基本情報/Course Schedule Information

開講区分(開講学期)／Semester	Fall and Winter Term
曜日・時間／Day and Period	Fri3
開講科目名／Course Name (Japanese)	分子科学入門　ー化学と社会ー
開講科目名(英)／Course Name	Introduction to Molecular Science - Chemistry and Society -
授業形態／Type of Class	講義科目/Lecture
単位数／Credits	2
担当教員／Instructor	HIRANO Koji

※メディア授業科目について

授業回数の半数以上を、多様なメディアを高度に利用して教室等以外の場所で行う授業を「メディア授業科目」としています。

学部学生が「メディア授業科目」を卒業要件に算入できるのは60単位が上限です。

なお、非該当の場合であっても、メディアを利用した授業を実施する場合があります。

授業担当教員一覧

詳細情報/Detailed Syllabus Information

授業サブタイトル／Course Subtitle	
開講言語／Language of the Course	English
学習方法／Learning Method 右の8つの学習方法のうち、 該当するものにチェックをつけてください。 「その他（自由記述）」を選択した場合は、 右の黄色セルに具体的な内容を入力してください。	聴講・視聴/Listening and watching face-to-face/online class,討論/Discussion,発表/Presentation ☑ Listening and watching face-to-face/online class: Listening and watching a lecture, video, or demonstration, face-to-face or via online (e.g., attending a face-to-face ☐ Reading: Reading books and academic papers (e.g., summarizing an academic paper, reading information on a website) ☑ Discussion: Learning through question-and-answer interactions and exchanges of opinions among students and between students and the instructor (e.g., pair/group discussion, online chat, one-on-one guidance for writing an academic paper) ☐ Collaborative work: Working as a pair or a group (e.g., producing a poster through group work) ☐ Research: Collecting information from books and academic papers; gathering and analyzing data by fieldwork (e.g., review of previous research, fieldwork) ☐ Experience/practice: Learning from experience- and practice-based activities, and feedback on such activities (e.g., solving problems; laboratory work using ☑ Presentation: Writing papers, making presentations, and creating works (e.g., report writing, oral/poster presentation, creation of works, portfolio development) ☐ Others(free description)
授業の目的と概要／Course Objective	How many different objects can you see around you? Maybe, too many to count. Then, widen your view and imagine how they can be made. Most of the things we use in daily life are different or modified from the substances and materials in natural state. Is there any order or simple rule in making up the matter? The science of chemistry addresses such a fundamental question. Life itself involves a very intricate sequence of chemical changes of matter. Chemistry also contributes a lot to solving the global issues of vital importance with which we are confronting, such as our environment, foods, resources, energies, and diseases by way of controlling chemical reactions. This course will focus on several important topics of current chemistry that are closely related to the human life and our society.
履修条件・受講条件／Requirement / Prerequisite	
出欠席及び受講に関するルール／Attendance and Student Conduct Policy	
教科書・指定教材／Textbooks	
参考図書・参考教材／Reference	
成績評価に関する補足情報／Additional Information on Grading	
特記事項／Special Note	The schedule of lectures will be subject to change.
オフィスアワー／Office Hour	
実務経験のある教員による授業科目／Course conducted by instructors with practical experience	

※　合理的配慮は定型文につき除外。

学習目標・成績評価詳細情報/Learning Goals &Grading Policy Information

学習目標(1)／Learning Goal(1)	To cultivate the ability to explain the multiple roles of chemistry in society.
学習目標(2)／Learning Goal(2)	
学習目標(3)／Learning Goal(3)	
学習目標(4)／Learning Goal(4)	
学習目標(5)／Learning Goal(5)	

↑　5行以上必要な場合は、行を挿入してください。

	評価方法／Evaluation Method　（プルダウンで選択してください。「その他（自由記述）」を選択した場合は、カッコ内に具体的な内容を入力してください。）		
学習目標／Learning Goals	学習への参加度/Learning Engagement	小テスト/Quiz	
学習目標(1)／Learning Goal(1)	○	○	
学習目標(2)／Learning Goal(2)			
学習目標(3)／Learning Goal(3)			
学習目標(4)／Learning Goal(4)			
学習目標(5)／Learning Goal(5)			
評価割合(%)／Grade Breakdown	20%	80%	%

↑　5行以上必要な場合は、行を挿入してください。

評価割合/Allocation of Marks（%）：100%

授業計画/Class Plan Detailed Information

回／Time	題目／Title	内容／Content	授業時間外学習／ Independent Study Outside of Class

1	Introduction to Chemistry - Structure and Reactivity	A molecule is the smallest particle of a substance that possesses the properties of matter, and it can also be described as the fundamental building block in the assembly of matter. The structure of a molecule determines these properties, which, in turn, define the characteristics and reactivity of the molecule, as well as the substance as a whole. In this lecture, we will begin with the basics of molecular structure—such as bonding, orbitals, and electronegativity—and provide an overview of how these are linked to physical properties and reactivity.	Special preparations are not essential, while the review is highly recommended.
2	Organometallic Chemistry	Organometallic compounds are chemical species that contain metal–carbon bonds formed through the combination of organic molecules and metal ions. These compounds have been widely studied for their important role as reagents in the synthesis of complex organic molecules. In this course, I will introduce the methods for synthesizing organometallic compounds and explain their key properties, as well as how they are used as catalysts in chemical reactions to produce useful materials. I will also show the broader impact of these catalytic processes on society.	Special preparations are not essential, while the review is highly recommended.
3	Supramolecular Chemistry	Supramolecules are molecular assemblies formed by the association of multiple molecules through noncovalent bonds. This lecture will provide an overview of the fundamentals of supramolecular chemistry, including its history and the interactions involved in the formation of supramolecules.	Special preparations are not essential, while the review is highly recommended.
4	Chemistry of Biomaterials	Polymer chemistry has attracted much attention in biomedical field for the preparation of biodegradable and biocompatible materials for in vivo transplantation or in vitro cell culture. Here, I would like to introduce the importance of polymer chemistry and materials for biomedical application.	Special preparations are not essential, while the review is highly recommended.
5	What is the Periodic Table?	When you look at an object beside you, you are looking at something that is made of atoms of various elements. Everything on earth is made of elements, and this includes your body and the air you breathe. Elements control everything in the world. The relationship between our life and elements will be explained in this lecture.	Special preparations are not essential, while the review is highly recommended.
6	Coordination Chemistry	This lecture focuses on metal complexes, which play essential roles in the function of metalloenzymes. It provides an overview of the relationships among structure, electronic states, and function of metal complexes. Students will explore the diverse properties and functions of metal complexes from the perspectives of geometric structure, optical properties, redox behavior, magnetism, and reactivity.	Special preparations are not essential, while the review is highly recommended.
7	Invitation to Organic Chemistry	This course provides an introduction to the depth and breadth of organic chemistry, highlighting both its intellectual appeal and practical potential. Students will discover the creative joy of constructing molecules, designing chemical reactions, and the artistic elegance inherent in molecular architecture. Through a series of illustrative examples, the course will demonstrate how a solid understanding of organic chemistry opens the door to cutting-edge research and a wide range of real-world applications.	Special preparations are not essential, while the review is highly recommended.

8	Fundamental of Chemical Biology	Chemical biology is an interdisciplinary research field that employs chemical approaches to investigate biological phenomena. Compound-based chemical probes have demonstrated to visualize cellular dynamics or regulate biological activity via interaction with targeted biomolecules. This contributes to elucidation of biological function and development of new drugs. This lecture will provide an overview of the fundamental principles of chemical biology, including chemical structures of biomolecules and design strategy of bioactive probes, in line with the history of chemical biology.	Special preparations are not essential, while the review is highly recommended.
9	An Organic Photochemistry	This lecture explores how light energy can induce chemical reactions in organic molecules. Topics may include molecular excitation, various types of photoreactions, and their synthetic applications. Key concepts could cover quantum yield, singlet and triplet states, energy and electron transfer, and the differences between photochemical and thermal reactions. Additionally, specific photoreactions, such as photocycloadditions, photocyclizations, photorearrangements, hydrogen abstraction, and atom transfer, will likely be discussed, along with their mechanisms and synthetic applications.	Special preparations are not essential, while the review is highly recommended.
10	Molecular Chirality	Chirality is an important structural property of organic molecules. A pair of chiral molecules (enantiomers) are usually designated as the relationship between right–hand and left-hand, which are in nonsuperimposable mirror image shapes. In this lecture, we first focus on the point chirality with some representative chiral molecules for sufficient understanding of the concept. Some additionall examples of different types of chirality will be introduced as well.	Special preparations are not essential, while the review is highly recommended.
11	Petrochemistry	Petrochemistry is one of the most important field in science. Many commodities of everyday existence such as clothes, plastic goods, PC, smart phones, and drugs are made from materials generated from petroleum. This course introduces the importance of petrochemistry in modern society to students taking this course. And, the following important industrial processes are explained: (1) Oil Refinery (2) Process for Oxidation Products of Ethylene (3) Process for Oxidation Products of Propylene.	Special preparations are not essential, while the review is highly recommended.
12	Chemistry for Low-dimensional Materials	Low-dimensional materials can exhibit properties that differ significantly from those of their bulk states. With the advancement of nanotechnology, various materials have been miniaturised or synthesised via bottom-up approaches. This lecture focuses on the chemical aspects of low-dimensional materials, including two-dimensional, one-dimensional, and zero-dimensional systems, explaining their synthesis and representative functions with examples.	Special preparations are not essential, while the review is highly recommended.
13	Can Molecules Feel Frustrated?	Chemical bonds are formed through the sharing of electrons between atoms. Molecules that donate electrons are called Lewis bases, while molecules that accept electrons are called Lewis acids. For chemical bonds to form, Lewis bases and Lewis acids must approach each other sufficiently close. What would happen if we intentionally hinder this approach, creating a state where molecules "want to get closer but cannot, yet want to separate but are unable to"? Perhaps molecules might also experience frustration. Moreover, molecular frustration may have unexpected applications. This lecture will provide an overview of the generation and applications of molecules that experience such frustration.	Special preparations are not essential, while the review is highly recommended.
14	Fundamental of Molecular Imaging	Molecular imaging is a powerful method for understanding cellular processes within complex biological environments. It allows visualization of how targeted biomolecules /cells behave in a living system. For visualization, it is essential to convert information about biomolecules, such as localizations, concentration changes, and biochemical reactions, into optically detectable signals, such as fluorescence. To this end, researchers have developed a variety of chemical and biological tools for imaging targeted biomolecules. This lecture will introduce the fundamental principles of molecular imaging and the chemical probes used to visualize biomolecules.	Special preparations are not essential, while the review is highly recommended.

15	Trace elements in biology	This lecture examines the relationship between biology and elements. In particular, this lecture focuses on the relationship between elements other than hydrogen, carbon, oxygen, and nitrogen that are present in only small amounts in living organisms and have remained a mystery until now. Tihs lecture explains the role of such trace elements such as iron, copper, zinc, manganese, cobalt, and molybdenum in living organisms, presenting some examples.	Special preparations are not essential, while the review is highly recommended.
16	Conclusion and Outlook	All contents are reviewed, and conclusion and future perspectives are provided.	Special preparations are not essential, while the review is highly recommended.

↑　16行以上必要な場合は、行を挿入してください。

授業担当教員/Instructor(s)

教員氏名／Instructor Name	ふりがな／Name (hiragana)	所属・職名・講座名／Affiliation, Title, Course	e-mail／E-mail
HIRANO Koji	ひらの　こうじ	Department of Applied Chemistry, Graduate School of Engineering	k_hirano@chem.eng.osaka-u.ac.jp

↑　5行以上必要な場合は、行を挿入してください。