and stellar explosions.

## Course Contents

It was in the middle of 20th century that the atomic nuclei are found to play essential roles in the evolution of the universe and origin of elements. A variety of elements exist in this world have been synthesized through nuclear reactions from hydrogen atoms, which is on going even today. All these synthesis of elements mainly took place at the early universe (100 seconds after Big bang), and in the main sequence stars that have been created and destroyed for 10 billion years. Nuclear reactions are also dominating the stellar evolution process in producing the energy to shine the stars, and eventually could induce a supernova explosion. Challenges have been made to study these nuclear reactions experimentally on the earth. For example, the RI beam factory (RIBF) at RIKEN, they create various nuclides which have never been produced by mankind before, to know the origin of the elements. Our knowledge on the nucleosynthesis is still not complete,e.g., the synthesis of heavy elements was once considered to be well-known, but recent studies revealed some deficit in our understanding. In this lecture, an overview on the role of atomic nuclei in stellar phenomena is given, and the research method to study that is introduced.

## Others

※Please refer to the ″Syllabus & Class Schedule Search System″ for details including course schedule, evaluations, textbooks and others.
<URL>
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CB126

| Course Title | Special Topic in Astrophysics and Solar Terrestrial Physics 1 | | |
|---|---|---|---|
| Instructor | Kitamoto Shunji | | |
| Semester | Spring Semester | Credit | 2 Credits |
| Course Number | PHY3310 | Language | Japanese |

## Course Objectives

This course presents our recent understanding of the universe, especially based on observational results with X-ray. The overview of the interaction between X-rays and matter is also explained in order to interpret the observational results.

## Course Contents

In this course, students will first learn recent concepts about the structure and evolution of the universe. Then students will review interaction between X-rays and matter. The results of the X-ray observation, including recent topics, will be provided and students will understand various astronomical phenomena. X-ray optics and detectors will be introduced.

## Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.
<URL>
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CB128

| Course Title | Introduction to Astrophysics and Solar Terrestrial Physics | | |
|---|---|---|---|
| Instructor | Yamada Shinya | | |
| Semester | Spring Semester | Credit | 2 Credits |
| Course Number | PHY2310 | Language | Japanese |

## Course Objectives

The aim of this course is to understand the structure of the universe and its evolution, high-energy phenomena, black holes, planets (including the earth and moon) and small bodies in the solar system, and exoplanets, based on the latest research results.

## Course Contents

This course is composed of 4 parts:
(1) Overview of phenomena in the planetary atmospheres based on the observations by planetary probes and ground-based telescopes and theories of planetary physics and chemistry. Introduction of polar sciences including fields other than physics. Principle and application of optical remote sensing for planetary observation.
(2) A supermassive black hole that resides in a galaxy, where it is believed to affect the star formation rate and the thermal history of inner galactic gas and to interact with the gas in a cluster of galaxies. Overview of a supermassive black hole, a cluster of galaxies, co-evolution of the galaxy and the black hole, and the latest X-ray observation technologies used for the space mission.
(3) Introduction of Hayabusa2, Martian Moon Exploration mission, and exoplanetary science
(4) Overview of various celestial objects from the large-scale structure to the solar system. Introduction of the formation and circulation of chemical elements in the universe.

## Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.
<URL>
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CB134

| Course Title | Quantum Optics | | |
|---|---|---|---|
| Instructor | Kanai Norikane/Koh Keishin | | |
| Semester | Fall Semester | Credit | 2 Credits |
| Course Number | PHY3510 | Language | Japanese |

## Course Objectives

The aim of the course is to deepen the understanding of the wave nature of light such as interference and diffraction, and the quantum effects of lasers.

## Course Contents

The course outlines the basics of wave optics, quantum theory of light, and the principle of laser. Some physical phenomena using the laser with its application will be also introduced.

## Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.
<URL>
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CB135

| Course Title | Introductory Particle Physics | | |
|---|---|---|---|
| Instructor | Sasagawa Shuji | | |
| Semester | Fall Semester | Credit | 2 Credits |
| Course Number | PHY2410 | Language | Japanese |

## Course Objectives

This course is aimed to learn about the theory, properties and phenomena of elementary particles.

## Course Contents

What are the constituents of matter?　What is the law governing matter? The problem is one of the themes that humanity has pursued for a long time. The result is the standard model of elementary particles. This course explains special relativity, quantum mechanics, quantum field theory and introduces the phenomena of the elementary particles and the properties of quark, leptons, gauge bosons in the context of the historical background. Since the goal of this class is to understand the overview of the theory, individual details will be omitted.

## Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.
<URL>
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CB136

| Course Title | Special Topic in Astrophysics and Solar Terrestrial Physics 8 | | |
|---|---|---|---|
| Instructor | Kameda Shingo | | |
| Semester | Spring Semester | Credit | 2 Credits |
| Course Number | PHY3310 | Language | Japanese |

## Course Objectives

This course aims to develop knowledge about the phenomena observed in the recent lunar and planetary exploration program; the observation results of the astronomical objects and the latest results from the planetary and satellite landing surveys. Students also come to understand the nature of the exoplanets.

## Course Contents

In Japan's lunar and planetary exploration program, the moon orbiting satellite Kaguya and the asteroid explorer have observed an astronomical object with no atmosphere. Subsequently, the asteroid explorer Hayabusa2 and Mervury Explorer Mio was launched. The Mars satellite exploration plan MMX is in preparation. The moon, asteroids and Mercury are all objects with almost no atmosphere. In this course, we will study the latest research results on these objects and the scientific purpose of future exploration plans. On the moon, Mercury surface is near vacuum but there is a dilute metallic atmosphere. We will discuss the origin of the dilute atmosphere using observations from ground-based telescopes and observations from spacecraft. As for asteroids, I will focus on Ryugu on which Hayabusa 2 performed observations and other similar objects, and introduce scientific results obtained by sample return.
In addition, many observations of exoplanets by telescopes have been made, and planets expected to be similar to the Earth have been discovered.

## Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.
<URL>
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CB139

| Course Title | Introduction to Astrophysics 2 | | |
|---|---|---|---|
| Instructor | Taguchi Makoto | | |
| Semester | Fall Semester | Credit | 2 Credits |
| Course Number | PHY2310 | Language | Japanese |

## Course Objectives

Focusing inside the solar system, students are expected to learn basic concepts about the universe's structure and evolution.

## Course Contents

After defining basic concepts to understand this course, students will learn basic ideas about structure and evolution of the celestial bodies in the solar system (sun, planets, dwarf planets, asteroids and comets), physical phenomena on them, exoplanets, and techniques of in-situ and remote observations of them. Students are requested to have prepared their homework referring materials distributed prior to the class and to present their homework and solution of problems shown in class.

## Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.
<URL>
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CB142

| Course Title | Mathematics for Physics 3 | | |
|---|---|---|---|
| Instructor | Suzuki Kenta | | |
| Semester | Spring Semester | Credit | 2 Credits |
| Course Number | PHY2610 | Language | Japanese |

## Course Objectives

The aim of this course is to understand complex analysis for physics problems.

## Course Contents

Complex differentiable functions as known as holomorphic functions have a lot of useful mathematical properties. We learn some theorems relating to them and their applications to calculate definite integrals of real functions on the real domain.

## Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.
<URL>
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CB143

| Course Title | JAXA Space Science and Technology | | |
|---|---|---|---|
| Instructor | Kameda Shingo | | |
| Semester | Fall Semester | Credit | 2 Credits |
| Course Number | PHY2310 | Language | Japanese |

## Course Objectives

This course aims to develop knowledge of space science based on physics through examples of planning, development, and operation in the ongoing space observation project, in addition to the history of space science achievements and technology development by satellites and planetary explorers etc.

## Course Contents

Researchers of the Japan Aerospace Exploration Agency (JAXA), who have been conducting solar system exploration and space observation projects, introduce historical background of space missions and basics about the scientific results of the latest space science projects and the technologies.

## Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.
<URL>
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CB144

| Course Title | Physics Research Internship | | |
|---|---|---|---|
| Instructor | Murata Jiro/Kurita Kazuyoshi | | |
| Semester | Fall Others | Credit | 2 Credits |
| Course Number | PHY9410 | Language | Japanese |

## Course Objectives

1. Widening and deepening understanding of the field and learning how to approach a research project
2. Training students' research skills by taking part in real research
3. Encouraging active involvement in research and developing the career mind of the students

## Course Contents

As one of the shared use national research institutes of Japan, KEK is making steady progress in the basic science using high energy particles from accelerators and stands up front in the world. This training camp internship allows students to work on research projects under the supervision of the world class scientists. They will learn how to approach the problems and the hands on experience will help them acquainting the research matters. Especially students who are interested in the high energy and nuclear physics are strongly encouraged.

## Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.
<URL>
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CB145

| Course Title | English for Physics 1 | | |
|---|---|---|---|
| Instructor | Hirayama Takato/Nakagawa Naoko | | |
| Semester | Fall Semester | Credit | 2 Credits |
| Course Number | PHY2923 | Language | Others |

## Course Objectives

This course provides an opportunity for physics students to use their ability to read text or literature written in English and also to hear lectures in English. Especially, this course provides exercises to understand the technical terms and grammar used in scientific literature. The skill of writing a scientific report will also be taught.

## Course Contents

Students will be divided into two groups. Each group will attend one of either Nakagawa's class or Hirayama's class during the first half of the semester. In the second half of the semester, the groups will be switched. The content of the two classes are as follows:

Nakagawa:

I will conduct reading practice combining rough reading and extensive reading, listening practice with speech materials, and speaking practice on the subject of physics. Writing practice by developing an experiment report in English will be also conducted.

Hirayama:

Students will learn the difference between usual English and scientific English. Then students will read a piece of scientific literature to understand terms, phrases and grammar often used in scientific literature.

## Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.

<URL>

https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CB310

| Course Title | English for Physics 2 | | |
|---|---|---|---|
| Instructor | Nakajima Hideaki | | |
| Semester | Spring Semester | Credit | 2 Credits |
| Course Number | PHY2923 | Language | Others |

## Course Objectives

This course is designed to develop English communication skills for the preparation of presentation materials and scientific manuscripts for publications.

## Course Contents

In this course, reading practice combining rough reading and extensive reading is conducted in various subjects of physics, such as relativity, astrophysics, geophysics, and thermodynamics. Listening practice with speech materials, speaking practice, writing practice, and grammar practice are also included in this course. How to give scientific presentations in English assuming you are presenting at an international conference is also included. This class includes some small tests to check comprehension.

## Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.
<URL>
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CB311

| Course Title | Chemistry for Physics Students | | |
|---|---|---|---|
| Instructor | Tachibana Yuichi | | |
| Semester | Fall Semester | Credit | 2 Credits |
| Course Number | PHY2920 | Language | Japanese |

## Course Objectives

1. The course aims to develop understanding of basic chemical topics that are essential for students' future learning of other scientific subjects and real world experience.
2. The course aims to cultivate a perspective on chemistry essential for students in physics.

## Course Contents

1. The essential points learned in high school "basic chemistry" and "chemistry" will be reviewed and supplemented with additional topics from the physics perspective.
2. Intensive topics in addition to high school chemistry will be introduced. In order to develop better understanding, students will be required to attempt exercises in every lesson.

## Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.
〈URL〉
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CB322

CB323

| Course Title | Biology for Physics Students | | |
|---|---|---|---|
| Instructor | Taki Keiko | | |
| Semester | Spring Semester | Credit | 2 Credits |
| Course Number | PHY2920 | Language | Japanese |

## Course Objectives

This course is designed to learn basics and concepts of Biology and discover your own viewpoints of interest in Life Science.
This class is also designed to gain the ability to make use of information brought about by the diverse fields in Life Science.

## Course Contents

The information brought about by Life Science affects a wide range of fields, and more opportunities using such information are available. In this course, students will learn basic Life Science from some perspectives and discover their viewpoints of interest and get close to Life Science.

## Others

※Please refer to the ″Syllabus & Class Schedule Search System″ for details including course schedule, evaluations, textbooks and others.
〈URL〉
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CB323

| Course Title | Introductory Seminar on Basic Physics | | |
|---|---|---|---|
| Instructor | Harada Tomohiro | | |
| Semester | Spring Semester | Credit | 2 Credits |
| Course Number | PHY1910 | Language | Japanese |

## Course Objectives

Students aim to learn the active attitude required for studying physics in a university and basic knowledge of mathematics and physics. This course supports them to accomplish the goal by themselves. Communication skill is also cultivated through discussion among students, lecturers and teaching assistants.

## Course Contents

Students are designated to a problem exercise class (up to 30 students) or a research class according to the result of placement test conducted at the beginning of school year.
Students in the problem exercise class should be aware of their weak point through solving problems of mathematics and physics learned in a high school. They overcome the weakness by themselves and aim to learn basic academic skills required for studying physics in a university.
Students in the research class are divided into subgroups with approximately 10 students and a lecturer. They perform research or read in turn a textbook concerning a theme they choose to reach a goal as scheduled by themselves. They present the result of their research and discuss questions and courses of the research with other participants in the class

## Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.
<URL>
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CB490

| Course Title | Thesis 1 | | |
|---|---|---|---|
| Instructor | ※ | | |
| Semester | Spring Others | Credit | 4 Credits |
| Course Number | PHY4000 | Language | Japanese |

## Course Objectives

To perform research in theoretical physics or in experimental physics while learning the latest topics of the given theme.

## Course Contents

To perform research in theoretical physics or in experimental physics while learning the latest topics. Students are asked to be active participants of this final course.

## Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.
<URL>
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CB531

| Course Title | Thesis 2 | | |
|---|---|---|---|
| Instructor | ※ | | |
| Semester | Fall Others | Credit | 4 Credits |
| Course Number | PHY4000 | Language | Japanese |

## Course Objectives

To perform research in theoretical physics or in experimental physics while learning the latest topics of the given theme.

## Course Contents

To perform research in theoretical physics or in experimental physics while learning the latest topics. Students are asked to be active participants of this final course. It is required to submit the final paper and there is a final aural presentation.

## Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.
<URL>
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CB561

| Course Title | Organic Chemistry 1 | | |
|---|---|---|---|
| Instructor | Yamanaka Masahiro | | |
| Semester | Fall Semester | Credit | 2 Credits |
| Course Number | CHE2400 | Language | Japanese |

## Course Objectives

In this course, students will acquire fundamental knowledge necessary to study organic chemistry, while developing their ability to think logically about organic reaction mechanisms.

## Course Contents

Students will acquire knowledge fundamental to the understanding of molecular structure and organic reactions. Lewis dot structure, resonance theory, inductive and resonance effects, and other fundamental concepts will be discussed. In addition, students will acquire how to denote electron movement using curved arrow notation. Based on those basic concepts, students will acquire knowledge in terms of organic reactions utilizing halogenated alkanes/alkenes and fundamental aspects of nucleophilic addition reactions of carbonyl compounds..

## Others

※Please refer to the ″Syllabus & Class Schedule Search System″ for details including course schedule, evaluations, textbooks and others.
〈URL〉
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CC006

| Course Title | Organic Chemistry 2 | | |
|---|---|---|---|
| Instructor | Minoura Mao | | |
| Semester | Spring Semester | Credit | 2 Credits |
| Course Number | CHE2400 | Language | Japanese |

## Course Objectives

Focusing on the chemical reactions which form the backbone of organic chemistry, this course aims to give students a systematic understanding of the field.

## Course Contents

The organic chemistry concepts and reactions traditionally taught in lectures have been systematically condensed into this course. In our university, understanding and uses of various functional groups are discussed in the lectures, which are divided into Organic Chemistry 1 – 3 and other more advanced courses. This course is a continuation of Organic Chemistry 1. The structures and reactions of various classes of organic compounds (aldehydes, ketones, carbonic acid derivatives, and aromatic compounds) will be discussed with the mechanistic approach. The characteristic properties of carbonyl and amino groups will be discussed along with the reactions of organic compounds containing them. This lecture will build upon concepts fundamental to organic chemistry (hybridized orbitals, resonance effects, and induction effects).

## Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.
<URL>
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CC014

| Course Title | Biology for Chemistry Students | | |
|---|---|---|---|
| Instructor | Taki Keiko | | |
| Semester | Fall Semester | Credit | 2 Credits |
| Course Number | CHE2910 | Language | Japanese |

## Course Objectives

This course is designed to learn basics and concepts of Biology and discover your own viewpoints of interest in Life Science.
This class is also designed to gain the ability to make use of information brought about by the diverse fields in Life Science.

## Course Contents

The information brought about by Life Science affects a wide range of fields, and more opportunities using such information are available. In this course, students will learn basic Life Science from some perspectives and discover their viewpoints of interest and get close to Life Science.

## Others

※Please refer to the ″Syllabus & Class Schedule Search System″ for details including course schedule, evaluations, textbooks and others.
〈URL〉
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CC025

| Course Title | Physics 1 | | |
|---|---|---|---|
| Instructor | Sato Hirohiko | | |
| Semester | Fall Semester | Credit | 2 Credits |
| Course Number | CHE2900 | Language | Japanese |

## Course Objectives

One could say that all natural phenomena are governed by the laws of physics. This class deals with the physics governing objects on the macro-scale. In other words, the fundamentals of classical mechanics will be discussed in this class. Thus, in taking this course, students will gain the ability to quantitatively describe the motion of an object. In addition, they will learn methods for predicting an object's motion and trajectory. Furthermore, students will learn the fundamental concepts necessary to study quantum mechanics, the laws which govern atoms and molecules at the microscopic level.

## Course Contents

Utilizing differential calculus, students will learn how to accurately express the movement of an object. Next, while solving real-world problems, students will learn about mass and force. Furthermore, students will learn the general concept of energy in order to better comprehend the big picture painted by the laws of motion. Finally, students will learn about momentum and angular momentum. In this class, the basics of electromagnetism are also scheduled to be touched upon.

## Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.
<URL>
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CC034

| Course Title | Physics 2 | | |
|---|---|---|---|
| Instructor | Sato Hirohiko | | |
| Semester | Spring Semester | Credit | 2 Credits |
| Course Number | CHE2910 | Language | Japanese |

## Course Objectives

The microscopic world of atoms and molecules is governed by the physics of quantum mechanics. In this class, students will learn the fundamentals of quantum mechanics. This course was specifically designed with students majoring in chemistry in mind. Essential concepts necessary to understand the nature of atoms will be emphasized. Within quantum mechanics, many phenomena exist that are very abnormal compared to what one sees in their daily life. While it takes time to familiarize oneself with these foreign concepts, students will surely find it to be a very interesting subject, even among the pure sciences.

## Course Contents

To start the course, the limits of classical mechanics will be discussed, followed by a simple introduction to the details surrounding the discovery of quantum mechanics. Following this, the Schrodinger equation, which forms the basis for quantum mechanics, will be introduced, followed by an explanation of the significance of the wave function. By solving some simple cases of the Schrodinger equation, students will cultivate a deeper understanding of eigenvalues and eigenfunctions. Finally, by using the Schrodinger equation in three dimensions and applying it to central force potential problems, students will be able to understand the current state of electrons within an atom.

## Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.
<URL>
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CC035

| Course Title | Introduction to Physical Chemistry | | |
|---|---|---|---|
| Instructor | Edamoto Kazuyuki | | |
| Semester | Spring Semester | Credit | 2 Credits |
| Course Number | CHE1200 | Language | Japanese |

## Course Objectives

This course aims to provide students with the basic content of the field of "quantum chemistry" in physical chemistry, which is necessary for studying chemistry at the collegiate level.

## Course Contents

The basic concepts of physics (momentum, energy, etc.) necessary for learning physical chemistry will be explained. Based on this, the concepts of quantum theory (wavefunction, Schrödinger equation, etc.) that are necessary for understanding the electronic structure of atoms will be explained. In addition, the electronic states of molecules and the nature of chemical bonds will be also explained.

## Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.
<URL>
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CC073

| Course Title | Introduction to Analytical Chemistry | | |
|---|---|---|---|
| Instructor | Miyabe Kanji | | |
| Semester | Spring Semester | Credit | 2 Credits |
| Course Number | CHE1300 | Language | Japanese |

## Course Objectives

This course aims to teach students the fundamentals of analytical chemistry as well as quantitative analysis methods grounded in stoichiometric chemical equilibrium.

## Course Contents

The goal of analytical chemistry is the identification of all of a substance's components (qualitative) and concentrations (quantitative). The methodology employed to do so can be divided into chemical methods (volumetric methods, gravimetric methods, etc.) and physical methods (instrumental analysis). Analytical chemistry is a discipline that forms the foundation of chemical analysis from both a theoretical and experimental standpoint.
In this lecture, students will receive the complete picture of the important areas of analytical chemistry (units, how to deal with varying means of expressing concentration and quantity of a substance, etc.). Following this, students will be shown how to deal with chemical equilibrium in solution from a thermodynamic perspective. Afterwards, using acid–base equilibrium as a concrete example, stoichiometric analysis procedures will be explained together with related topics. After this, the common ion effect will be discussed along with how to treat the dissociation of polyprotic acids from a stoichiometric perspective. At the end, the course's contents will be solidified with a review of the fundamentals of analytical chemistry and stoichiometric calculations.

## Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.
<URL>
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CC074

| Course Title | Introduction to Organic Chemistry | | |
|---|---|---|---|
| Instructor | Yamanaka Masahiro | | |
| Semester | Spring Semester | Credit | 2 Credits |
| Course Number | CHE1400 | Language | Japanese |

## Course Objectives

This course aims to give students an understanding of the basic concepts such as the nature of chemical bonds, resonance effects, and hybrid orbitals in organic chemistry. Additionally, it aims to show students how to denote the flow of electrons using curved-arrow notation, gaining a clearer understanding of acidity/basicity and how reactions occur between organic molecules.

## Course Contents

By gaining a firm understanding of the chemical bonds that make up organic compounds and the flow of electrons that dictates the organic reactions, students will learn the fundamentals of organic chemistry that govern life itself. This is a course that connects the high school chemistry courses with the organic chemistry learned at the collegiate level. Students will learn how to properly write Lewis dot structures and understand the causes and effects of resonance structures. By learning how to denote the flow of electrons and the breaking and formation of chemical bonds with curved-arrow notation, students will learn the fundamentals of organic chemistry with reaction mechanisms.

## Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.
<URL>
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CC075

| Course Title | Introduction to Inorganic Chemistry | | |
|---|---|---|---|
| Instructor | Matsushita Nobuyuki | | |
| Semester | Spring Semester | Credit | 2 Credits |
| Course Number | CHE1500 | Language | Japanese |

## Course Objectives

As an introduction into inorganic chemistry, this course aims to give students an understanding of the fundamental nature of elements, atomic structure, periodicity of elements and the periodic table. As basics of composition of substances, an understanding of chemical bonds, molecular structure, and crystal structures is also aim.

## Course Contents

Inorganic chemistry chiefly deals with inorganic substances, however it is impossible to pull all types of inorganic compounds, each with their own unique properties and characteristics, under a single comprehensive umbrella. In this field, one gains an understanding of an element's characteristics via the periodic table, allowing one to systematically understand the properties and reactions for various inorganic substances.
In this course, the aim is to lay the groundwork for students to gain a systematic understanding of various elements and substances through the periodic table.
To that end, students will first learn atomic structure, the origins of periodic law, and the periodicity of various properties of elements.
Next, students will learn the characteristics of molecular structure and bonds as well as what information one can infer regarding them from the periodic table.
Following this, students will learn crystal structures commonly seen in inorganic substances, which adapt solid states in many cases. The relation of these crystal structures to chemical bonds will be discussed, in addition to periodic trends.

## Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.
<URL>
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CC076

| Course Title | Mathematics for Chemistry Students | | |
|---|---|---|---|
| Instructor | Mochizuki Yuji | | |
| Semester | Spring Semester | Credit | 2 Credits |
| Course Number | CHE1900 | Language | Japanese |

## Course Objectives

This course covers the fundamental mathematics required to study physical chemistry and computational chemistry in this department.

## Course Contents

Students will learn the fundamentals of number sequences, calculus, linear algebra, and statistics. Mathematical ability and understanding should be necessary in physical chemistry and computational chemistry. Thus, this course will serve as a preparation of base for those subjects.

## Others

※Please refer to the ″Syllabus & Class Schedule Search System″ for details including course schedule, evaluations, textbooks and others.
〈URL〉
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CC077

| Course Title | Basic Experiments in Chemistry | | |
|---|---|---|---|
| Instructor | Tabuchi Mari | | |
| Semester | Spring Semester | Credit | 2 Credits |
| Course Number | CHE1100 | Language | Japanese |

## Course Objectives

As an introduction phase in “Academic Learning Methods,” this discipline teaches students the fundamental experimental techniques, calculations, and information science knowledge required from one who wishes to conduct chemical research. At the same time, students will learn the proper mental attitude, ethics, conduct, safety management skills, and information literacy required by those wishing to go into research.

## Course Contents

This discipline is laboratory based, and consists of the following three categories: (1) information science, (2) synthesis experiments, and (3) measurement experiments. (1) In the information science, students will learn the fundamental information necessary to appropriately interact with the sudden changes brought about by the internet and mobile devices. (2) In the synthesis, students will synthesize simple organic compounds, familiarizing themselves with the fundamental skills of weighing and filtering reagents. (3) In the measurement experiment, students will perform a neutralization titration, learning about the theory and techniques employed while dealing with acids, bases, pH measurement, and titrations. Additionally, students will learn about how to process the data they gather.

## Others

※Please refer to the ″Syllabus & Class Schedule Search System″ for details including course schedule, evaluations, textbooks and others.
<URL>
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CC078

| Course Title | Physical Chemistry 1 | | |
|---|---|---|---|
| Instructor | Edamoto Kazuyuki | | |
| Semester | Fall Semester | Credit | 2 Credits |
| Course Number | CHE2200 | Language | Japanese |

## Course Objectives

Physical and chemical changes are accompanied by a net increase in entropy. This lecture aims to provide insight into the concept of entropy, which is necessary to thoroughly understand the nature of spontaneous change and equilibrium.

## Course Contents

The First Law of Thermodynamics (Energy Conservation Law) will be explained. The concept of a state function will be introduced, and Hess's Law, which is critical to the understanding of thermochemistry, will be discussed.

The Second Law of Thermodynamics (Principle of Increase of Entropy) will be explained. Entropy will be defined as a state function, and through various exercises, students will come to learn that spontaneous changes are accompanied by an increase in entropy.

The concept of Gibbs energy will be introduced, enabling students to gain a unified understanding of phase and chemical equilibrium.

## Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.

<URL>

https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CC079

| Course Title | Analytical Chemistry 1 | | |
|---|---|---|---|
| Instructor | Sasaki Naoki | | |
| Semester | Fall Semester | Credit | 2 Credits |
| Course Number | CHE2300 | Language | Japanese |

## Course Objectives

By gaining a fundamental understanding of the principles and theory behind various instrumental analysis techniques, the groundwork will be laid for students to apply both qualitative and quantitative analysis methods as well as structural and state analysis methods to practical problems. This course aims to teach students fundamental instrumental analysis techniques.

## Course Contents

A wide variety of instrumental analysis methods are used in order to gain qualitative and quantitative data on various analytes. Additionally, instruments can be used for structural analysis, state analysis, and the determination of an analyte's physical properties, among many other things. In this lecture, the fundamental ideas behind highly versatile spectroscopic analysis methods and separation analysis methods will be discussed.
First, the general ideas behind spectroscopy will be introduced, after which the fundamentals behind various individual spectroscopic analysis methods will be explained. Next, the general ideas behind separation analysis will be introduced, after which the fundamentals behind various individual separation analysis methods will be explained.

## Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.
<URL>
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CC080

| Course Title | Inorganic Chemistry 1 | | |
|---|---|---|---|
| Instructor | Matsushita Nobuyuki | | |
| Semester | Fall Semester | Credit | 2 Credits |
| Course Number | CHE2500 | Language | Japanese |

## Course Objectives

This course aims to give students an understanding of acid–base reactions and oxidation–reduction reactions as basics of inorganic chemistry. Furthermore, an understanding of metal coordination compounds from the standpoint of acid–base reactions and d–orbital bonds is aim. Additionally, an understanding of hydrogen, in terms of elemental science, and hydrogen compounds is also aim.

## Course Contents

Inorganic chemistry chiefly deals with inorganic substances, however it is impossible to pull all types of inorganic compounds, each with their own unique properties and characteristics, under a single comprehensive umbrella. In this field, students will gain an understanding of an element's characteristics via the periodic table, allowing them to systematically understand the properties and reactions for various inorganic substances.
In this course, students will first learn acid–base and oxidation–reduction reactions as fundamental and important chemical reactions in inorganic chemistry, based on an understanding in high school.
Next, students will learn about metal coordination compounds, which were not thoroughly covered in high school, from the perspective of acid–base reactions and d–orbital bonds.
Lastly, students will learn about hydrogen as the first element of the periodic table in terms of elemental science. This course will give in detail properties and bonds of hydrogen atom, hydrogen molecule and hydrogen compounds, while considering about the relationship with other elements.

## Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.
<URL>
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CC081

| Course Title | Standard Experiments in Chemistry A | | |
|---|---|---|---|
| Instructor | Wada Tohru | | |
| Semester | Fall Semester | Credit | 2 Credits |
| Course Number | CHE2100 | Language | Japanese |

## Course Objectives

By conducting experiments in the major fields of chemistry, physical chemistry, inorganic chemistry, organic chemistry, and analytical chemistry, this course aims to teach students how to manage experiments, analyze data, and write summary reports. Through conducting actual experiments, students will deepen their understanding of the concepts discussed in the lectures.

## Course Contents

The experiments to be conducted are listed as follows. In physical chemistry: “Determining the Heat of Solvation and the Temperature Dependence of the Solubility of Oxalic Acid.” In organic chemistry: “Synthesis of Methyl Benzoate.” In inorganic chemistry: “Synthesis and Identification of Metal Complexes.” In analytical chemistry: “Redox Titration.” Before each experiment, the relevant theory will be thoroughly discussed along with data analysis and processing methods, how to create the necessary charts and graphs, and how to create the experimental report. After each experiment, one-on-one or small group interview will be conducted to ensure that students completely understand the experiment, and to help them write better reports.

## Others

※Please refer to the ″Syllabus & Class Schedule Search System″ for details including course schedule, evaluations, textbooks and others.
〈URL〉
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CC082

| Course Title | Physical Chemistry 2 | | |
|---|---|---|---|
| Instructor | Tanabe Ichiro | | |
| Semester | Spring Semester | Credit | 2 Credits |
| Course Number | CHE2200 | Language | Japanese |

## Course Objectives

To learn basics of the quantum mechanics/quantum chemistry which describe states and behaviors of electrons, atoms, and molecules.

## Course Contents

The course begins with the introduction (the necessity and characteristics) of the quantum mechanics. While the classic mechanics successfully describes the dynamics of macro matters, the quantum mechanics is need to describe that of micro matters. Subsequently, the mathematical techniques to learn the quantum mechanics are introduced, and quantum mechanical descriptions of the translational, oscillatory, and rotational movements are explained. Finally, electronic structures of atoms are explained through the Schrodinger.

## Others

※Please refer to the ″Syllabus & Class Schedule Search System″ for details including course schedule, evaluations, textbooks and others.
〈URL〉
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CC083

| Course Title | Standard Experiments in Chemistry B | | |
|---|---|---|---|
| Instructor | Nagano Shusaku | | |
| Semester | Spring Semester | Credit | 4 Credits |
| Course Number | CHE2100 | Language | Japanese |

## Course Objectives

Students will conduct synthesis experiments (organic and inorganic chemistry) as well as calculation/measurement experiments (physical, analytical, and computational chemistry) in order to improve their skills at managing experiments, analyzing data, and writing reports. Through conducting actual experiments, students will deepen their understanding of the concepts discussed in the lectures. In addition, students will learn the proper ethics, conduct, and safety skills that are required when they conduct responsible experiments and research activities.

## Course Contents

Students will conduct synthetic experiments (organic and inorganic chemistry) as well as calculation/measurement experiments (physical, analytical, and computational chemistry). Students will build upon the data analysis and processing methods, as well as the graphing/table-making skills learned in “Basic Experiments in Chemistry” and “Standard Experiments in Chemistry A.” After each experiment, one-on-one or slightly larger meetings will be conducted to ensure that students completely understand the experiment, and to help them write better reports.

## Others

※Please refer to the ″Syllabus & Class Schedule Search System″ for details including course schedule, evaluations, textbooks and others.
<URL>
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CC084

| Course Title | Standard Experiments in Chemistry C | | |
|---|---|---|---|
| Instructor | Yamanaka Masahiro | | |
| Semester | Fall Semester | Credit | 4 Credits |
| Course Number | CHE2100 | Language | Japanese |

## Course Objectives

The aims of this experimental class are to learn experimental techniques, data analyses, and report-writings through synthesis experiments (organic and inorganic chemistry) and measurement experiments (physical and analytical chemistry). Through conducting actual experiments, students will raise their experimental skills and deepen their understanding of the concepts discussed in the lectures.

## Course Contents

Students will conduct synthetic experiments (organic and inorganic chemistry) and measurement experiments (physical and analytical chemistry). Students will prepare experimental reports based on the data analysis and processing methods, as well as the graphing/table-making skills learned in "Basic Experiments in Chemistry," "Standard Experiments in Chemistry A," and "Standard Experiments in Chemistry B." After each experiment, a one-on-one interview or a group interview will be conducted to ensure that students completely understand the experiment, and to help them write better reports.

## Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.
<URL>
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CC085

| Course Title | English for Chemistry Students | | |
|---|---|---|---|
| Instructor | Nakagawa Naoko/Wada Tohru/Sasaki Naoki | | |
| Semester | Fall Semester | Credit | 2 Credits |
| Course Number | CHE2903 | Language | Others |

## Course Objectives

This course provides an opportunity for chemistry students to use their ability to read text or literature written in English and also to hear lectures in English.　Especially, this course provides exercises to understand the technical terms and grammar used in scientific literature.　The skill of writing a scientific report will also be taught.

## Course Contents

Students, divided into two groups, will attend classes given by Nakagawa and Wada/Sasaki, respectively.

Nakagawa Class:
Students will perform intensive and extensive reading exercises based on chemical topics, listening exercises using recorded sounds, writing exercises, comprising writing an experiment report, and speaking exercises.

Wada/Sasaki Class:
What is Chemical English? How is it different from ″ordinary″ English? Students will learn the grammars that appear frequently in Chemical English and perform listening and reading exercises.

## Others

※Please refer to the ″Syllabus & Class Schedule Search System″ for details including course schedule, evaluations, textbooks and others.
〈URL〉
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CC086

| Course Title | Molecular Dynamics Theory | | |
|---|---|---|---|
| Instructor | Komeiji Yuuto | | |
| Semester | Fall Semester | Credit | 2 Credits |
| Course Number | CHE3610 | Language | Japanese |

## Course Objectives

This course will discuss molecular dynamics simulation (MD), an important computational method of determining a molecule's structure, properties, and functions. The students wil learn how to perform MD simulations, as well as the the theory behind them and their potential applications.

## Course Contents

The molecular dynamics (MD) simulation is a computational method to simulate dynamical behaviors of molecules. In MD, the forces acting upon component atoms of molecules are calculated and used to calculate their motion in real time. The MD method is applied to a wide variety of substances including water, liquid crystals, proteins, DNA, and so on, to give conjectures as to their stable structure, their dynamic structure, and their energy state. In this class, students will be taught how to perform MD simulation. In addition, the theory and algorithms behind it, as well as its practical applications, will be discussed. This lecture will mostly focus on the classical MD method, which is based on classical mechanics; however, the ab initio MD method based on quantum mechanics and combination of AI and MD will also be introduced.　During the lectures, simulation calculations will often be run. Practice makes perfect in this subject; as such, good attendance and punctual report submissions are a must. Students will be required to take a test to gauge their level of understanding at the end.

## Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.
<URL>
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CC106

| Course Title | Organic Chemistry 3 | | |
|---|---|---|---|
| Instructor | Morimoto Masakazu | | |
| Semester | Fall Semester | Credit | 2 Credits |
| Course Number | CHE2410 | Language | Japanese |

## Course Objectives

A degree from the College of Science is a result of much hard work and study, and is meant to show that a student "understands the fundamental principles, laws, and theory in [their] chosen field, and can apply them as necessary." In order to make such a statement true, students need to learn about the structure and reactions of polycyclic aromatic compounds and heterocyclic aromatic compounds. They will also need to learn about radical reactions, rearrangement reactions, and pericyclic reactions in order to deepen their understanding of the practical applications of organic chemistry.

## Course Contents

Polycyclic aromatic compounds and heterocyclic aromatic compounds have important uses in pharmaceuticals and various biological processes, and are often used in certain industries as functional materials. In the first half of this course, students will build upon the fundamental organic chemistry concepts learned in Organic Chemistry 1 and 2 to learn about the structure, reactions, and synthesis of polycyclic and heterocyclic aromatic compounds. For example, the reactivity and selectivity in their electrophilic and nucleophilic substitution reactions will be compared to what students have previously learned about benzene. This will be discussed from the point of view of their electronic structures and the stability of reaction intermediates. In the second half of the course, radical reactions, rearrangement reactions, and pericyclic reactions (Diels–Alder reactions and electrocyclic reactions) will be lectured.

## Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.
<URL>
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CC113

| Course Title | Spectrometric Identification of Organic Compounds | | |
|---|---|---|---|
| Instructor | Morimoto Masakazu | | |
| Semester | Spring Semester | Credit | 2 Credits |
| Course Number | CHE2400 | Language | Japanese |

## Course Objectives

A degree from the College of Science is a result of much hard work and study, and is meant to show that a student "understands the fundamental principles, laws, and theory in [their] chosen field, and can apply them as necessary." In order to make such a statement true, students need to learn the theory behind nuclear magnetic resonance (NMR) spectroscopy, mass spectrometry (MS), infrared spectroscopy (IR), as well as other instrumental analysis methods. Students will need to learn spectral analysis methods, and be able to apply this knowledge to identify the chemical structure of organic compounds from spectral data.

## Course Contents

In organic chemistry research, being able to determine the chemical structure of reaction products is essential. In this lecture, students will learn the theory behind NMR, MS, IR, and other instrumental analysis methods, as well as how to interpret the spectral data.
After explaining the phenomenon of nuclear magnetic resonance, the necessary information on chemical shifts, integration intensities, spin–spin coupling, and chemical equivalence required to analyze $^{1}$H NMR spectra will be explained. Students will then practice how to determine a chemical structure from NMR spectra. $^{13}$C NMR will also be discussed, paying particular attention to its similarities and differences compared to $^{1}$H NMR, as well as how it can be used as a compliment to $^{1}$H NMR.
Following this, the theory behind various ionization methods and ion separation methods will be discussed. Students will then be taught how to interpret mass spectrometry data based on electron–impact ionization.
The course will then move on to IR, whereupon molecular vibrational modes and selection rules will be discussed. Students will then be taught the absorption wavenumbers of various functional groups through real examples, whereupon it will be explained how to interpret IR spectra.
Finally, students will practice identifying the structure of unknown compounds through interpretation of NMR, MS, and IR data.

## Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.
<URL>
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CC114

| Course Title | Organic Chemistry of Natural Products | | |
|---|---|---|---|
| Instructor | Ohsaki Ayumi | | |
| Semester | Spring Semester | Credit | 2 Credits |
| Course Number | CHE3410 | Language | Japanese |

## Course Objectives

The aim of this course is to help students acquire an understanding of the naturally occurring organic compounds familiar to us.

## Course Contents

This course deals with the structure and properties of natural products, focusing on sugars, amino acids, aromatic compounds, terpenoids and alkaloids. It covers from the review of high school to the latest finding of the research. Structure determination and biological activity of natural products used in research are also discussed.

## Others

※Please refer to the ″Syllabus & Class Schedule Search System″ for details including course schedule, evaluations, textbooks and others.
<URL>
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CC115

| Course Title | Organic Synthetic Chemistry | | |
|---|---|---|---|
| Instructor | Minoura Mao | | |
| Semester | Fall Semester | Credit | 2 Credits |
| Course Number | CHE3410 | Language | Japanese |

## Course Objectives

Using students' fundamental knowledge of the various properties of organic compounds as a basis, this course aims to deepen their understanding of the fundamentals whilst enabling them to cultivate a systematic understanding of common synthesis methods.

## Course Contents

This course will discuss the fundamental reaction types and reagents encountered in organic synthesis. While gaining a systematic understanding of the fundamentals, students will practice using reaction mechanisms to analyze the outcomes of a reaction. Lectures will be mainly conducted on the blackboard, but important explanations and practice problems will be handed out in class. In order to ensure that students have completely understood the material covered in the lectures, three exams will be conducted (includes the final exam).

## Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.
<URL>
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CC116

| Course Title | Seminar on Chemistry | | |
|---|---|---|---|
| Instructor | Tabuchi Mari | | |
| Semester | Fall Semester | Credit | 2 Credits |
| Course Number | CHE2010 | Language | Japanese |

## Course Objectives

In order to cultivate a broad outlook with regards to the field of chemistry, students will sharpen their problem-solving abilities through independent study of a topic of their choice.

## Course Contents

Each instructor will be in charge of a few students, who will each choose a subject within the field of chemistry to independently investigate. Students will consult with their assigned instructor to determine the specific contents of their independent study. At the end, students will give an oral presentation of their findings. Students will need to take an active approach towards the investigation of their chosen subject and make steady progress, as frequent discussions with their assigned instructor will play a large part in determining the quality of their final presentation. Students will learn how to reference information found in texts as well as on the internet for use in their investigations. While creating their presentation and reports, students will need to use Word and PowerPoint.

## Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.
<URL>
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CC148

| Course Title | Reaction Kinetics | | |
|---|---|---|---|
| Instructor | Nagano Shusaku | | |
| Semester | Spring Semester | Credit | 2 Credits |
| Course Number | CHE2200 | Language | Japanese |

## Course Objectives

In this course, students study empirical chemical kinetics for analysis of chemical reactions, as well as how to make predictions about reaction mechanisms based on the rate of reaction.

## Course Contents

Chemical reaction theory is a field in which one examines how the chemical composition of a substance changes as a function of time. The course will start by defining the reaction rate and using this definition to discuss the kinetics of various chemical reactions. Students will learn why reaction rates vary from reaction to reaction, and why they change as a result of certain reaction conditions such as temperature and pressure. Additionally, the relation between a reaction's rate equation and its mechanism will be discussed along with research methods that make use of reaction rate theory.

## Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.
<URL>
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CC167

| Course Title | Solid Materials Science | | |
|---|---|---|---|
| Instructor | Edamoto Kazuyuki | | |
| Semester | Spring Semester | Credit | 2 Credits |
| Course Number | CHE3210 | Language | Japanese |

## Course Objectives

This course aims to provide the comprehensive understanding about solids' physical properties necessary for understanding the origins of a variety of solids' functionalities.

## Course Contents

Many physical properties of solids are determined by electronic structures in solids. This course aims to explain theories of electronic structures in solids and to discuss electrical conduction and optical properties of solids on the basis of the theories. Additionally, the course discusses magnetic properties of solids, which are important especially for practical applications.

## Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.
<URL>
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CC173

| Course Title | Inorganic Chemistry 2 | | |
|---|---|---|---|
| Instructor | Matsushita Nobuyuki | | |
| Semester | Spring Semester | Credit | 2 Credits |
| Course Number | CHE2510 | Language | Japanese |

## Course Objectives

This course aims to give students an understanding of properties and characteristics of substances of the s-block and p-block elements of the periodic table, standing on "the elements", while taking account of the similarities and systematic changes depending on "groups" and "periods".

## Course Contents

Inorganic chemistry is a field that deals with all elements found on the periodic table. Characters of diverse elements, and properties and bonds of compounds formed by combination of the elements can be logically understood based on atomic and molecular orbitals.
In this lecture, students will learn about s-block and p-block elements and the properties and bonds of their compounds, while paying particular attention to the groups and periods of the periodic table. The course will not consist of memorizing the properties of each element one-by-one, but rather understanding the similarities and differences of each group of elements systematically.
Continuing from Inorganic Chemistry 1, where students learned about hydrogen, the course will first cover oxygen, which forms compounds with almost of all elements. Students will learn about the character of oxygen as the element, and the properties and bonds of the compounds (oxides).
Afterwards, students will learn about the similarities and differences exhibited by elements within each group on the periodic table. Trends of element's periodicity within and across groups will be discussed.

## Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.
<URL>
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CC175

| Course Title | Analytical Chemistry 2 | | |
|---|---|---|---|
| Instructor | Miyabe Kanji | | |
| Semester | Spring Semester | Credit | 2 Credits |
| Course Number | CHE2310 | Language | Japanese |

## Course Objectives

This course aims to teach students the fundamental principles of quantitative chemical analysis, which forms the backbone of analytical chemistry. Students will pick up the necessary knowledge required to perform actual analysis (experiments, research).

## Course Contents

Analytical chemistry is critical to research conducted in the physical sciences, pharmaceutical sciences, medical sciences, agricultural sciences, and engineering. On top of this, it is used in the QA/QC of industrial goods, environmental surveys, medical diagnoses, criminal investigations, and food safety evaluations, among other things closely related to our everyday lives. Analytical chemistry is made up of two fundamental components: qualitative analysis and quantitative analysis. The former analysis takes a sample (solid, liquid, gas, or multi-phase) and determines exactly what kind of chemical substance(s) it contains. The latter determines how much of the substance is present in the sample, or what its concentration is. Quantitative analysis also helps deepen one's understanding of chemical reactions. In this lecture, students will review the basics of quantitative analysis learned in Introduction to Analytical Chemistry. The applications of this knowledge will be discussed, including but not limited to: complex-forming reactions and chelatometric titrations, precipitation reactions and precipitation titrations, gravimetric analysis, oxidation-reduction reactions and titrations as well as partition equilibria.

## Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.
<URL>
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CC176

| Course Title | Physical Chemistry 3 | | |
|---|---|---|---|
| Instructor | Nagano Shusaku | | |
| Semester | Fall Semester | Credit | 2 Credits |
| Course Number | CHE2210 | Language | Japanese |

## Course Objectives

In this class, students study the basic concept of the molecular orbital method and understand the molecular structure and electronic state of molecules. Moreover, students also study basic spectroscopy, magnetic resonance, and X-ray scattering on how to evaluate molecular structure based on quantum chemistry and structural chemistry.

## Course Contents

To understand the molecular structure from quantum theory is necessary for structural analysis and studies on optical and electronic molecular properties. In this lecture, students study the basic concept and physical meaning of the molecular orbital method and understand the molecular structure and molecular electronic state. Students also study on spectroscopy, which analyzes molecular and electronic structures from the interaction between light and molecules. Students understand vibrational and rotational spectra and electronic spectra. Besides, students learn the basics of magnetic resonance and X-ray scattering for the structural analysis methods in chemistry.

## Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.
<URL>
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CC179

| Course Title | Molecular Orbital Theory | | |
|---|---|---|---|
| Instructor | Mochizuki Yuji | | |
| Semester | Spring Semester | Credit | 2 Credits |
| Course Number | CHE3610 | Language | Japanese |

## Course Objectives

Students will learn the fundamentals of molecular orbital calculations available with such as the GAUSSIAN program.

## Course Contents

The Hartree-Fock (HF) method is considered as a starting point toward more sophisticated molecular orbital methods providing numerical solutions of the Schrodinger equation for electrons. The HF wavefunction is of single determinant type, and the electron-electron interactions are approximated in an averaged way with self-consistency. In this course, the fundamental concept and associated mathematical representations of HF are briefed, and then the protocols for computational processing to obtain the HF solution are described. Furthermore, several topics of electron correlated treatment, density functional theories, geometry optimization, and even quantum computer will be addressed as well. As a general statement, this course will be beneficial as a suitable review of theoretical backgrounds in the practices using the GAUSSIAN program in the course of Chemistry experiments B.

## Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.
<URL>
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CC180

| Course Title | Polymer Chemistry | | |
|---|---|---|---|
| Instructor | Morimoto Masakazu | | |
| Semester | Spring Semester | Credit | 2 Credits |
| Course Number | CHE3410 | Language | Japanese |

## Course Objectives

A degree from the College of Science is a result of much hard work and study, and is meant to show that a student "understands the fundamental principles, laws, and theory in [their] chosen field, and can apply them as necessary." In order to make such a statement true, this course will cover the fundamentals of polymer chemistry, specifically focusing on the structures and properties of polymer compounds as well as organic chemistry in polymer synthesis.

## Course Contents

Polymers are widely used as indispensable materials in our daily life, such as synthetic fibers, packaging materials, heat-resistant materials, and so on. In this course, the structure and properties of polymers will be discussed in comparison with low-molecular-weight compounds and then students learn about the chemical reactions that convert monomers into polymers (polymerization reactions) and the chemical reactions of polymers from the viewpoint of organic chemistry. In addition, examples of functional polymers used in electronics, photonics, biomedicine, and other fields and recent academic research topics will be introduced.

## Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.
<URL>
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CC182

| Course Title | Physical Properties of Polymers | | |
|---|---|---|---|
| Instructor | Nojima Shuichi | | |
| Semester | Fall Semester | Credit | 2 Credits |
| Course Number | CHE3210 | Language | Japanese |

## Course Objectives

The purpose of this course is that the students gain a deeper understanding of the structure and properties characteristic of polymers. They will learn about the shape and behavior of isolated polymer chains, the nature of polymer solutions, and the structure and functions of polymer aggregates, along with the various general properties of polymeric materials.

## Course Contents

This course will cover the shape and behavior of isolated polymer chains (single polymer chains), the properties of dilute and concentrated polymer solutions, as well as the structure and properties of polymer blends. Furthermore, the formation and structure of polymer aggregates will be discussed along with the various general properties of polymeric materials. With this knowledge, this course aims to show the students how to relate the macroscopic properties exhibited by polymers to their microscopic structure and behavior. Lastly, the various structures formed within polymer aggregates and the methods to elucidate them will be discussed.

## Others

※Please refer to the ″Syllabus & Class Schedule Search System″ for details including course schedule, evaluations, textbooks and others.
<URL>
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CC183

| Course Title | Frontier of Chemistry | | |
|---|---|---|---|
| Instructor | Sasaki Naoki | | |
| Semester | Fall Semester | Credit | 2 Credits |
| Course Number | CHE2010 | Language | Japanese |

## Course Objectives

By hearing about the contents of the latest research in various specialized fields, students will learn exactly what research is and what it entails.

## Course Contents

Each professor will discuss the latest research in their respective fields of specialization, including the background information and related research. This course is related to “Research Experiments,” and as such, those who wish to take that course in the future are urged to register for this course. In addition, this course is related to the Graduation Research, thus students who plan to register for that course should optimally take this course as well.

## Others

※Please refer to the ″Syllabus & Class Schedule Search System″ for details including course schedule, evaluations, textbooks and others.
<URL>
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CC187

| Course Title | Exercises in Organic Chemistry | | |
|---|---|---|---|
| Instructor | Nishimura Ryo/Kawano Yasuro | | |
| Semester | Fall Semester | Credit | 2 Credits |
| Course Number | CHE2410 | Language | Japanese |

## Course Objectives

In this course, students will learn the fundamentals of organic chemistry through various practice problems and exercises.

## Course Contents

Students will gain a deeper understanding of the knowledge acquired from Organic Chemistry 1 and 2, solidifying it through the act of problem solving. They will gain a deeper understanding of the basic principles that drive organic reactions through various practice exercises focusing on reaction mechanisms.

## Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.
<URL>
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CC191

| Course Title | Exercises in Physical Chemistry | | |
|---|---|---|---|
| Instructor | Tanabe Ichiro | | |
| Semester | Fall Semester | Credit | 2 Credits |
| Course Number | CHE2210 | Language | Japanese |

## Course Objectives

This course aims to deepen students' understanding of the fundamentals of physical chemistry learned in Introduction to Physical Chemistry, Physical Chemistry 1 and 2, and Reaction Kinetics (quantum theory, thermodynamics, reaction kinetics) through problem solving.

## Course Contents

Lectures 1–4 will cover the material learned in Physical Chemistry 1 (first and second laws of thermodynamics, Gibbs free energy, chemical potential, etc.). Lectures 5–7 will discuss material learned in Reaction Kinetics (first and second order reactions, equilibrium reactions, steady state approximations, etc.). Lastly, lectures 8–14 will cover material learned in Introduction to Physical Chemistry and Physical Chemistry 2 (molecular orbitals, chemical bonds, operators, Schrodinger equation, wave functions, etc.). Students will solve problems related to these topics in order to deepen their understanding of the subject.

## Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.
<URL>
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CC192

| Course Title | Basic Physics | | |
|---|---|---|---|
| Instructor | Shimano Masahiro | | |
| Semester | Spring Semester | Credit | 2 Credits |
| Course Number | CHE1910 | Language | Japanese |

## Course Objectives

This course aims to teach students the fundamental physics knowledge necessary to study chemistry at the collegiate level.

## Course Contents

In order to understand the nature of matter, chemical reactions, or even biological phenomena at the molecular and atomic level, students will need a solid grounding in physics.
In this course, students will acquire the fundamentals physics knowledge necessary to study chemistry at the collegiate level. Primarily focusing on classical mechanics and electromagnetism, this course bridges the gap between the physics learned in high school and first year university physics.
This course is essential to students who did not take physics in high school. Also, students who doubt their understanding of high school level physics classes (Physics Fundamentals, Physics) should ideally take this course. Students will solve practice problems during the lecture a few times throughout the duration of the course.
Additionally, various tips and pointers aimed at incoming students on how to pass this course will be given during the lectures. Following these pieces of advice will be beneficial to one's success in this course.

## Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.
<URL>
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CC196

| Course Title | Computer and Information Science for Chemistry Students | | |
|---|---|---|---|
| Instructor | Mochizuki Yuji/Doi Hideo/Komeiji Yuuto | | |
| Semester | Spring Semester | Credit | 2 Credits |
| Course Number | CHE2610 | Language | Japanese |

## Course Objectives

This course will give an outline of modern-day computer science and computer programming techniques.

## Course Contents

The importance of data processing has risen sharply in all fields, and terms like artificial intelligence (AI) and internet of things (IoT) have become very familiar. In this course, students will learn fundamental knowledge related to data processing (information literacy), as well as various computer programming technologies.
Programming refers to writing a computer program, namely a discrete list of data processing commands for the computer to follow. Computer programming has become a central part of data processing. Even in chemistry research, programs like Gaussian, GAMESS, and Amber are used to run large molecular computations. Two programming languages are taught in this class: Fortran and Python. Fortran has a lengthy history (created in 1957) and has been used to perform arithmetic operations in a wide variety of fields. In contrast, Python is a relatively new language (created in 1991). It is extremely versatile and is particularly essential to the research of natural language (human languages) and AI. Using these two fairly different languages, students will learn the basics of computer programming. Furthermore, fundamentals of the so-called chemoinfomatics are addressed.
They learn the fundamental data processing knowledge and techniques that will pay dividends throughout the rest of their time in school and will surely prove useful in the working world. This course consists primarily of hands-on practice, and hence it is important to attend every lecture.

## Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.
<URL>
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CC202

| Course Title | Coordination Chemistry 1 | | |
|---|---|---|---|
| Instructor | Wada Tohru | | |
| Semester | Fall Semester | Credit | 2 Credits |
| Course Number | CHE2510 | Language | Japanese |

## Course Objectives

This course aims to give students a logical and systematic understanding of transition metal complexes. Through the use of crystal field theory and ligand field theory, students will learn of the relation between the structure of transition metal complexes and their electronic state. Photochemical properties of transition meta complexes and the theory of electronic absorption and vibration spectra will also be discussed.

## Course Contents

Metal complexes are compounds consisting of a central metal ion with molecules or other ions bonded to it as ligands. Compounds with the same metal ion can exhibit very different properties depending on the type and arrangement of the ligands attached to it. In industry, transition metal complexes are widely used as catalysts in various synthesis methods; they also can function as sensors in some contexts. In addition, many enzymes in the body contain transition metal complexes as their reaction active sites. These diverse functionalities arise from the interactions between the central metal ion and the ligands. It is possible to express a desired functionality by the precise design of complex molecules.

This course aims to give students a systematic and logical understanding of the relation between electronic and physical structures of transition metal complexes. The two theories crucial to understanding the nature of metal complexes will be discussed: crystal field theory and ligand field theory. Using these theories, students will learn about the properties of metal complexes, particularly their photochemical properties (electron absorption and vibration spectra).

This course covers the theory necessary to understand Standard Experiments in Chemistry C: Inorganic Chemistry Experiments. As such, it is recommended to be proactive in attending this course.

## Others

※Please refer to the ″Syllabus & Class Schedule Search System″ for details including course schedule, evaluations, textbooks and others.

〈URL〉

https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CC203

| Course Title | Analytical Chemistry 3 | | |
|---|---|---|---|
| Instructor | Tabuchi Mari | | |
| Semester | Fall Semester | Credit | 2 Credits |
| Course Number | CHE2310 | Language | Japanese |

## Course Objectives

This course aims to teach students the fundamental theory, characteristics, and applications of various instrumental analysis methods. Relevant data processing techniques will also be covered.

## Course Contents

A wide variety of instrumental analysis methods are used in order to gain qualitative and quantitative data on various analytes. Additionally, instruments can be used for structural analysis, state analysis, and the determination of an analyte's physical properties, among many other things. In this course, students will learn the theory and characteristics of various important instrumental analysis methods. In addition, they will learn how to treat data as well as how to calculate measurement error. Furthermore, students will learn about the diverse applications of various instrumental analysis methods, gaining insight into how analytical chemistry is actually used in the real world. By solving practice problems, students will deepen their understanding of the material (each student must bring a scientific calculator).

## Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.
<URL>
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CC204

| Course Title | Photophysical Chemistry | | |
|---|---|---|---|
| Instructor | Tanabe Ichiro | | |
| Semester | Spring Semester | Credit | 2 Credits |
| Course Number | CHE3210 | Language | Japanese |

## Course Objectives

To learn relationship between light and materials from macro and micro perspectives.

## Course Contents

The relationship between light and materials is one of fundamental properties of moleculaes, leading to various applications such as photocatalysts, solar cells, and other opitical materials. First, from the molecular perspective, the relationship between light and molecules is introduced. Subsequentlly, from the macro perspective, optical properties of materials and optical propagation in materials are explained. Finally, from both micro and macro perspectives, the interation between the light and materials, in cases of non-metals and metals, are summerized.

## Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.
<URL>
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CC205

| Course Title | Coordination Chemistry 2 | | |
|---|---|---|---|
| Instructor | Wada Tohru | | |
| Semester | Spring Semester | Credit | 2 Credits |
| Course Number | CHE3510 | Language | Japanese |

## Course Objectives

In this course, students will gain a better understanding of the reactivity of transition metal complexes through the use of crystal field theory and ligand field theory. Furthermore, students will acquire important knowledge concerning the synthesis and reactivity of organic metal complexes.

## Course Contents

In this lecture, reactivity of transition metal complexes will be discussed. Transition metal complexes are not only used as catalysts in organic synthesis reactions, but are also found in the active sites of many enzymes in the human body. They are widely understood to be materials with a broad range of diverse uses. In coordination chemistry, organic chemistry, biochemistry, and many other fields, understanding the reactivity of transition metal complexes is critical. In the first half of the course, students will learn substitution reactions and redox reactions from the viewpoint of coordination chemistry. In the latter half, basic reactions involving organic metal complexes, which contain at least one metal–carbon bond, will be discussed. Catalytic reactions using metal complexes will also be covered. The concepts taught in this course are grounded in crystal field theory and ligand field theory.　It is desireble for students who take this class to be familiar with the material covered in Coordination Chemistry 1.

## Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.
<URL>
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CC207

| Course Title | Experiments in Physics for Chemistry Students | | |
|---|---|---|---|
| Instructor | Taguchi Makoto/Sawada Makoto | | |
| Semester | Fall Semester 1 | Credit | 1 Credit |
| Course Number | CHE3110 | Language | Japanese |

## Course Objectives

The goal is to acquire basic knowledge and learn experimental methods spanning across the entirety of physics experiments in order to obtain a sturdy foundation for experiments.

## Course Contents

I will be providing a guidance initially. Students will need to attend this guidance session, as I will distribute guidelines for experiments, the schedule, etc., and explain about precautions for experiments , reports, and other similar things.
Students should also prepare a dedicated notebook for experiments. They should read the experiment guidelines carefully before each experiment so that they can understand the purpose and the contents of each experiment. To prevent an accident from occurring, always follow the instructions of the teacher when performing an experiment.
Depending on the experiment, graph paper, a scientific calculator, etc., may be required, so be sure to bring the appropriate items to each experiment.
Some experiments will also require statistical processing of errors.

## Others

※Please refer to the ″Syllabus & Class Schedule Search System″ for details including course schedule, evaluations, textbooks and others.
<URL>
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CC208

| Course Title | Experiments in Biology for Chemistry Students | | |
|---|---|---|---|
| Instructor | Morita Hitoshi/Hanada Yuki | | |
| Semester | Fall Semester 2 | Credit | 1 Credit |
| Course Number | CHE3110 | Language | Japanese |

## Course Objectives

This course aims to enable students to learn the fundamental knowledge and experimental methods for overall biological experimentation and to provide students with experimental sophistication in biology.

## Course Contents

In the beginning of the course, students will receive firm guidance. The Guidelines of Biological Experimentation, which will be the main text used in this course, will be handed out along with a schedule and name tags. The guidelines for writing reports will also be explained, so attendance during this part of the course is required.

From there on after, various “Biological Experiments” will be conducted using the course text as a reference.

In “Animal Dissection,” students will dissect a frog and learn about its internal organs.

In “Microscope Observations,” students will observe the chromosomes of onion cells undergoing division while learning about somatic cell division.

In “DNA preparation/Electrophoresis,” students will learn how to handle plasmid DNA using molecular biology methods while gaining a better understanding of characteristics of DNA.

In “The Physiological Adaptations of Cells,” students will learn about the lac operon while gaining an understanding of the physiological adaptation mechanisms of E. coli.

## Others

※Please refer to the ″Syllabus & Class Schedule Search System″ for details including course schedule, evaluations, textbooks and others.

〈URL〉

https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CC209

| Course Title | Research Experiments 1 | | |
|---|---|---|---|
| Instructor | ※ | | |
| Semester | Spring Others | Credit | 2 Credits |
| Course Number | CHE3110 | Language | Japanese |

## Course Objectives

In this course, students will conduct experiments related to each laboratory's specialization and learn from their respective experimental techniques. While reading literature related to their experiments, students will understand the background and significance of their research. Through understanding the fundamental principles, laws, and theories at play, students will gain insight into the mindset needed to conduct and make progress in chemical research.

## Course Contents

In Standard Experiments in Chemistry A–C, the experiments conducted always had a pre–planned "answer," so to speak. That is, if students conducted the experiments exactly as directed, it was a "class" where they would always be able to attain the desired end result. However, during their 4th year Graduation Research, students will be required to conduct "research," where there is no pre–planned answer awaiting them. The goal of Research Experiments 1 is to bridge the gap between the lab courses students have taken thus far and the Graduation Research. Students will conduct experiments according to the research theme and guidance provided by the instructor. Through discussions with the instructor, the goal is not only for the students to manage their own experiments, but for them to understand their background and significance as well. Furthermore, students will analyze and organize their experimental results, cultivating the ability to accurately and concisely report the results of their research.

## Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.
<URL>
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CC210

| Course Title | Research Experiments 1 | | |
|---|---|---|---|
| Instructor | ※ | | |
| Semester | Spring Others | Credit | 2 Credits |
| Course Number | CHE3110 | Language | Japanese |

## Course Objectives

In this course, students will conduct experiments related to each laboratory's specialization and learn from their respective experimental techniques. While reading literature related to their experiments, students will understand the background and significance of their research. Through understanding the fundamental principles, laws, and theories at play, students will gain insight into the mindset needed to conduct and make progress in chemical research.

## Course Contents

In Standard Experiments in Chemistry A–C, the experiments conducted always had a pre–planned "answer," so to speak. That is, if students conducted the experiments exactly as directed, it was a "class" where they would always be able to attain the desired end result. However, during their 4th year Graduation Research, students will be required to conduct "research," where there is no pre–planned answer awaiting them. The goal of Research Experiments 1 is to bridge the gap between the lab courses students have taken thus far and the Graduation Research. Students will conduct experiments according to the research theme and guidance provided by the instructor. Through discussions with the instructor, the goal is not only for the students to manage their own experiments, but for them to understand their background and significance as well. Furthermore, students will analyze and organize their experimental results, cultivating the ability to accurately and concisely report the results of their research.

## Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.
<URL>
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CC212

| Course Title | Research Experiments 1 | | |
|---|---|---|---|
| Instructor | ※ | | |
| Semester | Spring Others | Credit | 2 Credits |
| Course Number | CHE3110 | Language | Japanese |

## Course Objectives

In this course, students will conduct experiments related to each laboratory's specialization and learn from their respective experimental techniques. While reading literature related to their experiments, students will understand the background and significance of their research. Through understanding the fundamental principles, laws, and theories at play, students will gain insight into the mindset needed to conduct and make progress in chemical research.

## Course Contents

In Standard Experiments in Chemistry A–C, the experiments conducted always had a pre–planned "answer," so to speak. That is, if students conducted the experiments exactly as directed, it was a "class" where they would always be able to attain the desired end result. However, during their 4th year Graduation Research, students will be required to conduct "research," where there is no pre–planned answer awaiting them. The goal of Research Experiments 1 is to bridge the gap between the lab courses students have taken thus far and the Graduation Research. Students will conduct experiments according to the research theme and guidance provided by the instructor. Through discussions with the instructor, the goal is not only for the students to manage their own experiments, but for them to understand their background and significance as well. Furthermore, students will analyze and organize their experimental results, cultivating the ability to accurately and concisely report the results of their research.

## Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.
<URL>
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CC213

| Course Title | Research Experiments 2 | | |
|---|---|---|---|
| Instructor | ※ | | |
| Semester | Fall Others | Credit | 2 Credits |
| Course Number | CHE3110 | Language | Japanese |

## Course Objectives

In this course, students will conduct experiments related to each laboratory's specialization and learn from their respective experimental techniques. While reading literature related to their experiments, students will understand the background and significance of their research. Through understanding the fundamental principles, laws, and theories at play, students will gain insight into the mindset needed to conduct and make progress in chemical research.

## Course Contents

In Standard Experiments in Chemistry A–C, the experiments conducted always had a pre–planned "answer," so to speak. That is, if students conducted the experiments exactly as directed, it was a "class" where they would always be able to attain the desired end result. However, during their 4th year Graduation Research, students will be required to conduct "research," where there is no pre–planned answer awaiting them. The goal of Research Experiments 2 is to bridge the gap between the lab courses students have taken thus far and the Graduation Research. Students will conduct experiments according to the research theme and guidance provided by the instructor. Through discussions with the instructor, the goal is not only for the students to manage their own experiments, but for them to understand their background and significance as well. Furthermore, students will analyze and organize their experimental results, cultivating the ability to accurately and concisely report the results of their research.

## Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.
<URL>
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CC230

| Course Title | Research Experiments 2 | | |
|---|---|---|---|
| Instructor | ※ | | |
| Semester | Fall Others | Credit | 2 Credits |
| Course Number | CHE3110 | Language | Japanese |

## Course Objectives

In this course, students will conduct experiments related to each laboratory's specialization and learn from their respective experimental techniques. While reading literature related to their experiments, students will understand the background and significance of their research. Through understanding the fundamental principles, laws, and theories at play, students will gain insight into the mindset needed to conduct and make progress in chemical research.

## Course Contents

In Standard Experiments in Chemistry A–C, the experiments conducted always had a pre–planned "answer," so to speak. That is, if students conducted the experiments exactly as directed, it was a "class" where they would always be able to attain the desired end result. However, during their 4th year Graduation Research, students will be required to conduct "research," where there is no pre–planned answer awaiting them. The goal of Research Experiments 2 is to bridge the gap between the lab courses students have taken thus far and the Graduation Research. Students will conduct experiments according to the research theme and guidance provided by the instructor. Through discussions with the instructor, the goal is not only for the students to manage their own experiments, but for them to understand their background and significance as well. Furthermore, students will analyze and organize their experimental results, cultivating the ability to accurately and concisely report the results of their research.

## Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.
<URL>
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CC232

| Course Title | Research Experiments 2 | | |
|---|---|---|---|
| Instructor | ※ | | |
| Semester | Fall Others | Credit | 2 Credits |
| Course Number | CHE3110 | Language | Japanese |

## Course Objectives

In this course, students will conduct experiments related to each laboratory's specialization and learn from their respective experimental techniques. While reading literature related to their experiments, students will understand the background and significance of their research. Through understanding the fundamental principles, laws, and theories at play, students will gain insight into the mindset needed to conduct and make progress in chemical research.

## Course Contents

In Standard Experiments in Chemistry A–C, the experiments conducted always had a pre–planned "answer," so to speak. That is, if students conducted the experiments exactly as directed, it was a "class" where they would always be able to attain the desired end result. However, during their 4th year Graduation Research, students will be required to conduct "research," where there is no pre–planned answer awaiting them. The goal of Research Experiments 2 is to bridge the gap between the lab courses students have taken thus far and the Graduation Research. Students will conduct experiments according to the research theme and guidance provided by the instructor. Through discussions with the instructor, the goal is not only for the students to manage their own experiments, but for them to understand their background and significance as well. Furthermore, students will analyze and organize their experimental results, cultivating the ability to accurately and concisely report the results of their research.

## Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.
<URL>
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CC233

| Course Title | Colloquium | | |
|---|---|---|---|
| Instructor | ※ | | |
| Semester | Full Year Others | Credit | 2 Credits |
| Course Number | CHE4900 | Language | Japanese |

## Course Objectives

In this course, students will intensely study literature related to the field of their Graduation Research and present the information they have learned. In addition to acquiring the knowledge necessary to complete their Graduation Research, this course aims to help students sharpen their literature reading comprehension skills along with their presentation skills.

## Course Contents

In this course, students will intensely study literature (specialized publications and academic papers) related to the field of their Graduation Research. Students will present the information they have learned along with progress updates on their research project. Through lively group discussions with the instructor and other lab members, students will acquire knowledge in various fields of research while sharpening their presentation skills and cultivating a logical way of thinking.

## Others

※Please refer to the ″Syllabus & Class Schedule Search System″ for details including course schedule, evaluations, textbooks and others.
〈URL〉
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CC301

| Course Title | Colloquium | | |
|---|---|---|---|
| Instructor | ※ | | |
| Semester | Full Year Others | Credit | 2 Credits |
| Course Number | CHE4900 | Language | Japanese |

## Course Objectives

In this course, students will intensely study literature related to the field of their Graduation Research and present the information they have learned. In addition to acquiring the knowledge necessary to complete their Graduation Research, this course aims to help students sharpen their literature reading comprehension skills along with their presentation skills.

## Course Contents

In this course, students will intensely study literature (specialized publications and academic papers) related to the field of their Graduation Research. Students will present the information they have learned along with progress updates on their research project. Through lively group discussions with the instructor and other lab members, students will acquire knowledge in various fields of research while sharpening their presentation skills and cultivating a logical way of thinking.

## Others

※Please refer to the ″Syllabus & Class Schedule Search System″ for details including course schedule, evaluations, textbooks and others.
〈URL〉
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CC302

| Course Title | Colloquium | | |
|---|---|---|---|
| Instructor | ※ | | |
| Semester | Full Year Others | Credit | 2 Credits |
| Course Number | CHE4900 | Language | Japanese |

## Course Objectives

In this course, students will intensely study literature related to the field of their Graduation Research and present the information they have learned. In addition to acquiring the knowledge necessary to complete their Graduation Research, this course aims to help students sharpen their literature reading comprehension skills along with their presentation skills.

## Course Contents

In this course, students will intensely study literature (specialized publications and academic papers) related to the field of their Graduation Research. Students will present the information they have learned along with progress updates on their research project. Through lively group discussions with the instructor and other lab members, students will acquire knowledge in various fields of research while sharpening their presentation skills and cultivating a logical way of thinking.

## Others

※Please refer to the ″Syllabus & Class Schedule Search System″ for details including course schedule, evaluations, textbooks and others.
〈URL〉
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CC303

| Course Title | Research Experiments | | |
|---|---|---|---|
| Instructor | ※ | | |
| Semester | Full Year Others | Credit | 8 Credits |
| Course Number | CHE4100 | Language | Japanese |

## Course Objectives

Each student will draft their own research plan relating to their topic, proceeding independently using trial and error. Furthermore, through analyzing and organizing their own research results, this course aims to endow students with the mindset, problem-solving abilities, and logical way of thinking needed to conduct research.

## Course Contents

Students will belong a laboratory and independently tackle their own research theme under guidance from their supervisor. Research is to delve into uncharted territory untouched by textbooks and their research themes are often on the reading edge of the research field. It is important for students to proceed the research independently through the trial and error attempts from comprehending their research background to consideration of results, with cooperation of their supervisor and lab members. Students will give an oral presentation of their results at the Interim Meeting and the Year End Meeting. Furthermore, they will prepare and submit a graduation thesis. As a compilation of all of the student's efforts thus far, we hope that they will have fulfilling research life.

## Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.
<URL>
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CC351

| Course Title | Research Experiments | | |
|---|---|---|---|
| Instructor | ※ | | |
| Semester | Full Year Others | Credit | 8 Credits |
| Course Number | CHE4100 | Language | Japanese |

## Course Objectives

Each student will draft their own research plan relating to their topic, proceeding independently using trial and error. Furthermore, through analyzing and organizing their own research results, this course aims to endow students with the mindset, problem-solving abilities, and logical way of thinking needed to conduct research.

## Course Contents

Students will belong a laboratory and independently tackle their own research theme under guidance from their supervisor. Research is to delve into uncharted territory untouched by textbooks and their research themes are often on the reading edge of the research field. It is important for students to proceed the research independently through the trial and error attempts from comprehending their research background to consideration of results, with cooperation of their supervisor and lab members. Students will give an oral presentation of their results at the Interim Meeting and the Year End Meeting. Furthermore, they will prepare and submit a graduation thesis. As a compilation of all of the student's efforts thus far, we hope that they will have fulfilling research life.

## Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.
<URL>
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CC352

| Course Title | Research Experiments | | |
|---|---|---|---|
| Instructor | ※ | | |
| Semester | Full Year Others | Credit | 8 Credits |
| Course Number | CHE4100 | Language | Japanese |

## Course Objectives

Each student will draft their own research plan relating to their topic, proceeding independently using trial and error. Furthermore, through analyzing and organizing their own research results, this course aims to endow students with the mindset, problem-solving abilities, and logical way of thinking needed to conduct research.

## Course Contents

Students will belong a laboratory and independently tackle their own research theme under guidance from their supervisor. Research is to delve into uncharted territory untouched by textbooks and their research themes are often on the reading edge of the research field. It is important for students to proceed the research independently through the trial and error attempts from comprehending their research background to consideration of results, with cooperation of their supervisor and lab members. Students will give an oral presentation of their results at the Interim Meeting and the Year End Meeting. Furthermore, they will prepare and submit a graduation thesis. As a compilation of all of the student's efforts thus far, we hope that they will have fulfilling research life.

## Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.
<URL>
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CC353

| Course Title | Molecular Biology 3 | | |
|---|---|---|---|
| Instructor | Goto Satoshi | | |
| Semester | Fall Semester | Credit | 2 Credits |
| Course Number | LFS3100 | Language | Japanese |

## Course Objectives

In recent years, it has become very difficult to fully understand cutting edge advancements in medicine and biology if one lacks basic fundamental knowledge of molecular biology. The aim of this course is to understand this fundamental mechanisms of gene expression in eukaryotes.

## Course Contents

The aim of this course is to understand the fundamental mechanisms underlying gene expression such as transcriptional and translational regulation in eukaryotes. Non-coding RNA-mediated control of gene expression and development will be lectured as well.

## Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.
<URL>
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CD003

| Course Title | Fundamental Chemistry | | |
|---|---|---|---|
| Instructor | Ishitsuka Megumi | | |
| Semester | Spring Semester | Credit | 2 Credits |
| Course Number | LFS2200 | Language | Japanese |

## Course Objectives

You will grasp the major chemical concepts and learn the properties of biological molecules (particularly those of low molecular weight) to prepare for more advanced biochemistry in the future.

## Course Contents

This lecture will give contents on the basic idea of covalent bonding and chemical equilibrium, and the properties of biological molecules. These concepts are very important for your understanding of biological molecules.

## Others

※Please refer to the ″Syllabus & Class Schedule Search System″ for details including course schedule, evaluations, textbooks and others.
〈URL〉
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CD004

| Course Title | Biochemistry 1 | | |
|---|---|---|---|
| Instructor | Iwakawa Hirooki | | |
| Semester | Fall Semester | Credit | 2 Credits |
| Course Number | LFS2200 | Language | Japanese |

## Course Objectives

In this course, students will learn about the structures, chemical properties, biosynthesis, and physiological roles of biological macromolecules to gain the basis for understanding living organisms at the molecular level.

## Course Contents

Living organisms are mainly made of six elements, carbon, hydrogen, nitrogen, oxygen, phosphorus and sulfur. These elements constitute amino acids, nucleotides, fatty acids, and simple sugars, which are building blocks of biological macromolecules such as proteins, DNA, RNA, lipids, and polysaccharides. In this course, students will learn about the structures, chemical properties, biosynthesis, and physiological roles of these macromolecules that are necessary for life. The course uses Principles of Biochemistry by Horton et al. as a reference.

## Others

※Please refer to the ″Syllabus & Class Schedule Search System″ for details including course schedule, evaluations, textbooks and others.
〈URL〉
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CD005

| Course Title | Biophysics 1 | | |
|---|---|---|---|
| Instructor | Yamada Yasuyuki | | |
| Semester | Fall Semester | Credit | 2 Credits |
| Course Number | LFS2200 | Language | Japanese |

## Course Objectives

In this course, students will learn the concept of energy, the flow of energy in biological systems, as well as how energy is acquired and expended. Students will gain an understanding regarding what conditions must be fulfilled for a reaction to occur. Reaction rate will also be discussed.

## Course Contents

To begin the course, the concepts of energy and work will be introduced, and The Law of Energy Conservation (The First Law of Thermodynamics) will be explained.
Next, the concept of entropy will be introduced (The Second Law of Thermodynamics).
The goal is to enable students to determine which direction chemical reactions are likely to proceed and to find out how much energy they expend or produce (net change in Gibbs energy).
Utilizing this way of thinking, the energy acquisitions and expenditures resulting from various biological reactions will be discussed.
Next, the concept of electrochemical potential difference of ions will be discussed, which is one of the key concepts of bioenergetics.
Students will also learn about the rates of chemical reactions as well as the enzyme reactions.

## Others

※Please refer to the ″Syllabus & Class Schedule Search System″ for details including course schedule, evaluations, textbooks and others.
<URL>
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CD006

| Course Title | Molecular Biology 1 | | |
|---|---|---|---|
| Instructor | Shiomi Daisuke | | |
| Semester | Fall Semester | Credit | 2 Credits |
| Course Number | LFS2100 | Language | Japanese |

## Course Objectives

In this course, students are expected to learn about gene structure and mechanisms for gene expression. The purpose of this course is for students to understand the most fundamental principles and concepts necessary for studying life science.

## Course Contents

This course aims to provide students understanding of basic principles and concepts that constitute molecular biology. Specifically, students learn about gene structure, mechanisms for gene expression, and replication of genetic materials at the molecular level. At the beginning, students are introduced to genes' concept and structure. Next, the structure of DNA and RNA is discussed, using mainly prokaryotes and bacteriophages as models. Students learn about transcription and replication of genes and genomic DNA, as well as mechanisms that regulate these processes. The course refers to molecular biology's historical background and enables students to cultivate deeper understanding of phenomena studied by the field as a whole. The course uses Molecular Biology of the Gene by Watson et al. as a reference.

## Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.
<URL>
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CD007

| Course Title | Molecular Biology 2 | | |
|---|---|---|---|
| Instructor | Sekine Yasuhiko | | |
| Semester | Spring Semester | Credit | 2 Credits |
| Course Number | LFS2100 | Language | Japanese |

## Course Objectives

In this course, students will learn the fundamental concepts, principles, and approach necessary to the study of molecular biology. Furthermore, through the approach learned in this course, students will be able to cultivate a deeper understanding of biological phenomena.

## Course Contents

Molecular biology aims to explain biological phenomena through the various molecules involved. How do individual molecules behave within cells, and, as a result, what biological phenomena does occur? How is a delicate system like a living organism created and maintained by the cooperation of these various molecules? This course will build upon the material students learned in Molecular Biology 1, and will cover protein synthesis mechanisms and DNA repair mechanisms, focusing on examples found in bacteria.

Rather than simply listing fact after fact, this course will place importance on understanding the fundamental concepts and principles at play. Students should come prepared to not merely copy what is written on the blackboard, but to use their heads to proactively grapple with the concepts discussed in the lecture. Various phenomena will be covered that are difficult to comprehend simply through reading the textbook. Thorough explanations of these phenomena will be given during the lectures, so attendance is essential.

## Others

※Please refer to the ″Syllabus & Class Schedule Search System″ for details including course schedule, evaluations, textbooks and others.

<URL>

https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CD009

| Course Title | Biochemistry 2 | | |
|---|---|---|---|
| Instructor | Suetsugu Masayuki | | |
| Semester | Spring Semester | Credit | 2 Credits |
| Course Number | LFS2200 | Language | Japanese |

## Course Objectives

Cells produce energy through metabolic reactions, using it to assemble or disassemble various molecules used in biological processes. This course will teach students how this process works.

## Course Contents

A cell's metabolism is a dynamic network of chemical reactions that occur in all living cells. From bacteria all the way to humans, all types of life share this fundamental process. Through their metabolism, cells produce energy, enabling them to both assemble and disassemble various biological macromolecules. Just how do cells manage to pull off such a sophisticated array of processes?

Students will learn the answer to this question through the study of the following topics: 1. The mechanism of how cells metabolize sugars, producing the energy they need to sustain life.

2. The mechanism of photosynthesis, through which plant cells produce energy.

3. The mechanisms through which cells assemble and disassemble various biological molecules, such as lipids, amino acids, and nucleotides.

## Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.

<URL>

https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CD010

| Course Title | Biophysics 2 | | |
|---|---|---|---|
| Instructor | Hanai Ryo | | |
| Semester | Fall Semester | Credit | 2 Credits |
| Course Number | LFS3210 | Language | Japanese |

## Course Objectives

The objective of this course is to provide students with a Structural Biological framework to understand the functions of proteins and nucleic acids, the central actors who play out biological activities: the functions of these biological macromolecules are attained by their three-dimensional structures through various physicochemical "forces."

## Course Contents

Case studies on the structure-function relationship of proteins and nucleic acids. Systems that students have already learned in Molecular Biology are taken up and quantitatively re-explained in terms of such inter-molecular forces as ionic bond, hydrogen bond and van der Waals force, and hydrophobic effect. These interactions are also delineated. It is emphasized that living organisms have evolved to today's form within the bounds of physics and chemistry.

## Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.
<URL>
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CD011

| Course Title | Bioethics | | |
|---|---|---|---|
| Instructor | Mizoguchi Hajime | | |
| Semester | Fall Semester | Credit | 2 Credits |
| Course Number | LFS2020 | Language | Japanese |

## Course Objectives

The goals of this course are as follows. One is to allow students to concretely imagine the effects of human-related life science knowledge and medical technology on modern society. The other is to have students acquire basic knowledge, understanding basic issues and the scientific background of bioethics from the viewpoint of human biology, therefore allowing them to express their own thoughts and ideas in discussions.

## Course Contents

In this lecture-based class, the lecturer will explain how biological knowledge is related to medicine and medical care, where the natural scientific basis of advanced medical technology is placed, etc. Some examples of topics this touches on include reproductive biology, developmental biology, cell biology and infertility treatments, regenerative medicine, human cloning, genetics, genomics, evolutionary biology and gene therapy, eugenics, neurobiology, immunology and pain therapy, organ transplants. The fact will be highlighted that scientific knowledge rapidly permeates throughout modern society, which has social impacts beyond what researchers may expect. Additionally, even if you are a natural science researcher or engineer, in some cases as a citizen you will have to face bioethics, whether that be related to the physical condition of yourself or a family member, ethical dilemmas, etc. In such cases you will need to know the specifics regarding the differences between research level and clinical level. The aim is to provide the materials that will lead to you thinking on your own in the context of bioethics and hope that will create opportunities leading to a review of how you perceive life, and more specifically, human life. Depending on the number of students, discussions and free talks will also be held. We will discuss the following topics.

## Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.
<URL>
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CD014

| Course Title | Botany 2 | | |
|---|---|---|---|
| Instructor | Koga Hiroyuki | | |
| Semester | Fall Semester | Credit | 2 Credits |
| Course Number | LFS3210 | Language | Japanese |

## Course Objectives

Plants show various kinds of characteristics. This class aims to provide an understanding of those plant characteristics at the genome, cellular, and individual levels.

## Course Contents

The evolution of plants was a crucial event in Earth's history that had major consequences for the biotic regulation of the global environment. It is considered that this environmental change led to the sequence of events that made up the transition from aquatic to terrestrial habitats in animals. Additionally, plants have an important role to maintain the environment and to feed us. In this course, we will learn about the characteristics of plants from various aspects to understand how plants achieve their roles.

## Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.
<URL>
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CD021

| Course Title | Introductory Informatics | | |
|---|---|---|---|
| Instructor | Yamada Yasuyuki/Iwakawa Hirooki | | |
| Semester | Spring Semester | Credit | 2 Credits |
| Course Number | LFS1000 | Language | Japanese |

## Course Objectives

In this course, students will learn how to use the computer software used in the life sciences. This knowledge will enable them to better organize and present experimental data and so on.

## Course Contents

In order to solve various problems in the life sciences, the assistance of data processing applications is indispensable.
In this course, students will acquire knowledge and skills necessary in their future specialized coursework through getting hands-on experience using various kinds of software.
Specifically, students will use programs for e-mail, document writing, and spreadsheet calculations (Excel) in a Windows environment.
Additionally, students will use PowerPoint to create and give presentations. Furthermore, students will learn how to use software to visualize 3D structures of proteins and DNA using PDB data.
Following lectures, students will complete various exercises related to the material covered, on which they will then write and submit a report. Report submissions and questions will all be handled via Canvas LMS or Blackboard systems. In the class, students will have as much practice time with an actual computer as possible.

## Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.
<URL>
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CD022

| Course Title | Laboratory Experiments in Life Science 1 | | |
|---|---|---|---|
| Instructor | Shiomi Daisuke | | |
| Semester | Fall Semester | Credit | 5 Credits |
| Course Number | LFS2400 | Language | Japanese |

## Course Objectives

DNA and RNA manipulation have a wide variety of uses in a diverse array of fields. They play an important role in medicine, agricultural science, pharmaceuticals, and engineering, among other fields. In this course, students will learn the fundamental techniques necessary to manage experiments with DNA and RNA. In addition, they will learn how to interpret data and write reports.

## Course Contents

Focusing on DNA and RNA extraction and purification, reactions of nucleic acids with various enzymes, and analysis via agarose gel electrophoresis, students will conduct fundamental experiments in molecular biology and molecular genetics, applying the knowledge they have acquired from their lecture courses.

## Others

※Please refer to the ″Syllabus & Class Schedule Search System″ for details including course schedule, evaluations, textbooks and others.
〈URL〉
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CD028

| Course Title | Introduction to Life Science | | |
|---|---|---|---|
| Instructor | Sakakibara Keiko/Higuchi Maiko | | |
| Semester | Spring Semester | Credit | 2 Credits |
| Course Number | LFS1000 | Language | Japanese |

## Course Objectives

Students will learn the outline of life science, what is the cell, the basic unit of life, as a starting point and how multicellular organisms have developed.

## Course Contents

In the present day, knowledge of biological phenomena at the molecular level has been rapidly accumulated. The curriculum in Department of Life Science at this university offer a wide variety of courses that cover from the basics to the special knowledge to understand the biological phenomena at the molecular level. Students will learn the basic knowledge of cells, the basic unit of life, enough to understand our curriculum through the lecture. In the first half of this lecture, chapters 1–4 in "Essential Cell Biology" will be covered, focusing on the basic structure and functions of a cell. In the latter half, chapters 7 and 8 will be covered, along with the outline how multicellular organisms have developed.

## Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.
<URL>
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CD031

| Course Title | Basic Experiments in Life Science | | |
|---|---|---|---|
| Instructor | Yamada Yasuyuki | | |
| Semester | Spring Semester | Credit | 2 Credits |
| Course Number | LFS1400 | Language | Japanese |

## Course Objectives

In this course, students will learn basic techniques for the experiments in the life sciences while becoming familiar with living things.

## Course Contents

Through performing basic experiments using actual living things, students will learn the correct frame of mind necessary to carry out experiments while sharpening their observation skills.
Specifically, students will conduct the following experiments; animal dissections, microscopic observation of plant and animal cells, tissue, and chromosomes, DNA analysis by using restriction enzyme and electrophoresis, PCR, thin layer chromatography ,protein quantitation, the physiological adaptations of cells, and the genetics of plants.

## Others

※Please refer to the ″Syllabus & Class Schedule Search System″ for details including course schedule, evaluations, textbooks and others.
〈URL〉
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CD032

| Course Title | Molecular Cytology 1 | | |
|---|---|---|---|
| Instructor | Horiguchi Gorou | | |
| Semester | Fall Semester | Credit | 2 Credits |
| Course Number | LFS2300 | Language | Japanese |

## Course Objectives

The genetic material possessed by living things is passed on via mitosis and reproduction. This course aims to teach students about these processes on the molecular level.

## Course Contents

Building on the material taught in Introduction to Biology and Introduction to Life Science in the spring semester, students will learn exactly how genes in the form of DNA are passed from parent to child. First, the lecture will review why DNA molecules alone are sufficient as a means of storing genetic information. Next, students will learn about DNA replication and repair, along with cellular reproduction and cell death. Particular attention will be given to the proteins and cytoskeletons that regulate these processes. Furthermore, Mendel's Laws of Heredity will be discussed along with the principles behind them. The lecture will also cover how living things reproduce as well as how organisms cope with reproduction. In addition, inheritance of organelles that does not follow Mendel's Laws will be introduced.

## Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.
<URL>
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CD033

| Course Title | Fundamental Chemistry 1 | | |
|---|---|---|---|
| Instructor | Suetsugu Masayuki | | |
| Semester | Spring Others | Credit | 2 Credits |
| Course Number | LFS2200 | Language | Japanese |

## Course Objectives

Even complex biological phenomena are made up of microscopic organic compounds and continuous reactions, all of which follow the laws of chemistry and physics. By understanding the laws of reaction for organic chemistry, you can establish a basis for learning the characteristics of biomolecules and their complex and diverse reactionary systems.

## Course Contents

Organisms can be regarded as a collection of organic molecules. Complex life phenomena in the organisms are achieved through the actions of countless organic compounds. In order to truly understand life, we must dive down to the molecular level and learn about the characteristics of organic compounds and the chemical reactions weaved by those compounds.
The first half of these lectures will focus on the basics of organic chemistry necessary to explain biochemical reactions. By acquiring these basics, we can logically explain the characteristics of biological components and their chemical reactions. The second half will introduce the basics of biochemistry that will be followed upon in the next semester, applying those chemical reactions we learned about in the first half while discussing familiar biological topics.

## Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.
<URL>
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CD034

CD035

| Course Title | Fundamental Chemistry 2 | | |
|---|---|---|---|
| Instructor | Ishitsuka Megumi | | |
| Semester | Spring Semester | Credit | 2 Credits |
| Course Number | LFS2200 | Language | Japanese |

## Course Objectives

You will grasp the major chemical concepts and learn the properties of biological molecules (particularly those of low molecular weight) to prepare for more advanced biochemistry in the future.

## Course Contents

This lecture will give contents on the basic idea of covalent bonding and chemical equilibrium, and the properties of biological molecules. These concepts are very important for your understanding of biological molecules.

## Others

※Please refer to the ″Syllabus & Class Schedule Search System″ for details including course schedule, evaluations, textbooks and others.
<URL>
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CD035

| Course Title | Molecular Cytology 2 | | |
|---|---|---|---|
| Instructor | Oka Toshihiko | | |
| Semester | Spring Semester | Credit | 2 Credits |
| Course Number | LFS2300 | Language | Japanese |

## Course Objectives

To gain an understanding of the molecular basis of cell structure and organellar functions.

## Course Contents

Lectures in this class will focus on the following three items.
1. The structure of biological membrane.
2. The mechanism underlying transport of ions and other substances across biological membranes.
3. The roles of intracellular compartments, called organelles, and the molecular mechanism of transport of proteins and lipids between organelles.
The lectures will focus on the following content found in Chapters 11,12, and 15 of the textbook "Essential Cell Biology". It will be explained that the structure of the biological membranes that make up cells and the role of transporting substances across membranes. Through these lectures, my hope is that you will learn about the ingenuity and fine details with which cells are structured, as well as the precisely controlled functions that keep them operating. Diagrams and tables used in the lectures will be distributed as PDF files.

## Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.
<URL>
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CD036

| Course Title | Experiments in Physics for Life Science Students | | |
|---|---|---|---|
| Instructor | Kitamoto Shunji | | |
| Semester | Fall Semester 2 | Credit | 1 Credit |
| Course Number | LFS2400 | Language | Japanese |

## Course Objectives

The goal is to acquire basic knowledge and learn experimental methods spanning across the entirety of physics experiments in order to obtain a sturdy foundation for experiments.

## Course Contents

I will be providing a guidance initially. Students will need to attend this guidance session, as I will distribute guidelines for experiments, the schedule, etc., and explain about precautions for experiments , reports, and other similar things.
Students should also prepare a dedicated notebook for experiments. They should read the experiment guidelines carefully before each experiment so that they can understand the purpose and the contents of each experiment. To prevent an accident from occurring, always follow the instructions of the teacher when performing an experiment.
Depending on the experiment, graph paper, a scientific calculator, etc., may be required, so be sure to bring the appropriate items to each experiment.
Some experiments will also require statistical processing of errors.

## Others

※Please refer to the ″Syllabus & Class Schedule Search System″ for details including course schedule, evaluations, textbooks and others.
〈URL〉
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CD037

| Course Title | Experiments in Chemistry for Life Science Students | | |
|---|---|---|---|
| Instructor | Tabuchi Mari/Watanabe Eiji/Nishimura Ryo | | |
| Semester | Fall Semester 1 | Credit | 1 Credit |
| Course Number | LFS2400 | Language | Japanese |

## Course Objectives

This course aims to enable students to learn the fundamental knowledge and experimental methods for overall chemical experimentation and to provide students with experimental sophistication.

## Course Contents

In the first class, students will receive initial guidance. In the guidance, experimental guidelines and schedules will be distributed. Important notices and safety information before starting experiments, as well as how to take notes and write reports, will be explained. Class attendance for the guidance is a must. Bring a lab notebook to be used solely for experiments. One must read the experimental guidelines thoroughly and comprehend both its goals and contents before starting the experiment. In order to prevent accidents, it is crucial for students to obey the instructions of the instructor in charge whilst conducting an experiment. A scientific calculator will be necessary to conduct experiments in this course. Each individual is required to bring their own calculator.

## Others

※Please refer to the ″Syllabus & Class Schedule Search System″ for details including course schedule, evaluations, textbooks and others.
<URL>
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CD038

| Course Title | Laboratory Experiments in Life Science 2A | | |
|---|---|---|---|
| Instructor | Suetsugu Masayuki | | |
| Semester | Spring Semester | Credit | 5 Credits |
| Course Number | LFS3400 | Language | Japanese |

## Course Objectives

Through hands-on experience, students will consolidate their foundation of life science they have built in lecture courses. They will learn basic techniques commonly used in life-science, data analysis methods, and structured report writing.

## Course Contents

Students will carry out biochemical projects in (1) protein purification, (2) protein-protein interaction, (3) single-molecule and kinetics analyses of F1-ATPase, (4) DNA topology and topoisomerase, and (5) DNA-protein interaction.

## Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.
<URL>
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CD039

| Course Title | Laboratory Experiments in Life Science 2B | | |
|---|---|---|---|
| Instructor | Oka Toshihiko | | |
| Semester | Fall Semester | Credit | 5 Credits |
| Course Number | LFS3400 | Language | Japanese |

## Course Objectives

Molecular cell biology is a field that aims to understand cellular functions at the molecular level and their roles in the context of tissues, organs, and organisms. Students will learn various experimental techniques commonly used in cell biology in addition to those learned in Laboratory Experiments in Life Science 1 and 2A. They will hone their skills in data handling and interpretation, logical reasoning, and report writing. They will also deepen their understanding of the theoretical background learned in lecture courses.

## Course Contents

Students will learn new experimental techniques and apply them, in addition to those learned previously, to the cell-biology analyses of model organisms and cultured cells. More specifically,

1. Analysis of protein-protein interactions
2. Roles of protein phosphorylation on autophagy in yeast
3. Developmental genetics using Arabidopsis thaliana

## Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.

<URL>

https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CD040

| Course Title | Colloquium | | |
|---|---|---|---|
| Instructor | ※ | | |
| Semester | Full Year Others | Credit | 2 Credits |
| Course Number | LFS4800 | Language | Japanese |

## Course Objectives

In this course, students will engage in intensive reading of the literature of specific fields of research, which is relate to their own Graduation Research, while giving reports on the progress of their Graduation Research. In doing so, they will sharpen their presentation skills while deepening their knowledge of various fields.

## Course Contents

This course should be taken in one's final year studying in the Department of Life Science, and is supposed to be taken in conjunction with one's Graduation Research. During this course, students are to obtain knowledge from various fields necessary to complete their Graduation Research while honing their ability to think in a logical manner. Students will also be able to sharpen their presentation skills. Each individual will be given a plan of study from a supervisor, which they are to follow over the course of the year.

## Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.
<URL>
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CD051

| Course Title | Research Experiments | | |
|---|---|---|---|
| Instructor | ※ | | |
| Semester | Full Year Others | Credit | 8 Credits |
| Course Number | LFS4800 | Language | Japanese |

## Course Objectives

Students will join the lab of their supervisor, conducting research on an assigned topic over the course of the year. They will present their findings in the form of a graduation thesis, deepening their understanding of what it means to conduct research in the natural sciences, which aims to discover yet unknown phenomenon.

## Course Contents

The Graduation Research serves as the culmination of one's time studying in the Department of Life Science. The final results of the research, presented as a graduation thesis, represent a completely new discovery that cannot be found in any textbook or any webpage; knowledge unknown even to the supervisor. For that reason, completing the Graduation Research will enable students to learn various methods of conducting research and managing experiments, while sharpening their ability to think logically and solve complex problems. As such, the Graduation Research is an indispensable part of each student's education. Thus, it is important for each student to actively and independently grapple with their research over the course of the year. The hope is for students to experience great intellectual stimulation as they collaborate with their supervisor to uncover a fragment of one of the many mysteries of life.

## Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.
<URL>
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CD071

| Course Title | Biotechnology | | |
|---|---|---|---|
| Instructor | Oka Toshihiko | | |
| Semester | Spring Semester | Credit | 2 Credits |
| Course Number | LFS3020 | Language | Japanese |

## Course Objectives

This course provides students with an opportunity to hear about cutting-edge biotechnologies from specialists working in industry; thereby, it aims to get them to understand that these technologies are based on the sciences they are currently studying at school and also to provide information useful in considering future careers in biotech industries.

## Course Contents

Topics include: pharmaceuticals, cosmetics, protein engineering, fermentation technology, microbial gene engineering, microbial metabolic engineering, biologic prospecting, and biological analytics.

## Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.
<URL>
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CD109

| Course Title | Biology of Diversity | | |
|---|---|---|---|
| Instructor | Ito Motomi | | |
| Semester | Spring Others | Credit | 2 Credits |
| Course Number | LFS2020 | Language | Japanese |

## Course Objectives

To understand　the processes and mechanisms that give rise to diversity in organisms.

## Course Contents

Organisms are characterized by having universality and at the same time,　diversity. The lectures will cover a wide range of topics with regard to the diversity of organisms, including current biodiversity on the earth and the their phylogeny, the mechanisms through which diversity give rise, and conservation and sustainable use of biodiversity currently at risk, while introducing the latest research results. (Since this is an intensive course, the contents of the class are listed. However, the order shown will not necessarily be followed and the time spend on each will not be equal.)

## Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.
<URL>
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CD113

| Course Title | Botany1 | | |
|---|---|---|---|
| Instructor | Horiguchi Gorou | | |
| Semester | Spring Semester | Credit | 2 Credits |
| Course Number | LFS2310 | Language | Japanese |

## Course Objectives

Through examining the characteristics of plants at the level of genes, proteins, cells, organs, organisms, and environment, this course will give students an understanding of how plants live.

## Course Contents

Plants have evolved to possess structures and systems that differ greatly from those found in animals, enabling them to thrive. Preservation of the current global environment is a major problem currently facing humanity; however the environment exists as it does in the first place largely due to the work of plants. Furthermore, for the sake of agricultural production, understanding plants and their effective uses is a subject of great importance. Plants carry out carbon assimilation in the form of photosynthesis, have cells that are immobile, and possess a flexible physical structure that adapts to its environment. They also have a few distinct characteristics regarding their interactions with other forms of life. With the advent of molecular biology, these characteristics are now able to be understood at both the genetic and molecular level. In this course, students will learn about how plants are organized on the level of their cells, tissue, and organs. With this foundation, the roles of the various structures and systems found in plants will be reexamined from the point of view of evolution, adaptation, environmental response, development, and differentiation. They will also be examined in the context of how plants interact with other living things. Specific examples which are already well understood on the molecular level will be discussed, and results of the latest research in the field will be touched upon. Lastly, genetic recombination techniques in plants will be discussed.

## Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.
〈URL〉
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CD120

| Course Title | Bioinformatics | | |
|---|---|---|---|
| Instructor | Matsuzaki Yuri | | |
| Semester | Spring Semester | Credit | 2 Credits |
| Course Number | LFS3020 | Language | Japanese |

## Course Objectives

The field of bioinformatics has become essential in today's rapidly advancing life sciences as it allows the analysis of large amounts of experimental data on various phenomena. In this course, students will gain a foundational understanding of bioinformatics, a multidisciplinary field combining biology and computational science, by learning how to apply computational science concepts and perspectives to the study of life sciences.

Through hands-on experience with basic methods for analyzing information on genes, genomes, proteins, and other biological components, students will gain the skills necessary to identify appropriate tools and analysis methods for various research problems and develop the ability to formulate research plans.

## Course Contents

This course provides students with hands-on training in acquiring and analyzing life science data using public databases and tools. Through the practical exercises and case studies, students will be encouraged to consider how these tools can be applied to understanding various life science phenomena of their interests. During class sessions, students will have dedicated time to work on hands-on exercises, but it is highly recommended that students review material outside of class time. Additionally, assignments and quizzes will be given throughout the course.

## Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.

<URL>

https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CD123

| Course Title | Molecular Neurobiology | | |
|---|---|---|---|
| Instructor | Toriumi Kazuya | | |
| Semester | Fall Semester | Credit | 2 Credits |
| Course Number | LFS3310 | Language | Japanese |

## Course Objectives

The goal of this course is to understand the function of our brain at the levels of molecule, cell, tissue, organism, and society.

## Course Contents

The course will cover topics from the organization and the molecular mechanisms of the nervous system to the expression of higher brain functions, such as our perception and response to the outside world, referring to latest findings. It will also discuss the molecular mechanisms and research methodologies for psychiatric and neurodegenerative disorders.

## Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.
<URL>
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CD124

| Course Title | Molecular Immunology | | |
|---|---|---|---|
| Instructor | Kato Hidehito | | |
| Semester | Spring Semester | Credit | 2 Credits |
| Course Number | LFS3310 | Language | Japanese |

## Course Objectives

When we define confusion as disease, immunity is to restore confusion. By learning the immune system that excludes non-self, we can gain an understanding of the mysteries of life, the importance of harmony in relationships with other life, and even the meaning of life.

## Course Contents

Immunity is a system that eliminates non-self. This method of elimination is killing. The mother recognizes her child as non-self and starts to excluded soon after she conceives, so why is the fetus not excluded? Differentiation is discrimination. I think that war or bullying may be caused by a system that eliminates non-self. Additionally, while type O red blood cells can be transfused to people of any blood type, type AB red blood cells can't be transfused to anyone without type AB blood. This is due to the presence of antibodies in a person's blood that attack other type  than one's own blood type. But why are antibodies present even though there has been no transfusion in the past? These kinds of own questions are presented, and we dive down to the molecular level to find the answer. I'll explain how that knowledge is useful for the treatment of illnesses while sharing recent findings (such as the achievements of Dr. Honjo, who has received a Nobel prize).
If you gain a deep understanding of the mechanisms of immunity, maybe you can find a way to eliminate war and bullying as well.

## Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.
<URL>
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CD125

| Course Title | Molecular Developmental Biology | | |
|---|---|---|---|
| Instructor | Higuchi Maiko | | |
| Semester | Fall Semester | Credit | 2 Credits |
| Course Number | LFS3310 | Language | Japanese |

## Course Objectives

The aim of this course is to understand the molecular mechanisms of animal development including embryogenesis, morphogenesis and tissue regeneration.

## Course Contents

A multicellular organism develops from a single fertilized egg, that gives rise to the multitude of cell types, tissues, and organs. This course aims to provide a broad, comprehensive look at developmental biology, focusing on both classical experiments and modern molecular and genetic techniques. We will discuss about a multitude of questions; –How are the body axes established? –How does the brain develop? –What roles do stem cells play during development?

## Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.
<URL>
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CD126

| Course Title | Zoology | | |
|---|---|---|---|
| Instructor | Goto Satoshi | | |
| Semester | Spring Semester | Credit | 2 Credits |
| Course Number | LFS2310 | Language | Japanese |

## Course Objectives

The aim of this course is to understand the structures and functions of the tissues and organs in animals, and laboratory animals that are widely used for scientific researches.

## Course Contents

Animals are multicellular organisms that consist of various types of tissues and organs. This course aims to deepen students' understandings of the structures of these tissues and organs, as well as their physiological functions. Furthermore, the different types of model animals and experimental methods used in research will be discussed.

## Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.
<URL>
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CD130

| Course Title | Microbiology | | |
|---|---|---|---|
| Instructor | Watanabe Satoru/Iyoda Sunao | | |
| Semester | Fall Semester | Credit | 2 Credits |
| Course Number | LFS2110 | Language | Japanese |

## Course Objectives

Living things can be classified by the following three categories: animals, plants, and microbes. This course aims to teach students about the makeup, features, physiology, and ecology of microbes. Through doing so, students will understand their various similarities and differences with respect to plants and animals.

## Course Contents

Microbes can be broken up into prokaryotes and eukaryotes, however this course will primarily deal with prokaryotes (bacteria). Students will learn about the structure, features, and biosynthesis mechanisms of prokaryotic cells, and how they differ from those of eukaryotic cells. Through understanding these differences, students will ponder the mechanism by which antibiotics operate on prokaryotes. Students will learn about how prokaryotic cells propagate. After describing several virulence factors of bacteria, the students will learn the mechanisms by which pathogenic bacteria become virulent.
Chromosome translocation by both bacteriophage and conjugation will be discussed. Students will also learn about transposons and genetic modification, deepening their understandings of microbial genetics. Genetic engineering will be introduced through discussing the applications of these concepts.
The lecture will also discuss the evolution and diversity of prokaryotes. Students will understand the ways that prokaryotes evolve, and realize their stunning diversity through the variations in their metabolisms and ecologies. Industrial uses of microbes will be introduced from the standpoint of practical microbiology.

## Others

※Please refer to the ″Syllabus & Class Schedule Search System″ for details including course schedule, evaluations, textbooks and others.
〈URL〉
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CD131

| Course Title | Molecular Cytology 3 | | |
|---|---|---|---|
| Instructor | Mashima Keisuke | | |
| Semester | Spring Semester | Credit | 2 Credits |
| Course Number | LFS3300 | Language | Japanese |

## Course Objectives

This course aims to teach students about the nature of the signal transduction, tissue, and cancer at the molecular level.

## Course Contents

In order to understand diverse biological phenomena, it is necessary to understand cells, which contribute these biological phenomena. Cells consist of a wide variety of molecules, and these molecules make cooperatively a system and execute cellular functions. Therefore, we introduce cellular molecules involved in cell signaling and tissue construction. The diverse function of these molecules will be discussed.

## Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.
<URL>
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CD132

| Course Title | Methodology for Life Science | | |
|---|---|---|---|
| Instructor | Shiomi Daisuke | | |
| Semester | Spring Semester | Credit | 2 Credits |
| Course Number | LFS3010 | Language | Japanese |

## Course Objectives

Students will learn various experimental methods in life-science research. The goal of this course is to help students understand that the methods have their bases in molecular biology and biochemistry, thereby preparing students for future technological advances.

## Course Contents

Lectures on various experimental methods used in molecular biology, cell biology, and biochemistry.

1. Common generic techniques
2. Protein purification and identification
3. Phenotype analysis on the nano-, micro-, and macro-scales.

## Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.

<URL>

https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CD133

| Course Title | Seminar in Life Science 1 | | |
|---|---|---|---|
| Instructor | Suetsugu Masayuki | | |
| Semester | Spring Semester | Credit | 2 Credits |
| Course Number | LFS1520 | Language | Japanese |

## Course Objectives

In this course, students will learn the fundamentals necessary to study life science in small groups, ensuring their education in the Department of Life Science proceeds smoothly.

## Course Contents

This course is to be taken concurrently with Basic Experiments in Life Science. Before each experiment, students will learn the relevant theory, methods, and safety information in detail so that they can conduct each experiment with confidence.
After each experiment, students will discuss the significance of the results they have obtained, cultivating a better understanding of the subject and honing their ability to think critically. Additionally, advice on how to write reports and how to handle each experiment topic will be given.

As the need arises, various subjects relating to students' studies at the Department of Life Science will be discussed.

Students taking this course will be divided into four groups, with a different instructor being in charge of each group.

## Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.
<URL>
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CD134

| Course Title | Seminar in Life Science 2 | | |
|---|---|---|---|
| Instructor | Yoro Emiko | | |
| Semester | Spring Semester | Credit | 2 Credits |
| Course Number | LFS2520 | Language | Japanese |

## Course Objectives

In order to deepen their understanding of the fundamental coursework offered by the Department of Life Science, students will attend seminars related to various life science fields. Furthermore, students will create and give presentations regarding the results of each seminar, allowing them to hone their presentation skills.

## Course Contents

Students will attend various seminars related to the fundamental coursework offered by the Department of Life Science as well as subjects based upon them.
The instructor in charge will designate the field and choose the topics to be discussed during the seminar. Students will investigate the subject they are given and present their findings, discussing the subject with the rest of the class.

## Others

※Please refer to the ″Syllabus & Class Schedule Search System″ for details including course schedule, evaluations, textbooks and others.
〈URL〉
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CD135

| Course Title | Elementary Biology | | |
|---|---|---|---|
| Instructor | Suminokura Nobuhiko | | |
| Semester | Spring Semester | Credit | 2 Credits |
| Course Number | LFS1000 | Language | Japanese |

## Course Objectives

Our goal in this course is to gain the academic ability of ″biology″ necessary to study life science at university.

## Course Contents

As the goal of this course is to gain an understanding of basic life phenomena, lectures will focus on identifying the most important matters. Each lecture will be a lesson based around a single theme, with the items on the right being considered as the themes for this year. It is also important for students to read the texts both before and after the lecture, as there will be quizzes for some subject.

## Others

※Please refer to the ″Syllabus & Class Schedule Search System″ for details including course schedule, evaluations, textbooks and others.
〈URL〉
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CD136

| Course Title | Elementary Chemistry | | |
|---|---|---|---|
| Instructor | Tsushima Takashi | | |
| Semester | Spring Semester | Credit | 2 Credits |
| Course Number | LFS1000 | Language | Japanese |

## Course Objectives

Our goal in this course is to gain the power of "chemistry" necessary to study life science in university. This is preparation for "Basic Chemistry 1" taught in the fall semester of a student's first year.

## Course Contents

Knowledge of chemistry is essential in learning life science. However, the current situation is that, due to curriculum and examination subjects, many students entering college do so without having learned a lot of chemistry. That is why this class focuses on acquiring the knowledge of chemistry necessary for learning in the field of life science. We will touch not only on high school chemistry, but also on thermodynamics such as electron orbits for atoms and molecules, and entropy and enthalpy. We will try to fit as many actual exercises into class as possible, allowing us to not only gain knowledge but put that knowledge to use.

## Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.
<URL>
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CD137

| Course Title | Advanced Lectures on Life Science | | |
|---|---|---|---|
| Instructor | Higuchi Maiko | | |
| Semester | Fall Semester | Credit | 2 Credits |
| Course Number | LFS3020 | Language | Japanese |

## Course Objectives

This course aims to teach students about the frontiers of the life sciences, which progress with each passing day.

## Course Contents

Using the research being conducted in each full-time faculty member's laboratory and related subjects as a focal point, this course will discuss the cutting-edge research taking place in various life science fields. The life sciences consist of a diverse array of fields. Research progresses at a rapid pace, and as a result, it is essential to keep up with what is being found at the frontiers of discovery. The fundamental knowledge students have learned thus far is also necessary for comprehending the latest life science research. Through taking this course, students will deepen their understanding of the research being conducted by each laboratory in the department. This understanding will prove useful when it comes time to select a lab to join for one's Graduation Research.

## Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.
<URL>
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CD138

| Course Title | Special Exercises in Life Science 1 | | |
|---|---|---|---|
| Instructor | Shiomi Daisuke | | |
| Semester | Spring Semester | Credit | 1 Credit |
| Course Number | LFS3820 | Language | Japanese |

## Course Objectives

This course is aimed at third-year students with a strong thirst for knowledge. By providing an early opportunity research and learn, this course aims to deepen students' interest and understanding of the life sciences.

## Course Contents

This is a special training course in which each faculty member will be assigned only 1-2 students. The contents will vary depending on the faculty member, but students will research thier own original theme. Students will be expected to participate in round-table discussions with the laboratory members and to present their data.

Depending on each student's state of progress and individual needs, they will receive guidance in the following areas:

1. Understanding research contents
2. Drafting a research plan
3. Learning experimental methods
4. Investigation and analysis of experimental results
5. Reporting research results
6. Discussions of English papers related to the research topic

Each faculty member's research topic is listed below.

Sekine: Dynamic state mechanism of bacterial genomes; Function analysis of non-coding RNA
Goto: Organelles regulating development and aging
Oka: Controlling mitochondrial morphogenesis; Analysis of the physiological roles of organelle quality control
Yamada: Mechanisms of ATP synthase activity regulation
Horiguchi: Molecular mechanisms of morphogenesis and stress responses in higher plants
Sakakibara: Developmental Evolutional research of land plants
Shiomi: Survival strategies of bacteria in the presence of antibiotics
Suetsugu: Synthetic biological analysis of bacterial genomes
Higuchi: Signaling pathways regulating development, regeneration and tumorigenesis
Iwakawa: Mechanism of gene silencing by small non-coding RNAs

## Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.
<URL>
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CD139

| Course Title | Special Exercises in Life Science 2 | | |
|---|---|---|---|
| Instructor | Shiomi Daisuke | | |
| Semester | Fall Semester | Credit | 1 Credit |
| Course Number | LFS3820 | Language | Japanese |

## Course Objectives

This course is aimed at third-year students with a strong thirst for knowledge. By providing an early opportunity research and learn, this course aims to deepen students' interest and understanding of the life sciences.

## Course Contents

This is a special training course in which each faculty member will be assigned only 1-2 students. The contents will vary depending on the faculty member, but students will research thier own original theme. Students will be expected to participate in round-table discussions with the laboratory members and to present their data.

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2. Drafting a research plan
3. Learning experimental methods
4. Investigation and analysis of experimental results
5. Reporting research results
6. Discussions of English papers related to the research topic

Each faculty member's research topic is listed below.

Sekine: Dynamic state mechanism of bacterial genomes; Function analysis of non-coding RNA
Goto: Organelles regulating development and aging
Oka: Controlling mitochondrial morphogenesis; Analysis of the physiological roles of organelle quality control
Yamada: Mechanisms of ATP synthase activity regulation
Horiguchi: Molecular mechanisms of morphogenesis and stress responses in higher plants
Sakakibara: Developmental Evolutional research of land plants
Shiomi: Survival strategies of bacteria in the presence of antibiotics
Suetsugu: Synthetic biological analysis of bacterial genomes
Higuchi: Signaling pathways regulating development, regeneration and tumorigenesis
Iwakawa: Mechanism of gene silencing by small non-coding RNAs

## Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.
<URL>
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CD140

| Course Title | Physics 1 | | |
|---|---|---|---|
| Instructor | Iimura Shun | | |
| Semester | Fall Semester | Credit | 2 Credits |
| Course Number | LFS2920 | Language | Japanese |

## Course Objectives

The aim of the natural sciences is to discover and understand phenomena governed by natural law. Classical mechanics and electromagnetism in physics are typical examples of the natural sciences. The goal of this course is to acquire the basics of scientific thinking by learning classical mechanics and electromagnetism.

## Course Contents

In this course, we will learn kinematics, equation of motion, energy, and momentum from classical mechanics. The motion of charged particles in electric fields and magnetic fields will also be learned from electromagnetism. It is better if students know the basics of vector and differential and integral calculus, since they will be used to describe motions. In case of extra time, modern physics (theory of relativity, quantum mechanics) will be introduced. The contents will be changed according to the progress of this course.

## Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.
<URL>
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CD141

| Course Title | Biostatistics | | |
|---|---|---|---|
| Instructor | Onohara Ayaka | | |
| Semester | Spring Semester | Credit | 2 Credits |
| Course Number | LFS3010 | Language | Japanese |

## Course Objectives

Data is being continuously generated in large quantities to the point that the term “big data” is gradually permeating the vocabulary of general society. As a result of this, general societal interest in statistics has risen, and the need for people who can make decisions after interpreting data has increased. Nevertheless, there is still a distinct shortage of individuals capable practically applying data.
Applied uses of statistics exist in a wide variety of fields, not just disciplines related to the life sciences.
In this course, students will learn fundamental statistics concepts commonly used in experiments and investigations. Depending on one’s goals, one must be able to correctly collect data and select and appropriate method for analyzing it. They will learn frequently used statistical methods and fundamental knowledge while acquiring practical analysis abilities.

## Course Contents

The lecture will begin with basic statistics, whereupon students will come to understand data trends and scatter plots. The course will also outline various research methods encountered in statistics, including survey methods, experimental methods, and observation research. For example, students will learn methods for dealing with situations where there are two variables, like height and weight. Descriptive statistics methods will be covered in the first half of the course. From then on, the course will cover inferential statistics methods, in which one infers things about the nature of the whole after seeing a small part of it. First, students will be introduced to the basics of inferential statistics: random variables and the relationship between populations and samples. Students will then learn the important concept of sampling distribution. Next, students will learn about a critical part of inferential statistics: estimations. Particular focus will be placed on interval estimations. Following this, the idea of a hypothesis test will be introduced. The lecture will proceed with the aim of enabling students to learn how to conduct various types of hypothesis testing, such as analysis of variance.

## Others

※Please refer to the ″Syllabus & Class Schedule Search System″ for details including course schedule, evaluations, textbooks and others.
〈URL〉
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CD142

| Course Title | English for Life Science 1 | | |
|---|---|---|---|
| Instructor | Oka Toshihiko/Umino Rumi | | |
| Semester | Spring Semester | Credit | 2 Credits |
| Course Number | LFS2610 | Language | Japanese |

## Course Objectives

This course is designed to prepare students for reading scientific books and publications, and for listening to scientific oral presentations. Students should note that this is an English class, not a life-science class given in English.

## Course Contents

The course mainly deals with English grammar in general and terminology in molecular biology. It consists of two parts.
Part I: Students will learn science-specific English and perform reading, listening and speaking exercises.
Part II: Students will learn terminology and specialized expression in molecular biology through intensive reading of excerpts from "Essential Molecular Biology."

## Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.
<URL>
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CD310

| Course Title | English for Life Science 2 | | |
|---|---|---|---|
| Instructor | Horiguchi Gorou/Nakagawa Naoko | | |
| Semester | Spring Semester | Credit | 2 Credits |
| Course Number | LFS3620 | Language | Japanese |

## Course Objectives

The goal of this course is for students to be able to roughly comprehend biological literature and scientific texts in English. Additionally, this course aims to foster the ability of students to give basic presentations of their scientific research in English.

## Course Contents

The course consists of two parts.

Part I: Students will read short articles for non-professional readers and papers for scientists in the field of life sciences. Students will learn how these papers are structured, as well as how to summarize scientific literature and experimental methods. Students will learn how to organize data in a logical fashion. Tasks for preparation and reviews will be provided.

Part II: Students will perform intensive and extensive reading exercises based on biological topics, listening exercises using recorded sounds, writing exercises, comprising writing an experiment report, and speaking exercises. Several comprehension tests will be given.

## Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.
<URL>
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CD311

| Course Title | Career paths in science and technology | | |
|---|---|---|---|
| Instructor | Furusawa Kiyoshi/Noro Masayuki/Hirayama Takato/Tabuchi Mari/Shiomi Daisuke | | |
| Semester | Spring Semester | Credit | 2 Credits |
| Course Number | SCI1220 | Language | Japanese |

## Course Objectives

Students　are expected to obtain ideas toward their future career plans through talks of guest speakers and faculty members will share information on job markets and career. The goals of this course are to be careful listeners through the presentations and to set principles for how to lead their student lives as students of the College of Science.

## Course Contents

This course aims to support students to visualize their possible future plans. Alumni and faculty members will share their experiences with their skills and knowledge from the training in their own areas of science. Students will be expected to nurture the active skill of listening through the presentations of alumni and other speakers on the broad areas of careers after graduation from the College of Science.

## Others

※Please refer to the ″Syllabus & Class Schedule Search System″ for details including course schedule, evaluations, textbooks and others.
〈URL〉
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CK001

| Course Title | Science Education Planning | | |
|---|---|---|---|
| Instructor | Furusawa Kiyoshi/Nishino Takeo/Sawada Makoto/Tanabe Ichiro/Goto Satoshi | | |
| Semester | Fall Semester | Credit | 2 Credits |
| Course Number | SCI3220 | Language | Japanese |

## Course Objectives

The course focuses on designing and delivering skills of educational material in mathematics and science.

## Course Contents

Students are expected to draft a short science/mathematics course plan of high school level with support of faculty members. The task may require off-classroom work. Students are also expected to give presentations about their course design.

## Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.
<URL>
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CK003

| Course Title | History of Science | | |
|---|---|---|---|
| Instructor | Yamaguchi Mari | | |
| Semester | Spring Semester | Credit | 2 Credits |
| Course Number | SCI2110 | Language | Japanese |

## Course Objectives

This course aims not only to acquire scientific thinking through learning scientific arguments and scientific practices by forerunners but to establish your multidimensional perspective of science and technology. An additional aim is to develop your writing skill to express your thought as writing reaction papers.

## Course Contents

This course explores the history of science with keywords, atom(s) and molecule(s), from ancient Greece to the modern period, mainly in Europe and the United States. We will examine scientific thinking and scientific practices in the context of historical events.　This course will have opportunities for discussions or writing to think about science and technology in the context of the social dimension.

## Others

※Please refer to the ″Syllabus & Class Schedule Search System″ for details including course schedule, evaluations, textbooks and others.
〈URL〉
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CK004

| Course Title | Ethics in Science | | |
|---|---|---|---|
| Instructor | Mizoguchi Hajime | | |
| Semester | Fall Semester | Credit | 2 Credits |
| Course Number | SCI2210 | Language | Japanese |

## Course Objectives

The goals of this course are as follows. One is to allow students to concretely imagine the influence of science knowledge and medical technology on modern society. The other is to have students acquire basic knowledge, understanding basic issues and the scientific background of sciene ethics from the viewpoint of human activities, therefore allowing them to express their own thoughts and ideas in discussions.

## Course Contents

In this lecture-based class, the lecturer will explain how scientific knowledge is related to scientificmodern world, where the natural scientific basis of advanced medical technology is placed, etc. Some examples of topics this touches on include priority dispute, eugenic movement, development of nuclear wepons, geneti engineering bioethics ando so on. The fact will be highlighted that scientific knowledge rapidly permeates throughout modern society, which has social impacts beyond what researchers may expect. Additionally, even if you are a natural science researcher or engineer, in some cases as a citizen you will have to face ethical problems, In such cases you will need to know the specifics regarding the differences between research level and sociall level. The aim is to provide the materials that will lead to you thinking on your own in the context of science ethics and hope that will create opportunities leading to a review of how you perceive life, and more specifically, human life. Depending on the number of students, discussions and free talks will also be held. We will discuss the following topics.

## Others

※Please refer to the ″Syllabus & Class Schedule Search System″ for details including course schedule, evaluations, textbooks and others.
<URL>
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CK006

| Course Title | Intellectual Property Right | | |
|---|---|---|---|
| Instructor | Okada Hiroyuki | | |
| Semester | Spring Semester | Credit | 2 Credits |
| Course Number | SCI2210 | Language | Japanese |

## Course Objectives

In this course, students will acquire fundamental knowledge about intellectual property rights while gaining an understanding as to how to actually obtain and apply such rights. While a legal understanding is certainly essential, this course will aim to teach students practical knowledge about intellectual property.

## Course Contents

In this course, students will learn what intellectual property rights are and what they protect. We will provide an outline of intellectual property rights, with explanations focusing mostly on patents. Specifically, students will learn about the legal proceedings required to obtain a patent for an invention, as well as things to be cautious of throughout the process. In addition, students will learn the practical applications made possible after a patent is obtained. Other forms of intellectual property rights will be explained through comparison to patent rights. Relevant examples in the form of court cases and newspaper articles will be introduced and discussed. Furthermore, as a form of study to be conducted outside of class, students will draw up mock patent applications and perform mock patent examinations.

## Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.
<URL>
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CK007

| Course Title | Introduction to Science Communication | | |
|---|---|---|---|
| Instructor | Furusawa Kiyoshi | | |
| Semester | Spring Semester | Credit | 2 Credits |
| Course Number | SCI2220 | Language | Japanese |

## Course Objectives

In this course, students will learn about fundamental Science Communication methods as well as their applications.

## Course Contents

Science communication is a critical part of implementing research and development projects related to science and technology from a social standpoint. The flow of information between scientists is indispensable to the progression of research, and enables people from different fields including the public to come together to make good decisions, which is a necessity in our exceedingly interconnected society. In this course, we will start with the basics. First, students will learn what science communication is as a general concept. Then, students will use this knowledge and apply it to an example of science communication language. Following this, students will make a project plan and have a presentation about scientific topics. And students will hear from various individuals who deal with science communication in different contexts regarding the mental attitude and skills required.

## Others

※Please refer to the ″Syllabus & Class Schedule Search System″ for details including course schedule, evaluations, textbooks and others.
<URL>
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CK008

| Course Title | Introduction to Geology | | |
|---|---|---|---|
| Instructor | Seike Kazuma | | |
| Semester | Spring Semester | Credit | 2 Credits |
| Course Number | SCI2110 | Language | Japanese |

## Course Objectives

This course aims to give students a basic understanding of general geology. Students will learn the meanings of various terminology commonly used in Earth and Planetary Sciences, cultivating an understanding that will enable them to accurately explain them to others. The hope is that by acquiring some basic knowledge of geology, students will cultivate an interest and be able to better understand in geologic science news you encounter in their daily life.

## Course Contents

Whether it be daily weather, earthquakes and and volcanic activity, or news/newspaper articles regarding mineral resources, topics related to Earth and Planetary Sciences are very close for your life. For that very reason, you can expect receiving a basic grounding in the fundamentals of geology to rapidly expand your outlook. This course aims to give students the basic knowledge necessary to understand the history of the Earth as well as important topics related to the Earth sciences such as the formation of rocks and the mechanisms of earthquakes. This course will proceed with assuming students had not taken Earth Scicence course in high school. The course will be conducted in the classroom in lecture format using Power Point presentations. Handouts related to the contents of the PP presentations will be distributed at every lecture. Every student regardless of attendance or absence will be assigned the task of writing a simple summary of each lecture. Submitted tasks will also be added to each students score. Additionally, there will be a final examination.

## Others

※Please refer to the ″Syllabus & Class Schedule Search System″ for details including course schedule, evaluations, textbooks and others.
<URL>
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CK009

| Course Title | Geological Experiments (General) | | |
|---|---|---|---|
| Instructor | Seike Kazuma | | |
| Semester | Fall Semester | Credit | 1 Credit |
| Course Number | SCI2120 | Language | Japanese |

## Course Objectives

This course aims to give students the skills of reading topographic and geological maps, and understanding various geological phenomena through experimental practice. Students will put in effort to learn how to teach various topics related to geology, as well as how to use teaching materials and contents of a natural history museum, practically. This course will also teach techniques for leading geological excursion.

## Course Contents

In order to gain a deep understanding about geology, practical experiments and geological excursions are indispensable things. In this course, students will conduct various representative experiments related to earth science and a field trip. The course will be conducted in the classroom in lecture/practice format using Power Point presentations and various handouts, and will be also practiced hands-on training outdoors or at another location. Students will be evaluated by the practice exercises they will turn in every lecture, as well as the geological observing report about field trip. It is optimal for you to take this course only if they already took course of Introduction to Geology (spring semester). Precautions regarding registering for this course should be noted along with the other items.

## Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.
<URL>
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CK010

| Course Title | Science and Business Leadership(BL4) | | |
|---|---|---|---|
| Instructor | Uda Takefumi/Tateno Yoshikazu | | |
| Semester | Spring Semester | Credit | 2 Credits |
| Course Number | SCI3220 | Language | Japanese |

## Course Objectives

Through the problem-solving of a client company, enhance the ability of logical thinking and leadership, which are necessary to play an active role in society. In addition, learn and actually utilize skills that are useful in business.

## Course Contents

+ The aim is to develop a plan that is not only interesting as ideas but that the students want to implement and that is feasible. Furthermore, it is aimed to make the client company want to implement the plan through the presentation.

+ Skills covered in class (tentative):
- Industry/company analysis
- Idea generation (divergence and convergence)
- Designing and conducting interviews
- Profit calculation
- Business modelling
- Slide creation
- Presentation

## Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.
<URL>
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CK012

| Course Title | Science Communication Seminar 1 | | |
|---|---|---|---|
| Instructor | Furusawa Kiyoshi | | |
| Semester | Spring Semester | Credit | 2 Credits |
| Course Number | SCI4220 | Language | Japanese |

## Course Objectives

Students are expected to obtain practical skills for Science Communication and aim for applying an experiential learning cycle and a practical cycle.

## Course Contents

How can we create opportunities to communicate science and to think about science for our society together? In this course, students will implement a planning Science Communication project, carrying out the plan and reflecting, analyzing, evaluating it. And students aim for applying an experiential learning cycle and a practical cycle of Science Communication by using the result of the reflection. The theme and schedule will be decided by the discussion with students.

## Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.
<URL>
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CK014

| Course Title | Science Communication Seminar 2 | | |
|---|---|---|---|
| Instructor | Furusawa Kiyoshi | | |
| Semester | Fall Semester | Credit | 2 Credits |
| Course Number | SCI4220 | Language | Japanese |

## Course Objectives

Students are expected to obtain practical skills for Science Communication and aim for applying an experiential learning cycle and a practical cycle.

## Course Contents

How can we create opportunities to communicate science and to think about science for our society together? In this course, students will implement a planning Science Communication project, carrying out the plan and reflecting, analyzing, evaluating it. And students aim for applying an experiential learning cycle and a practical cycle of Science Communication by using the result of the reflection. The theme and schedule will be decided by the discussion with students.

## Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.
<URL>
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CK015

| Course Title | Introduction to Medicine | | |
|---|---|---|---|
| Instructor | Shikama Naoto | | |
| Semester | Fall Semester | Credit | 2 Credits |
| Course Number | SCI2110 | Language | Japanese |

## Course Objectives

The role of radiotherapy in multidisciplinary treatment for cancers will be introduced, and the role of science and technology for medical science will be clarified.

## Course Contents

Mortality due to cancers are still high, and the basic law for cancer control has been enacted as one of the important medical policies. Knowledge of biology, physics, and biostatistics is required to learn radiation therapy in cancer treatment, and the characteristics of cancer cells, radiation sensitivity, ingenuity to reduce toxicity, characteristics of new radiotherapy technology, etc. In order to practice patient-centered medical care, close cooperation with various medical staffs such as medical doctors, nurses, radiologists, medical physicists, clinical engineers, and laboratory engineers is essential. Clinical trials are important for the development of cancer treatment strategy, and various academic fields including biostatistics, behavioral medicine, and medical judgment are required. In order to understand the roles of various medical staffs and develop better medical care, active contributions of the science and engineering fields are desired, and we would like to consider the possibility together.

## Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.
<URL>
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CK016

| Course Title | Short-Term Study Abroad Program 1 | | |
|---|---|---|---|
| Instructor | Minoura Mao/Murata Jiro/Furusawa Kiyoshi | | |
| Semester | Summer Session | Credit | 2 Credits |
| Course Number | SCI1213 | Language | Others |

## Course Objectives

In this course, students will visit corporations in America's Silicon Valley. Through hearing the stories of people working there and discussing with them, students will learn about what working overseas is like while getting an opportunity to think about the path they wish to take in the future.

## Course Contents

Students who take this course will attend three lectures at Rikkyo University before embarking on a week long field trip to a company on the outskirts of Silicon Valley, where they will hear the stories of people that work there. Throughout the trip, students will keep a daily journal of their activities which they will email to their instructor. Furthermore, upon returning to Japan, students will summarize any thoughts and ideas they have conceived regarding their future as a result of the trip, which they will present to the class and turn in via a final report.

## Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.
<URL>
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CK017

| Course Title | Short-Term Study Abroad Program 2 | | |
|---|---|---|---|
| Instructor | Horiguchi Gorou/Geisser Thomas H./Furusawa Kiyoshi | | |
| Semester | Summer Session | Credit | 2 Credits |
| Course Number | SCI2213 | Language | Others |

## Course Objectives

This course aims for students to strengthen their English communication skills, to experience different culture in Singapore through classes and other activities, and to better understand international viewpoints through cultural exchanges with students from overseas.

## Course Contents

Students who take this course will attend lectures at Rikkyo University before heading to Singapore in August for two weeks. During this trip, students will attend a language lesson at inlingua School of Languages. Students will also participate in an excursion and visit places related to science and technology. Throughout the trip, students will keep a daily log of their activities, which they will submit to their instructor. Furthermore, upon returning to Japan, students will convene to present and submit a report regarding what they experienced and learned while they were in Singapore.

## Others

※Please refer to the "Syllabus & Class Schedule Search System" for details including course schedule, evaluations, textbooks and others.
<URL>
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CK018

| Course Title | Entrance into Mathematical World | | |
|---|---|---|---|
| Instructor | Kono Takahiko | | |
| Semester | Spring Semester | Credit | 2 Credits |
| Course Number | SCI2110 | Language | Japanese |

## Course Objectives

In this course, we study some basic mathematical ideas by studying how the number system has been developed.

## Course Contents

We will study some interesting properties related to natural numbers, integers, rational numbers, irrational numbers, and complex numbers.
We will also show how these properties can be expressed in basic mathematics such as sets and matrices.
Finally, we will also introduce quaternions as an extension of complex numbers.

## Others

※Please refer to the ″Syllabus & Class Schedule Search System″ for details including course schedule, evaluations, textbooks and others.
〈URL〉
https://sy.rikkyo.ac.jp/web/preview.php?nendo=2023&kodo_2=CK022


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