Introduction to Basic Chemistry

This class is offered to freshmen enrolled in the AMC course. Fundamental knowledge and cutting-edge research in chemistry and materials science will be presented in the form of seminars in each laboratory. Throughout these seminars, the differences in high school-level and college-level chemistry will be emphasized, and students will be given motivation for their future studies.

基礎化学序論
(南後 恵理子)

Special Class in Basic Chemistry I

In this lecture, we try to understand fundamentals of the quantum mechanics and quantum chemistry that are required for advanced chemistry courses. Starting with a lecture of the early quantum mechanics, we learn how to formulate the Schrödinger equation, which is the basic equation of quantum mechanics. The basic concept of wavefunctions (solutions of the Schrödinger equations) are presented to understand the wave nature of particles in atomic scale. Then the simple models for vibrational and rotational motions of molecules, and the electronic state of the hydrogen atom are treated quantum mechanically as the prototypes for more complex atoms and molecules.

専門基礎化学 I
(南後 恵理子)

Special Class in Basic Chemistry Ⅱ

This course builds from the basic electronic structure of atoms and molecules to bonding in compounds to structure and finally to the relationship between the structure and properties of compounds. It is my aim that students will develop tools needed to predict the properties from the electronic and physical structures of relatively simple compounds.

専門基礎化学 Ⅱ
(BREEDLOVE BRIAN)

Special Class in Basic Chemistry Ⅲ

Students will learn how to understand organic chemical reactions. The purpose is to learn the reactions of basic organic compounds, such as alkanes, alkenes, and organic halides, via the flow of electrons shown using arrows. 1. Structure and Bonding, 2. Organic Compounds, 3. Stereochemistry, 4. Alkanes, 5. Alkenes, 6. Alkynes. Intended for those students majoring in organic chemistry, this class will provide the broad fundamentals of organic chemistry needed to become a chemist. It is desirable to continue taking Chemistry C, Special Class in Basic Chemistry Ⅲ, and General Organic Chemistry A, B and C as well as to take Exercises in Organic Chemistry A and Organic Chemistry IA and ⅡA (class concerning spectroscopy).

専門基礎化学 Ⅲ
(和田 健彦)

Special Class in Basic Chemistry Ⅳ

This class will cover general analytical and inorganic chemistry, such as equilibria, acids and bases, acid- base equilibria, oxidation and reduction reactions, electrochemistry, etc.

専門基礎化学 Ⅳ
(BREEDLOVE BRIAN)

General Physical Chemistry A

In this course, we study thermodynamics, statistical mechanics, and the properties of many-body systems at finite temperature. The course is intended for the understanding both of chemical physical phenomena appeared in material science. We will cover the classical thermodynamics, the relationship between the macroscopic phenomena and the microscopic properties (statistical mechanics), and the application of these ideas to the observed states of actual materials.

物理化学概論 A
(米田 忠弘)

General Physical Chemistry B

The course deals with the introduction to the principles of quantum mechanics and their application to chemical systems. Topics include the formalism and mahtematical tools of quantum mechanics; approximate methods; atomic structure; the chemical bond, valence bond; and molecular orbital theory.

物理化学概論 B
(組頭 広志)

General Physical Chemistry C

Chemical kinetics, also known as reaction kinetics, is the study of the speed of chemical processes. A study of chemical kinetics includes investigations of how experimental conditions can influence on the speed of a chemical reaction. In this class, appropriate construction of mathematical models that can describe the characteristics of a chemical reaction will be discussed. Concept of "order of reaction" and "how to determine order of reaction along with integrated rate laws" are also the most important topics of this class. Moreover, the enzymatic reaction kinetics will be introduced to understand the specific examples of chemical reaction rate determination. On the other hand, starting from the discussion of molecular velocities in the gas phase (Maxwell-Boltzmann distribution), the relationship between molecular collisions and reaction rates will be discussed. This discussion will be continued to study the relationship between chemical reactions in the gas phase and the internal and potential energies of the reacting molecules.Through the trial to solve the problems in the textbook, the establishment of the knowledge will be achieved.

物理化学概論 C
(荒木 保幸)

General Physical Chemistry D

Gain the skill for the analysis of molecules, focusing on the understanding and application to the spectroscopic methods. We cover wide area of the spectroscopic methods, including optical absorprion/emission spectroscopy and magnetic resonance spectroscopy.

物理化学概論 D
(高岡 毅)

Exercises in Physical Chemistry A

Through lectures of physical chemistry classes, fundamentals of physical and mathematical knowledge will be lectured. However, it is also necessary to solve actual problems in physical chemistry issues. Topics and exercises in special cases will be extended.

物理化学演習 A
(米田 忠弘. 高岡 毅)

Exercises in Physical Chemistry B

Through lectures of physical chemistry classes, fundamentals of physical and mathematical knowledge will be lectured. However, it is also necessary to solve actual problems in physical chemistry issues. Topics and exercises in special cases will be extended.

物理化学演習 B
(米田 忠弘)

General Inorganic and Analytical Chemistry A

Analytical chemistry is an important area of chemistry as it covers not only qualitative anaylsis of samples using forms of spectroscopy, electrochemistry, etc. and quantification of species in samples but also data analysis. This class is designed for students to gain knowledge in analytical techniques and concepts involved in those techniques.

無機分析化学概論 A
(BREEDLOVE BRIAN)

General Inorganic and Analytical Chemistry B

This class is a survey of the general properties and reactivity of main group elements and transition metals. During the course, we cover chapters 9-22 in Inorganic Chemistry, 6th ed.

無機分析化学概論 B
(BREEDLOVE BRIAN)

General Inorganic and Analytical Chemistry C

The objective of this class is to introduce frontiers of inorganic chemistry. The aim of the class is to show how developments in inorganic chemistry impinges on the other disciplines, such as life science, condensed matter physics, and materials chemistry. We will discuss materials chemistry focusing on solid-state compounds, their structures, and electronic, magnetic, and optical properties. In addition, we will discuss nanomaterials and biosensors and introduce the area of catalysis.

無機分析化学概論 C
(BREEDLOVE BRIAN)

General Inorganic and Analytical Chemistry D

In this course, students will understand various analytical methods based on the fundamental knowledge on analytical chemistry learnt in Special Class in Basic Chemistry Ⅳ.

無機分析化学概論 D
(福山 真央)

Exercises in Inorganic and Analytical Chemistry B

Conduct exercises in inorganic and analytical chemistry, in particular an area from basic inorganic chemistry to coordination chemistry related to the solid-state molecular chemistry, by explaining their fields.

無機分析化学演習 B
(芳野 遼. 福山 真央)

General Organic Chemistry A

This class is part of organic chemistry classes, including Special Class in Basic Chemistry Ⅲ, and General Organic Chemistry A, C, and D. The lecture covers the following topics: 1. Basic chemistry of organic halides. 2. Nucleophilic substitution reactions and reaction theory, 3. Diene and allylic systems, 4. Conjugated and aromatic compounds, 5. Aromatic substitution reactions, 6. Properties of alcohols, phenols, ethers, and thiols. This class will provide the broad fundamentals of organic chemistry that are essential for students to be a chemist.

有機化学概論 A
(水上 進)

General Organic Chemistry C

Learning the chemistry of carbonyl compounds - main reactions, methods of synthesis, reaction mechanisms and synthetic applications.

有機化学概論 C
(鬼塚 和光)

General Organic Chemistry D

This class is part of series of organic chemistry classes, including General Organic Chemistry A, C, and D. This lecture will concersn the following topics: 1. Basic chemistry of amines and helelocycles, 2. Chemistry of biomolecules, 2-1 Carbohydrates, 2-2 Aminoacids, Peptides and Proteins, 2-3 Lipids, 2-4 Nucleic acids, 3. The organic chemistry of metabolic pathway, 4. Pericyclic reactions : electrocyclic reactions, cyclo additions and sigmatropic rearrangements.

有機化学概論 D
(永次 史)

Exercises in Organic Chemistry A

Understanding of organic chemistry will be deepened by performing exercises based on the lecture contents of "Chemistry C" and "Special Class in Basic Chemistry Ⅲ" and in parallel "General Organic Chemistry A" and "Laboratory Experiments in Chemistry A" (up to chapter 18 in McMurry, "Organic Chemistry", 8th ed.)

有機化学演習 A
(永次 史. 水上 進. 和田 健彦)

Exercises in Organic Chemistry B

Understanding of organic chemistry will be deepened by performing exercises based on the lecture contents of "General Organic Chemistry C" and "General Organic Chemistry D" (from chapter 19 up to chapter 29 in McMurry, "Organic Chemistry", 8th ed.)

有機化学演習 B
(永次 史. 和田 健彦)

General Biochemistry

To study the basic knowledge of molecular biology, biochemistry and structural biology and to understand biological phenomena at the molecular level, students will learn the following contents. 1) Structures and chemical properties of nucleic acids, 2) Structures and chemical properties of amino acids and proteins, 3) Biochemical methods for analyzing DNA sequence, amino acid sequence, protein structures and functions, 4) Mechanisms of enzyme catalysis.

生物化学概論
(高橋 聡. 永次 史. 南後 恵理子)

Biochemistry IA

To learn the biological phenomena at the molecular level and to gain a deeper understanding of biochemistry, molecular biology and biophysics. Students will learn: 1. Structures and properties of sugars and lipids, 2. Structures and properties of biological membranes, 3. Biological energy transduction. It is desirable to consistently attend the discussions in Biochemistry IIA concerning the DNA and RNA synthesis and metabolism of biomolecules.

生物化学 IA
(高橋 聡)

Basic Experiments in Chemistry

You learn experimental operations of basic inorganic chemistry, basic analytical chemistry, basic physical chemistry, and basic organic chemistry.

基礎化学実験
(豊田 耕三. 伊藤 優志. 道祖尾 恭之. 志賀 大亮. 高岡 毅. 田口 真彦. 藤原 孝彰)

Laboratory Experiments in Chemistry A

You learn fundamental experimental operations of inorganic chemistry, analytical chemistry, and the related fields.

化学一般実験 A
(豊田 耕三. 權 垠相. 中西 匠. 福山 真央. BREEDLOVE BRIAN. 芳野 遼)

Laboratory Experiments in Chemistry B

You learn fundamental experimental operations of physical chemistry, organic chemistry, and biochemistry.

化学一般実験 B
(豊田 耕三. 荒木 保幸. 岡 弘樹. 岡村 秀紀. 鬼塚 和光. 鎌形 清人. 小関 良卓. 小和田 俊行. 道祖尾 恭之. 志賀 大亮. 高岡 毅. 田口 真彦. 藤原 孝彰)

Analytical Chemistry A

Students will learn statistics and coding to obtain the conclusion from chemical experimental data correctly.

分析化学 A
(福山 真央)

Inorganic Chemistry IA

Properties of solid are mainly dominated by an electronic structure of material. In this class, we will learn how to understand the atomic bonds, which form a crystal structure, and electric properties such as electrical conductivity of materials based on the electronic structure.

無機化学 IA
(高坂 亘)

Inorganic Chemistry IIA

Topics will include the structure and mechanical and physical properties of supramolecular complexes and multi-dimensional framework systems. Each topic assigned to you should be pre-investigated before your presentation. We will get various knowledes on the basic science in the field of supramolecular complexes and multi-dimensional framework systems through our presentation and discussion.

無機化学 IIA
(宮坂 等)

Physical Chemistry IIA

This course focuses on physical chemistry hidden in life sciences. Biomolecules function obeying some rules based on physical chemistry. These physical chemistry bases are deeply discussed while introducing Nobel Prize stories and hot research topics.

物理化学 IIA
(未定)

Polymer Chemistry I

The category of polymeric (or macromolecular) materials is so broad as to include, for example, the familiar fibers (or textiles), rubbers, plastics, and photo-resists used to make semiconductor integrated circuits (ICs). Protein and nucleic acid are also a type of polymer, called biopolymers. This lecture will first introduce the synthesis, structure, and properties of polymers, which are quite different from ordinary low molecular weight organic compounds. Next, high performance and functional polymers and hybrid polymer materials will be explained in detail. Finally,

biopolymers are summarised from a biophysical point of view.

高分子化学 I
(和田 健彦)

Organic Chemistry IA

Since organic, coordination , inorganic, bio and materials chemistries all require the ability to use spectroscopy to characterize molecules. This course will provide students tools needed to interpret spectra from different spectroscopic techniques.

有機化学 IA
(BREEDLOVE BRIAN)

Biochemistry ⅡA

To learn the biological phenomena at the molecular level and to gain a deeper understanding of biochemsity, molecular biology and biophysics. It is desirable to consistently attend the discussions in Biochemistry ⅡB concerning the photosynthesis, protein turnover and protein trafficking.

生物化学 ⅡA
(未定)

Polymer Chemistry Ⅱ

The category of polymeric (or macromolecular) materials is so broad as to include, for example, the familiar fibers (or textiles), rubbers, plastics, and photo-resists used to make semiconductor integrated circuits (ICs). Protein and nucleic acid are also a type of polymer, called biopolymers. This lecture will first introduce the synthesis, structure, and properties of polymers, which are quite different from ordinary low molecular weight organic compounds. Next, high performance and functional polymers and hybrid polymer materials will be explained in detail. Finally, biopolymers are summarised from a biophysical point of view.

高分子化学 Ⅱ
(和田 健彦)