Introduction to Basic Chemistry

Second semester Wed. 4 Period 2 Credits

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.

(HITOSHI KASAI)

Special Class in Basic Chemistry Ⅰ

First semester Mon. 2 Period 2 Credits

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.

(YUICHI NEGISHI)

Special Class in Basic Chemistry Ⅱ

First semester Fri. 3 Period 2 Credits

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.

(BREEDLOVE BRIAN KEITH)

Special Class in Basic Chemistry Ⅲ

First semester Mon. 4 Period 2 Credits

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. Structure and Bonding. Organic Compounds Stereochemistry Alkanes Alkenes 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).

(TAKEHIKO WADA)

Special Class in Basic Chemistry Ⅳ

First semester Fri. 4 Period 2 Credits

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

(BREEDLOVE BRIAN KEITH)

General Physical Chemistry A

First semester Mon. 2 Period 2 Credits

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.

(TADAHIRO KOMEDA)

General Physical Chemistry B

Second semester Mon. 2 Period 2 Credits

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.

(HIROSHI KUMIGASHIRA)

General Physical Chemistry C

First semester Fri. 2 Period 2 Credits

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.

(YASUYUKI ARAKI)

General Physical Chemistry D

First semester Thu. 1 Period 2 Credits

Starting from a lecture of the basic of spectroscopy, we try to survey modem spectroscopic methods used in physical chemistry.

(TSUYOSHI TAKAOKA)

Exercises in Physical Chemistry A

Second semester Mon. 3 Period 1 Credit

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.

(TADAHIRO KOMEDA, TSUYOSHI TAKAOKA)

Exercises in Physical Chemistry B

First semester Wed. 1 Period 1 Credit

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.

(TADAHIRO KOMEDA)

General Inorganic and Analytical Chemistry A

Second semester Fri. 1 Period 2 Credits

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.

(BREEDLOVE BRIAN KEITH)

General Inorganic and Analytical Chemistry B

Second semester Mon. 4 Period 2 Credits

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.

(BREEDLOVE BRIAN KEITH)

General Inorganic and Analytical Chemistry C

First semester Thu. 2 Period 2 Credits

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.

(BREEDLOVE BRIAN KEITH)

General Inorganic and Analytical Chemistry D

Second semester Thu. 1 Period 2 Credits

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.

(MAO FUKUYAMA)

Exercises in Inorganic and Analytical Chemistry B

First semester Mon. 1 Period 1 Credit

Exercises in Inorganic and Analytical Chemistry: From Basic Inorganic Chemistry to Coordination Chemistry and Ligand-Field Theory

(HARUKA YOSHINO, MAO FUKUYAMA)

General Organic Chemistry A

Second semester Fri. 2 Period 2 Credits

Objective and Summary of Class: 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.

(SHIN MIZUKAMI)

General Organic Chemistry C

First semester Tue. 2 Period, Fri. 1 Period 2 Credits

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

(KAZUMITSU ONIZUKA)

General Organic Chemistry D

First semester Tue. 2 Period, Fri. 1 Period 2 Credits

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

(FUMI NAGATSUGI)

Exercises in Organic Chemistry A

Second semester Thu. 3 Period 1 Credit

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.)

(FUMI NAGATSUGI, TAKEHIKO WADA, SHIN MIZUKAMI)

Exercises in Organic Chemistry B

First semester Wed. 2 Period 1 Credit

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.)

(FUMI NAGATSUGI, TAKEHIKO WADA)

General Biochemistry

First semester Mon. 3 Period 2 Credits

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

(SATOSHI TAKAHASHI, ERIKO NANGO, FUMI NAGATSUGI)

Biochemistry IA

Second semester Thu. 2 Period 2 Credits

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.

(SATOSHI TAKAHASHI)

Basic Experiments in Chemistry

Second semester Mon. 3 Period, Tue. 3 Period, Wed. 3 Period, Thu. 3 Period, Fri. 3 Period 1 Credit

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

(KOZO TOYOTA, TSUYOSHI TAKAOKA, YUJI ITOH, MASAHIKO TAGUCHI, DAISUKE SHIGA, TAKAAKI FUJIWARA)

Laboratory Experiments in Chemistry A

Second semester Mon. 4 Period, Mon. 5 Period, Tue. 4 Period, Tue. 5 Period, Wed. 4 Period, Wed. 5 Period, Thu. 4 Period, Thu. 5 Period, Fri. 4 Period 5 Credits

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

(KOZO TOYOTA, HARUKA YOSHINO, BREEDLOVE BRIAN KEITH, MAO FUKUYAMA, EUNSANG KWON, SHIGERU SASAKI, SHINGO TSUJI)

Laboratory Experiments in Chemistry B

First semester Mon. 3 Period, Mon. 4 Period, Mon. 5 Period, Tue. 3 Period, Tue. 4 Period, Tue. 5 Period, Wed. 3 Period, Wed. 4 Period, Wed. 5 Period, Thu. 3 Period, Thu. 4 Period, Thu. 5 Period, Fri. 3 Period, Fri. 4 Period 6 Credits

You learn fundamental experimental operations of physical chemistry, organic chemistry, and biochem-

istry.

(KOZO TOYOTA, TSUYOSHI TAKAOKA, YASUYUKI ARAKI, DAISUKE SHIGA, MASAHIKO TAGUCHI, KOUKI OKA, KAZUMITSU ONIZUKA, YUUHEI YAMANO, TOSHIYUKI KOWADA, IRA NOVIANTI, TAKAAKI FUJIWARA, YUJI ITOH)

Analytical Chemistry A

First semester Tue. 1 Period 1 Credit

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

(MAO FUKUYAMA)

Inorganic Chemistry IA

Second semester Thu. 2 Period 1 Credit

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

(WATARU KOSAKA)

Inorganic Chemistry IIA

Second semester Tue. 2 Period 1 Credit

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.

(HITOSHI MIYASAKA)

Physical Chemistry IIA

Second semester Tue. 1 Period 1 Credit

(TOKUHISA KAWAWAKI)

Polymer Chemistry I

Second semester Wed. 2 Period 1 Credit

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.

(TAKEHIKO WADA)

Organic Chemistry IA

Second semester Mon. 1 Period 1 Credit

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.

(BREEDLOVE BRIAN KEITH)

Biochemistry IIA

Second semester Fri. 2 Period 1 Credit

To learn the biological phenomena at the molecular level and to gain a deeper understanding of biochemsity, molecular biology and biophysics.

(TOSHIYUKI KOWADA)

Polymer Chemistry II

Second semester Wed. 2 Period 1 Credit

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.

(TAKEHIKO WADA)