Molecular Science

Course Code	Course	Credit	Content of Subject
40COM003**	Practical Spoken English 1	1	The course focuses on improving and building the communication and presentation skills necessary for researchers.
40COM004**	Practical Spoken English 2	1	Following "Practical Spoken English 1", the course focuses on improving and building the communication and presentation skills necessary for researchers.
40COM005**	Practical Spoken English 3	1	Following "Practical Spoken English 2", the course focuses on improving and building the communication and presentation skills necessary for researchers.
40COM006**	Practical Spoken English 4	1	Following "Practical Spoken English 3", the course focuses on improving and building the communication and presentation skills necessary for researchers.
40COM007**	Practical Spoken English 5	1	Following "Practical Spoken English 4", the course focuses on improving and building the communication and presentation skills necessary for researchers.
40COM008**	Practical Spoken English 6	1	Following "Practical Spoken English 5", the course focuses on improving and building the communication and presentation skills necessary for researchers.
40COM009**	Practical Spoken English 7	1	Following "Practical Spoken English 6", the course focuses on improving and building the communication and presentation skills necessary for researchers.
40COM010**	Practical Spoken English 8	1	Following "Practical Spoken English 7", the course focuses on improving and building the communication and presentation skills necessary for researchers.

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40COM011**	Practical Spoken English 9	1	Following "Practical Spoken English 8", the course focuses on improving and building the communication and presentation skills necessary for researchers.
40COM012**	Practical Spoken English 10	1	Following "Practical Spoken English 9", the course focuses on improving and building the communication and presentation skills necessary for researchers.
40MLS001**	Biomolecular Simulation	1	Basic theories and computational methods for molecular simulations for biomoleculs will be introduced. For example, basic and various advanced methodologies for molecular simulations as well as fundamentals of analytical mechanics and statistical mechanics will be lectured.
40MLS002**	Fundamental Chemistry and Physics of Solids	2	To understand fundamental physical properties of solid materials, basic principles concerning solid state physics will be discussed. Structures, thermal properties, electronic structures, transport properties, magnetism, and superconductivity of solids will be introduced.
40MLS003**	Fundamentals of Biomolecular Science	2	Core aspects of biophysical chemistry will be overviewed with the life-science student in mind. This course aims at cultivating the fundamentals necessary to complete the advanced courses of Structural Biomolecular Science and of Functional Biomolecular Science. The lectures will be given with life-science examples using a textbook covering the lows of thermodynamics, biological standard state, chemical equilibrium and its temperature dependence, chemical kinetics, enzyme kinetics, and molecular dynamics.
40MLS004**	Introduction to Coordination Chemistry	2	Structure and bonding of transition metal complexes including organometallic complexes, with emphasis on electronic structures, spectroscopy, and elementary reactions.

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40MLS005**	Fundamental Electronic Physics	2	This lecture introduces the research field of the electronic structure and physical properties of materials using synchrotron radiation. The first half of the lecture will outline the generation of synchrotron radiation and basic experimental techniques, and the second half will describe advanced research using photoelectron spectroscopy and other techniques.
40MLS006**	Synchrotron radiation science	2	Synchrotron radiation is an important tool for elucidating the electronic and atomic structures that govern the properties and functions of matter. In the first half, we will give a lecture on basic knowledge of an electron accelerator and electromagnetic radiation generation from relativistic electron beams (synchrotron radiation). In the second half, we will summarize the interaction between light and matter, and outline the basic technology and application development of physical property analysis methods (photoelectron spectroscopy, X-ray absorption spectroscopy, etc.) using synchrotron radiation. A tour of UVSOR will also be conducted.
40MLS007**	Fundamental Physical Chemistry 1	2	In the part of quantum chemistry, we aim to understand the basic concepts and methodologies in quantum chemistry, and to learn the basics of studying various chemical phenomena by electronic structure calculations, and in the part of machine learning, we aim to understand the basic concepts and methods and to learn the fundamentals of machine learning in molecular and materials sciences.
40MLS008**	Fundamental Physical Chemistry 2	2	This course gives an introductory overview of fundamental theories in physical chemistry. In particular, it introduces basic theories related to dynamic processes in condensed matter systems.

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40MLS009**	Fundamental Photo-science	2	Photoexcitation and photoionization processes can provide detailed information on the molecular properties and are in widespread use of the physical and chemical sciences. This lecture provides the student with a firm grounding in the basic principles and experimental techniques employed. Use of case studies illustrates how photoabsorption and photoelectron spectra are assigned and how information can be extraced.
40MLS010**	Structural Photo-Molecular Science	2	The basic frameworks of various spectroscopic methods such as laser spectroscopy, nonlinear and time-resolved spectroscopy and microscopic methods, for investigation of structures and dynamics of small molecules to molecular assemblies are overviewed. Examples of applications of those methods for understanding/control of materials functionalities are also introduced.
40MLS011**	Materials Chemistry	2	The basic concept of structure-property relationship in organic/inorganic chemistry, materials chemistry, and solid-state physics and relevant experimental methods are overviewed. Actual examples of structural analysis, physical property measurement, and elucidation of functional activation mechanisms based on spectroscopic and surface science methods are also introduced.
40MLS012**	Structural Biomolecular Science	2	In this lecture, we will explain the structures of biomolecules such as proteins, DNA/RNA, and lipids, as well as the structures of organelles and cells formed by these biomolecules. We will also discuss how sophisticated activities of life are realized from structural perspectives. Furthermore, we will cover computational methods for predicting and designing the structures of proteins and DNA, accompanied by hands-on training.

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40MLS013**	Complex Catalysis	2	Molecular structures and functions of complex catalysts will be overviewed based on the understanding the features of transition metal catalysis, Lewis acid·Lewis base catalysis, and organo catalysis in catalytic molecular transformations.
40MLS014**	Functional Biomolecular Science	2	This course provides an overview of the principles and applications of physicochemical approaches for understanding biological phenomena at the molecular level, illustrated with representative examples. Particular emphasis is placed on nuclear magnetic resonance (NMR) spectroscopy, which provides atomic-level information on the three-dimensional structures, dynamics, and interactions of biomolecules. As model systems for understanding biological phenomena from a physicochemical perspective, studies on the structure and function of glycoproteins and membrane proteins are introduced. Through these topics, the course aims to cultivate fundamental knowledge and modes of thinking in molecular science that underpin integrative life science.
40MLS015**	Quantum dynamics	2	Lecture on principles of optical observation and control of ultrafast quantum dynamics of matter and of recent experimental challenges in the relevant field.
40MLS016**	Molecular Functional Materials	2	This course covers the fundamentals of the structure, properties, and functions of solid materials. First, it examines inorganic compounds, including metals and ionic crystals, and explains the relationships between structure and physical properties and functions. Furthermore, it focuses on similarities and differences between inorganic and organic solids and introduces the mechanisms responsible for the emergence of their properties and functions.

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80MLS001**	Seminar on Molecular Science IA	2	In seminars held by the research team to which the student belongs, the student will acquire basic knowledge of molecular science by taking a series of lectures on papers related to his/her own research project and participating in seminars to discuss the results of his/her research.
80MLS002**	Seminar on Molecular Science ⅠB	2	In seminars held by the research team to which the student belongs, the student will read papers related to his/her own research topics and present his/her research results, thereby learning how to interpret data rationally and how to make logical arguments based on the interpretation of data.
80MLS003**	Seminar on Molecular Science IIA	2	In seminars held by the research team to which the student belongs, the student will understand the level of achievement of his/her own research by studying advanced papers related to his/her research topics. In addition, the student will learn the basics of English presentation by presenting his/her research results in English in the seminars.
80MLS004**	Seminar on Molecular Science ⅡB	2	In seminars held by the research team to which the student belongs, the student will prepare his/her interim report, through which he/she will learn the basics of describing research results logically.

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80MLS005**	Seminar on Molecular Science ⅢA	2	In the seminars of the research team to which the student belongs, the student will set and discuss issues on his/her own initiative. The student will deepen his/her discussions in preparation for conference presentations.
80MLS006**	Seminar on Molecular Science ⅢB	2	In the seminar of the research team to which the student belongs, the student will study papers related to the research topic comprehensively and systematically so that the student can obtain international recognition for his/her research results.
80MLS007**	Seminar on Molecular Science ⅣA	2	In the seminar of the research team to which the student belongs, the student considers the future development of his/her own research results and proposes upgrading/extention of the research.
80MLS008**	Seminar on Molecular Science ⅣB	2	In the seminar of the research team to which the student belongs, the student will be required to proposes a novel research project with a view to developing his/her own research results into an unexplored research area.

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80MLS009**	Seminar on Molecular Science VA	2	In the seminar of the research team to which the student belongs, the student will gain a bird's-eye view of his/her own research results and understand their academic and social significance. The student will be expected to actively engage in discussions with related researchers.
80MLS010**	Seminar on Molecular Science ⅤB	2	In the seminar of the research team to which the student belongs, with the aim to prepare his/her PhD thesis, the student will summarize the scientific background of his/her own research, clarify the significance of his/her own research results, and proactively conduct a general seminar. The value of the research results as intellectual property will be discussed in consideration of their application and development.