科目名 Course Title	総合化学特別研究第一[Research in Chemical Sciences and Engineering I]		
講義題目 Subtitle			
責任教員 Instructor	総合化学院代議員（大学院総合化学院）		
担当教員 Other Instructors	Provided by supervisor		
科目種別 Course Type			
開講年度 Year	2023	**時間割番号 Course Number**	
期間 Semester	Full Year	**単位数 Number of Credits**	4
授業形態 Type of Class	Experiment	**対象年次 Year of Eligible Student**	1～3
対象学科・クラス Eligible Department/Class			
ナンバリングコード Numbering Code	CHEM_REQUI 7001		
補足事項 Other Information			
授業実施方式 Class Method			

キーワード Key Words

Chemical science and engineering, science, engineering, thesis writing

授業の目標 Course Objectives

Conduct specific research under the guidance of supervisors to acquire ability to solve problems about chemistry and write research papers.

到達目標 Course Goals

Acquire ability to solve specific problems using various knowledge and logical reasoning and write research papers.

授業計画 Course Schedule

Search specific subjects about chemistry, conduct research on them with highly expertized manner, and publish the results as research papers.

準備学習（予習・復習）等の内容と分量 Homework

Continuous efforts are required for experiments, data analysis, preparation of presentation and writing research papers.

成績評価の基準と方法 Grading System

Evaluation is based on the interim presentation, research activities in laboratory, published research papers during the doctor course.

他学部履修の条件 Other Faculty Requirements

テキスト・教科書 Textbooks

講義指定図書 Reading List

参照ホームページ Websites

研究室のホームページ Websites of Laboratory

備考 Additional Information

The registration of this course is not required since the credit appraisal is made at the time of completion or withdrawal after credit acquisition.

科目名 Course Title	総合化学研究・指導法[Research in Chemical Sciences and Engineering III]		
講義題目 Subtitle			
責任教員 Instructor	総合化学院代議員 (大学院総合化学院)		
担当教員 Other Instructors	Provided by supervisor		
科目種別 Course Type			
開講年度 Year	2023	**時間割番号 Course Number**	
期間 Semester	Full Year	**単位数 Number of Credits**	2
授業形態 Type of Class	Seminar	**対象年次 Year of Eligible Student**	1～3
対象学科・クラス Eligible Department/Class			
ナンバリングコード Numbering Code	CHEM_REQEL 7101		
補足事項 Other Information			
授業実施方式 Class Method			

キーワード Key Words

Development and improvement of experimental techniques: teaching and research skills: presentation skills: Chemical English

授業の目標 Course Objectives

Graduate course students are requested to play leaderships in both teaching and research. This course examines how to manage research experiments and to present student's achievements in Japanese and English. Also, the course examines how to gain teaching skills and abilities.

到達目標 Course Goals

Through the course, students will be able to

- get abilities on development and/or improvement of experimental techniques and equipment
- get high teaching and research skills
- get high presentation skills in both Japanese and English
- play leadership in each research field and teaching

授業計画 Course Schedule

On the basis of evaluating the teaching and research achievements of each student, the course offers on-the-job-training to

- get abilities in development and/or improvement of experimental skills and/or experimental equipment
- get high oral and poster presentation skills
- get speaking, hearing, and writing abilities in English
- get high teaching and research skills
- play leaderships in both research and teaching

準備学習 (予習・復習)等の内容と分量 Homework

Preparatory works for laboratory experiments

成績評価の基準と方法 Grading System

Evaluate based on total attitudes in teaching (50%), experimental and scientific achievements (50%).

他学部履修の条件 Other Faculty Requirements

テキスト・教科書 Textbooks

講義指定図書 Reading List

参照ホームページ Websites

研究室のホームページ Websites of Laboratory

備考 Additional Information

科目名 Course Title	先端総合化学特論 I [Modern Trends in Chemical Sciences and Engineering I]		
講義題目 Subtitle	総合化学特論 I [Modern Trends in Physical and Material Chemistry]		
責任教員 Instructor	松井　雅樹 [MATSUI Masaki] (大学院理学研究院)		
担当教員 Other Instructors	KUWATA Naoaki (NIMS), AOKI Yoshitaka (工学研究院), IIDA Kenji (触媒科学研究所), FUKUSHIMA Tomohiro (理学研究院), NASU Akira (理学研究院)		
科目種別 Course Type			
開講年度 Year	2023	**時間割番号 Course Number**	095111
期間 Semester	Intensive	**単位数 Number of Credits**	1
授業形態 Type of Class	Lecture	**対象年次 Year of Eligible Student**	～
対象学科・クラス Eligible Department/Class			
ナンバリングコード Numbering Code	CHEM_REQEL 7111		
補足事項 Other Information			
授業実施方式 Class Method			

キーワード Key Words

inorganic synthesis, defect thermodynamics in solids, solid electrolytes, nanomaterial, water, chemical sensing, battery, transition metal sulfide

授業の目標 Course Objectives

This course aims to provide opportunity for students to contact with different majors' professors and to expand students' horizons. In this course, professors explain the basic concept and overview absolutely essential for understanding of advanced research topics, and introduce their recent research works.

Topics introduced by professors are: Low temperature synthesis process for highly crystaline layered alkaline transition metal oxides, Metal/oxide-electrolyte heterointerfaces boost power generation of protonic solid oxide fuel cells, Lithium diffusion in solid-state battery materials, Theoretical and Computational Study on Nanostructures under Light and Voltage Bias, Physicochemical Properties of Water under Strong Coupling, Molecular recognition electronics based on materials chemistry, Development of Metastable Nanomaterials for Next Generation Battery Cathodes, Development of new functional polymorphs in transition metal sulfides as active materials for sodium secondary batteries

到達目標 Course Goals

Through a series of lectures, students understand various fields of chemistry and are expected to expand their horizons.

授業計画 Course Schedule

Detailed schedule will be informed one month before the start of this course.

List of lecture titles in this course

・Low temperature synthesis process for highly crystaline layered alkaline transition metal oxides
・Metal/oxide-electrolyte heterointerfaces boost power generation of protonic solid oxide fuel cells
・Lithium diffusion in solid-state battery materials
・Theoretical and Computational Study on Nanostructures under Light and Voltage Bias
・Physicochemical Properties of Water under Strong Coupling
・Molecular recognition electronics based on materials chemistry
・Development of Metastable Nanomaterials for Next Generation Battery Cathodes
・Development of new functional polymorphs in transition metal sulfides as active materials for sodium secondary batteries

準備学習（予習・復習）等の内容と分量 Homework

Students will be required to submit reports after the lectures.

成績評価の基準と方法 Grading System

Students are required to attend at least 70% of the lectures. Evaluation as pass/fail will be based on the submitted reports.

他学部履修の条件 Other Faculty Requirements

テキスト・教科書 Textbooks

講義指定図書 Reading List

参照ホームページ Websites

https://hokkaidosummerinstitute.oia.hokudai.ac.jp/en/courses/CourseDetail=G063

研究室のホームページ Websites of Laboratory

https://hokkaidosummerinstitute.oia.hokudai.ac.jp/
https://www.cse.hokudai.ac.jp/en/

備考 Additional Information

科目名 Course Title	先端総合化学特論 I [Modern Trends in Chemical Sciences and Engineering I]		
講義題目 Subtitle	総合化学特論 II [Modern Trends in Organic Chemistry and Biological Chemistry]		
責任教員 Instructor	渡慶次　学 [TOKESHI Manabu] (大学院工学研究院)		
担当教員 Other Instructors	OGASAWARA Yasushi (工学研究院), MAEKI Masatoshi (工学研究院), KAMADA Rui (理学研究院), ISHIGAKI Yusuke (理学研究院), YURINO Taiga (工学研究院), YONEDA Tomoki (工学研究院)		
科目種別 Course Type			
開講年度 Year	2023	**時間割番号 Course Number**	095112
期間 Semester	Intensive	**単位数 Number of Credits**	1
授業形態 Type of Class	Lecture	**対象年次 Year of Eligible Student**	～
対象学科・クラス Eligible Department/Class			
ナンバリングコード Numbering Code	CHEM_REQEL 7111		
補足事項 Other Information			
授業実施方式 Class Method			

キーワード Key Words

Physical Organic Chemistry, Organic Synthesis, Organic Reaction, Organic Transformations, Biological Chemistry, Applied Biochemistry, Microsystem Chemistry

授業の目標 Course Objectives

The progress in the fields of organic chemistry and biochemistry is remarkable. In this course, you will learn the basic concepts necessary for understanding research in the fields of advanced organic chemistry and biochemistry, give an overview of the latest trends, and then learn about cutting-edge research results. You will discuss various topics in organic chemistry and biochemistry research. The goal is to be able to write reports that include suggestions for your own ideas on cutting-edge organic and biochemical research.

到達目標 Course Goals

1. You can explain the basic concepts needed to understand advanced organic chemistry and biochemical research.
2. You can explain an overview of cutting-edge organic chemistry and biochemical topics.
3. You can discuss among students with different backgrounds.
4. You can make research proposals that incorporate your own ideas.

授業計画 Course Schedule

1. Guidance and Introduction to microsystem chemistry: learn the history of microsystem chemistry research and the basic concepts needed to understand microsystem chemistry research.
2. Advanced microsystem chemistry: introducing cutting-edge micro system chemistry.
3. Advanced biochemistry: introducing current topics in innate immune system
4. Advanced applied biochemistry: learn current topics on medicinal chemistry to develop useful unnatural natural products.
5. Advanced organic transformations: learn the basic concepts and examples of transition metal catalysed enantioselective addition reaction for synthesis of chiral organic compounds.
6. Advanced organic chemistry: introducing cutting-edge physical organic chemistry based on highly strained organic molecules.
7. Advanced organic synthesis: introducing the novel organic synthesis based on the precise control of the reactive sites.
8. Advanced organic reaction: learn cutting-edge physical organic chemistry and reaction chemistry of π-conjugated molecules.

準備学習 (予習・復習)等の内容と分量 Homework

In this course, you will be given an assignment each time and will submit an answer (report) by the specified date.

成績評価の基準と方法 Grading System

You will be evaluated by learning attitude (20%) and submitted reports (each time, 80% in total). You will submit a report each time according to the instructor's instructions. Attendance of 70% or more classes is the minimum condition to evaluate a student.

テキスト・教科書 Textbooks

講義指定図書 Reading List

参照ホームページ Websites

This course will be provided as part of the Hokkaido Summer Institute., For more information (invited lecturers, course details, etc.), please visit the website below:, https://hokkaidosummerinstitute.oia.hokudai.ac.jp/en/courses/CourseDetail=G051

研究室のホームページ Websites of Laboratory

備考 Additional Information

科目名 Course Title	先端総合化学特論Ⅱ[Modern Trends in Chemical Sciences and Engineering II]		
講義題目 Subtitle	Leading and Advanced Molecular Chemistry and Engineering IA - 2023[Leading and Advanced Molecular Chemistry and Engineering IA - 2023]		
責任教員 Instructor	石森　浩一郎 [ISHIMORI Koichiro] (大学院理学研究院)		
担当教員 Other Instructors	Peter BRZEZINSKI (Stockholm University), SADA Kazuki (理学研究院), UCHIDA Takeshi (理学研究院)		
科目種別 Course Type			
開講年度 Year	2023	**時間割番号 Course Number**	095121
期間 Semester	Intensive	**単位数 Number of Credits**	1
授業形態 Type of Class	Lecture	**対象年次 Year of Eligible Student**	～
対象学科・クラス Eligible Department/Class			
ナンバリングコード Numbering Code	CHEM_REQEL 7121		
補足事項 Other Information			
授業実施方式 Class Method			

キーワード Key Words

Electron Transfer, Proton Transfer, Respiratory Chain, Cytochromes, Kinetic Analysis

授業の目標 Course Objectives

The course aims to provide students with a foundation in the basic concepts of biophysics in electron and proton transfer. Topics will include functional and structural characterization of protein complexes in the respiratory chain. Basic ideas of diffusion, thermodynamics and kinetics will be discussed in the context of biological processes. Fundamental concepts that underlie biomolecular interactions will be discussed and biophysical methods that are employed for the structural analysis of these systems will be introduced, and some examples of the recent advance in this field are also included.

到達目標 Course Goals

After the course students should know how to explain thermodynamic principles if biological energy conversion. Account for the structure of membrane protein complexes for electron and proton transfer in the respiratory chain and photosynthesis. Account for processes of electron and proton transport proteins in the respiratory chain and photosynthesis. Account for the mechanisms of energy converting systems in living organisms. Understand spectroscopic and other physical and analytical methods for studying membrane processes. Understand modern biophysical methods to study molecular mechanisms in respiration system.

授業計画 Course Schedule

1. Introduction and Guidance
2. History, Peter Mitchell and Chemiosmotic Theory
3. Protons, Other Ions and Membranes
4. The Respiratory Chain, Complexes I, III, IV; Reduction of O2
5. Proton Transfer in Biology (Grotthuss Mechanism); Kinetics
6. Electron Transfer in Biology (Bacterial Photosynthesis)
7. Recent Advance of Biophysics in Bioinorganic Chemistry -1
8. Recent Advance of Biophysics in Bioinorganic Chemistry -2

準備学習（予習・復習）等の内容と分量 Homework

Short essay will be assigned at the end of each lecture.

成績評価の基準と方法 Grading System

The final grade corresponds to a weighted average of the results of the essays (40%) and two reports on the lectures of "Recent Advance of Biophysics in Bioinorganic Chemistry" (60%).

他学部履修の条件 Other Faculty Requirements

テキスト・教科書 Textbooks

No textbook required. Handouts will be distributed.

講義指定図書 Reading List

参照ホームページ Websites

This course will be provided as part of the Hokkaido Summer Institute., For more information (invited lecturers, course details, etc.), please visit the website below:, https://hokkaidosummerinstitute.oia.hokudai.ac.jp/en/courses/CourseDetail=G059

研究室のホームページ Websites of Laboratory

https://www.su.se/english/profiles/brzez-1.181925
http://wwwchem.sci.hokudai.ac.jp/~matchemS/english/index.html
http://wwwchem.sci.hokudai.ac.jp/~stchem/en/

備考 Additional Information

科目名 Course Title	先端総合化学特論Ⅱ[Modern Trends in Chemical Sciences and Engineering II]		
講義題目 Subtitle	Leading and Advanced Molecular Chemistry and Engineering IB - 2023[Leading and Advanced Molecular Chemistry and Engineering IB - 2023]		
責任教員 Instructor	清水　研一 [SHIMIZU Kenichi] (触媒科学研究所)		
担当教員 Other Instructors	E. PIDKO (TU Delft), Y. YEING (CUHK), C. SIEVERS (GT), M. LUNDBERG (Uppsala U), IIDA Kenji (触媒科学研究所), TOYAO Takashi (触媒科学研究所), NAKAJIMA Kiyotaka (触媒科学研究所), ASANO Keisuke (触媒科学研究所)		
科目種別 Course Type			
開講年度 Year	2023	**時間割番号 Course Number**	095122
期間 Semester	Intensive	**単位数 Number of Credits**	1
授業形態 Type of Class	Lecture	**対象年次 Year of Eligible Student**	～
対象学科・クラス Eligible Department/Class			
ナンバリングコード Numbering Code	CHEM_REQEL 7121		
補足事項 Other Information			
授業実施方式 Class Method			

キーワード Key Words

catalysis, reaction mechanism, catalyst design, catalysis theory

授業の目標 Course Objectives

Materials that promote chemical reactions are called Catalyst. Because many useful chemical compounds are produced using catalysts, there has been considerable interest in catalysis from academic and industrial viewpoints. Catalysts provide environmentally-friendly ways of chemical synthesis because catalysts do not change their catalytic properties and drive the chemical reaction with less energy. Therefore, catalysis is indispensable for realizing sustainable human society. However, the research on the catalytic mechanism is still in progress. Another important aspect is catalyst design. More efficient catalysts are desired for keeping the existing human society that is based on the energy consumptions. Therefore, both rational and efficient methods for the catalyst development are highly desirable.

This lecture provides electronic structure theory of catalysis, catalytic mechanism, theoretical methods to investigate catalysis, and material design for efficient catalytic systems. We also show current state of catalyst development. This lecture provides a unique opportunity to explain the forefront of the research by the front runners in the field of catalysis science.

到達目標 Course Goals

By the end of this course you will be able

1-1. to acquire fundamental knowledge of halogenation

1-2. to understand different methods of halogenation reactions

1-3. to learn applications of halogenation reactions in the synthesis of useful building blocks

2. to explain advanced techniques and methods used in computational modeling of heterogeneous catalysts

3. to explain quantum mechanical methods to investigate catalytic reactions

4. to explain how X-ray spectroscopy can be used to probe electronic and geometric structure of molecular catalysts

5-1. to correlate structure and composition of zeolites with the activity, selectivity and longevity in catalytic processes

5-2. to judge the advantages and disadvantages of using mechanical energy instead of heat for specific applications

授業計画 Course Schedule

1-1. Introduction of the background of halogenation

1-2. Discussion of different approaches of halogenation reactions including halide substitution, electrophilic halogenation and radical halogenation

2-1. Introduction of different halogenating agents. Their effects on reactions will be discussed.

2-2. Discussion of different methods including metal catalysis, organocatalysis, photo-triggered halogenation, and electrochemical method

2-3. Discussion of asymmetric halogenation

2-4. Discussion of applications of halogenation reactions in the synthesis of different building blocks. Their synthetic utilities will also be discussed.

3. Computations, Modeling and Catalysis

4. Chemical Complexity and Performance Metrics in Catalysis

5. Basic of Quantum Mechanical Method to Investigate Catalysis

6. Insights into molecular catalysts from X-ray spectroscopy

7. Structure-Performance Relationships of Zeolites in Catalysis

8. Fundamentals and Opportunities of Mechanocatalysis

Since the course schedule may be changed, please confirm final schedule.

準備学習（予習・復習）等の内容と分量 Homework

Students will be asked to write a report at the end of each lecture.

成績評価の基準と方法 Grading System

Grades are judged based on active attendance records and reports at the end of each lecture.

他学部履修の条件 Other Faculty Requirements

テキスト・教科書 Textbooks

講義指定図書 Reading List

参照ホームページ Websites

https://hokkaidosummerinstitute.oia.hokudai.ac.jp/en/courses/CourseDetail=G060

研究室のホームページ Websites of Laboratory

備考 Additional Information

科目名 Course Title	先端総合化学特論Ⅱ[Modern Trends in Chemical Sciences and Engineering II]		
講義題目 Subtitle	Leading and Advanced Molecular Chemistry and Engineering IIA - 2023[Leading and Advanced Molecular Chemistry and Engineering IIA - 2023]		
責任教員 Instructor	村越　敬 [MURAKOSHI Kei] (大学院理学研究院)		
担当教員 Other Instructors	Yen-Ju CHENG (National Yang Ming Chiao Tung University)		
科目種別 Course Type			
開講年度 Year	2023	**時間割番号 Course Number**	095123
期間 Semester	Intensive	**単位数 Number of Credits**	1
授業形態 Type of Class	Lecture	**対象年次 Year of Eligible Student**	～
対象学科・クラス Eligible Department/Class			
ナンバリングコード Numbering Code	CHEM_REQEL 7121		
補足事項 Other Information			
授業実施方式 Class Method			

キーワード Key Words

Organic Chemistry, Polymer Chemistry, Optoelectronics, Organic Semiconductors, Conjugated Molecules

授業の目標 Course Objectives

In this course students will learn design, synthesis, characterization and applications of organic materials for innovative optoelectronic applications, such as chemical sensors, nonlinear optics (NLOs), organic light-emitting diodes (OLEDs), organic transistor (OFETs), organic solar cells (OPVs) and photocatalysis. Particular emphasis will be placed on the classic examples of organic materials including semiconducting polymers, small molecules, molecular devices, self-assembled systems in the literature. Students will study how structure in organic molecules dictates materials properties and ultimately controls function. The objective of the course is to learn structure-property relationships in organic-based functional materials.

到達目標 Course Goals

The goal of this course is help students (1) understand the fundamental working principles of organic optoelectronic devices such as device physics, device engineering and fabrication; (2) understand the molecular design, molecular engineering and structure-property relationships to achieve optimal function of materials and properties; (3) familiar with the synthetic methods and tools to prepare state-of-the-art organic and polymer materials.

授業計画 Course Schedule

1. Introduction to organic materials chemistry
2. Organic thin film transistors
3. Organic solar cells
4. Visible-light-driven organic photocatalysis for hydrogen evolution
5. Advanced carbon-carbon bond formation for synthesis of organic semiconducting molecules and conjugated polymers.

準備学習 (予習・復習)等の内容と分量 Homework

The basic parts of a Physical Chemistry textbook covering the sections of Quantum Chemistry and Thermodynamics.

成績評価の基準と方法 Grading System

One final written exam will be given to students for the grading.

他学部履修の条件 Other Faculty Requirements

テキスト・教科書 Textbooks

講義指定図書 Reading List

参照ホームページ Websites

https://hokkaidosummerinstitute.oia.hokudai.ac.jp/en/courses/CourseDetail=G061

研究室のホームページ Websites of Laboratory

https://sites.google.com/view/yjclab?pli=1

備考 Additional Information

Other Instructor: Prof Yen-Ju CHENG (National Yang Ming Chiao Tung University)

科目名 Course Title	先端総合化学特論Ⅱ[Modern Trends in Chemical Sciences and Engineering II]		
講義題目 Subtitle	Leading and Advanced Molecular Chemistry and Engineering IIB - 2023[Leading and Advanced Molecular Chemistry and Engineering IIB - 2023]		
責任教員 Instructor	伊藤　肇 [ITOH Hajime] (大学院工学研究院)		
担当教員 Other Instructors	Jeung Gon KIM (Jeonbuk National U), SAJIKI Hironao (Gifu Pharmaceutical U), KUBOTA Koji (工学研究院), JIN Mingoo		
科目種別 Course Type			
開講年度 Year	2023	**時間割番号 Course Number**	095124
期間 Semester	Intensive	**単位数 Number of Credits**	1
授業形態 Type of Class	Lecture	**対象年次 Year of Eligible Student**	～
対象学科・クラス Eligible Department/Class			
ナンバリングコード Numbering Code	CHEM_REQEL 7121		
補足事項 Other Information			
授業実施方式 Class Method			

キーワード Key Words

organic chemistry, organic synthesis, mechanochemical synthesis

授業の目標 Course Objectives

Organic chemistry is a field of study that is important for the effective use of resources and for supporting people's comfortable and healthy lives. In this lecture, leading researchers from abroad and Hokkaido University will give intensive lectures on organic chemistry fields that have been developed remarkably recently and will be useful for students to have knowledge in the future. The courses will cover mechanochemical organic synthesis.

到達目標 Course Goals

After the completion of this course, you will be able to know concepts and recent progress in mechanochemical organic synthesis.

授業計画 Course Schedule

Course Schedule (the order of the following lectures is subject to change)

1. Mechanochemical organic synthesis I
2. Mechanochemical organic synthesis II
3. Mechanochemical organic synthesis III
4. Mechanochemical organic synthesis IV
5. Research proposal I
6. Research proposal II

準備学習（予習・復習）等の内容と分量 Homework

Students will make proposal presentations and reports.

成績評価の基準と方法 Grading System

Grades are judged based on attendance records, presentations, and reports during the course.

他学部履修の条件 Other Faculty Requirements

テキスト・教科書 Textbooks

講義指定図書 Reading List

参照ホームページ Websites

https://hokkaidosummerinstitute.oia.hokudai.ac.jp/en/courses/CourseDetail=G062

研究室のホームページ Websites of Laboratory

備考 Additional Information

Other instructors: Prof. Jeung Gon Kim and Prof. Hironao Sajiki

科目名 Course Title	先端総合化学特論Ⅱ[Modern Trends in Chemical Sciences and Engineering II]		
講義題目 Subtitle	Chemical Engineering Thermodynamics[Chemical Engineering Thermodynamics]		
責任教員 Instructor	菊地　隆司 [KIKUCHI Ryuji] (大学院工学研究院)		
担当教員 Other Instructors			
科目種別 Course Type			
開講年度 Year	2023	**時間割番号 Course Number**	095125
期間 Semester	Intensive	**単位数 Number of Credits**	1
授業形態 Type of Class	Lecture	**対象年次 Year of Eligible Student**	～
対象学科・クラス Eligible Department/Class			
ナンバリングコード Numbering Code	CHEM_REQEL 7121		
補足事項 Other Information			
授業実施方式 Class Method			

キーワード Key Words

Chemical Engineering Thermodynamics, Phase Equilibrium, Chemical Equilibrium, Material-Energy Conversion, Exergy

授業の目標 Course Objectives

Thermodynamics is lectured to utilize it in chemical engineering. Basic laws of heat phenomena are reviewed for advanced applications. This lecture helps you understand that thermodynamics deals with conversion of materials and energy. Preservation and loss of energy is lectured by introducing a concept of “exergy”. You can learn the quality of energy is expressed in terms of exergy, and energy/material conversion systems are to be analyzed to minimize exergy loss for designing clean energy systems. Fuel cell systems and hydrogen production processes are used as examples for exergy analysis.

到達目標 Course Goals

You can extend basic knowledge on thermodynamics in small closed systems to large open systems such as reactors, power plants, and chemical plants. You can understand the concept of exergy, that is, exergy quantifies the available amount of energy based on environmental conditions, and learn the method to calculate exergy for respective energy forms. You can also learn to express exergy losses accompanied with energy conversion by using energy conversion diagram.

授業計画 Course Schedule

First half of this course you will review and expand the concept of chemical thermodynamics to chemical engineering thermodynamics. Second half you will learn the concept of exergy, calculation procedure of exergy, and drawing of energy conversion diagram.

1. Introduction, basic concept of chemical engineering thermodynamics, definition and relation of heat and temperature, force and work, energy, work and power
2. Chemical thermodynamics, energy balance in closed and flow systems, energy balance of chemical processes
3. Ideal gas and real gas, compression and expansion, phase equilibrium, fugacity for multi-component system
4. Chemical equilibrium, equilibrium of heterogeneous reactions
5. Introduction to exergy concept, exergy change in energy conversion, energy diagram for energy conversion
6. Calculation procedure for exergy of various energy forms
7. Exergy for mixing and separation processes, synthesis of process systems
8. Exergy analysis of conversion processes in chemical engineering

準備学習 (予習・復習)等の内容と分量 Homework

It is required to study physical chemistry for preparation for the class. Materials are distributed for each class. Homework is assigned every class to well understand the course content. Unit of class is 1, which corresponds to 45 hours study. By considering total time of class, additional study of 3.6 hours is necessary before and after each class.

成績評価の基準と方法 Grading System

Grade is evaluated from the quizzes in the lecture and a term-end examination with weighting factors of 40% and 60%, respectively. Percentage of attendance above 70% is necessary to take a term-end examination.

テキスト・教科書 Textbooks

必要な教材は毎回配布する。参考書は，講義指定図書のとおり。
Handout made by the instructor will be delivered.

講義指定図書 Reading List

熱力学(基本の理解と応用)／石田愈:培風館, 1995
演習化学工学熱力学(第 2 版)／大竹伝雄・平田光穂:丸善, 1991
エクセルギー工学／吉田邦夫編:共立出版, 1999

参照ホームページ Websites

https://hokkaidosummerinstitute.oia.hokudai.ac.jp/en/courses/CourseDetail=G066

研究室のホームページ Websites of Laboratory

https://apchem.eng.hokudai.ac.jp/en/lab/chemical-system-engineering/

備考 Additional Information

科目名 Course Title	先端総合化学特論Ⅱ[Modern Trends in Chemical Sciences and Engineering II]		
講義題目 Subtitle	Separation Process Engineering I[Separation Process Engineering I]		
責任教員 Instructor	向井　紳 [MUKAI Shin] (大学院工学研究院)		
担当教員 Other Instructors			
科目種別 Course Type			
開講年度 Year	2023	**時間割番号 Course Number**	095126
期間 Semester	Intensive	**単位数 Number of Credits**	1
授業形態 Type of Class	Lecture	**対象年次 Year of Eligible Student**	～
対象学科・クラス Eligible Department/Class			
ナンバリングコード Numbering Code		CHEM_REQEL 7121	
補足事項 Other Information			
授業実施方式 Class Method			

キーワード Key Words

Porous Materials, Adsorption

授業の目標 Course Objectives

In this course, you can learn the basic principles of separation processes with a particular focus on processes using porous materials such as adsorption.

到達目標 Course Goals

By the end of this course, a successful learner will:
1. Understand the mechanisms which cause adsorption
2. Understand methods to obtain adsorption isotherms, and become able to describe the characteristics of the material from its isotherm
3. Understand general adsorption theories and adsorption equations, and become able to analyze adsorption isotherms using them

授業計画 Course Schedule

This course will be held as an in-person class at Sapporo Campus.

1. Overview of Adsorption Phenomena and Adsorbents
2. Adsorption Phenomena
3. Typical Adsorbents and Their Production Processes
4. Adsorption Mechanisms
5. Adsorption Isotherms
6. Adsorption Theories and Adsorption Equations (Henry Equation, Freundlich Equation, Langmiur Equation)
7. Adsorption Theories and Adsorption Equations (BET Equation)
8. Examination

準備学習（予習・復習）等の内容と分量 Homework

Students are encouraged to read relevant materials ahead of time and review what they have been taught, especially the contents of quizzes after classes to deepen their understanding.

成績評価の基準と方法 Grading System

The attendance rate must be over 70% to be qualified to take the final project. Evaluations will be made based on (1) learning attitude (20%), (2) quiz scores (20%) and final examination scores (60%). Quizzes will be used to evaluate the level of understanding of each class and examinations will be used to evaluate the achievement level of this course.

他学部履修の条件 Other Faculty Requirements

テキスト・教科書 Textbooks

講義指定図書 Reading List

参照ホームページ Websites

This course will be provided as part of the Hokkaido Summer Institute., For more information (invited lecturers, course details, etc.), please visit the website below:, https://hokkaidosummerinstitute.oia.hokudai.ac.jp/en/courses/CourseDetail=G064

研究室のホームページ Websites of Laboratory

備考 Additional Information

Prerequisite courses include undergraduate-level mathematics, transport phenomena, thermodynamics, statistical thermodynamics, and separation process

科目名 Course Title	先端総合化学特論Ⅱ[Modern Trends in Chemical Sciences and Engineering II]		
講義題目 Subtitle	Separation Process Engineering II[Separation Process Engineering II]		
責任教員 Instructor	荻野　勲 [OGINO Isao] (大学院工学研究院)		
担当教員 Other Instructors	Ron C. Runnebaum (University of California, Davis)		
科目種別 Course Type			
開講年度 Year	2023	**時間割番号 Course Number**	095127
期間 Semester	Intensive	**単位数 Number of Credits**	1
授業形態 Type of Class	Lecture	**対象年次 Year of Eligible Student**	～
対象学科・クラス Eligible Department/Class			
ナンバリングコード Numbering Code	CHEM_REQEL 7121		
補足事項 Other Information			
授業実施方式 Class Method			

キーワード Key Words

Porous Materials, Adsorption, Membrane Separation, Chromatography

授業の目標 Course Objectives

To understand the basic principles of separation processes with a particular focus on processes using porous materials such as adsorption and membrane separation.

到達目標 Course Goals

1. Understand the roles of separation operation in industrial processes
2. Understand the classification of separation processes in terms of rate and equilibrium
3. Deepen understanding on thermodynamics (including statistical thermodynamics) and transport phenomena relevant to the design of separation processes
4. Understand the fundamental principles of industrial adsorption and membrane separation processes and perform basic design of these processes.
5. Perform the basic design of devices and products equipped with adsorption and membrane-separation functions

授業計画 Course Schedule

1. Roles of industrial separation processes (I-chapter 1, II-chapter 1$2)
2. Thermodynamics and transport phenomena relevant to separation processes (I-chapter 2&3)
3. Adsorption process (I-chapter 15)
4. Case study 1: water filter (II-chapter 5)
5. Case study 2: waste-water treatment (I-chapter 15, II-chapter 5)
6. Membrane separation process (I-chapter 14)
7. Case study 3: reverse osmosis membrane unit (II-chapter 5)
8. Project(*)

*Invited lecture on membrane separation processes

(Remarks) I:textbook #1, II:textbook #2

準備学習（予習・復習）等の内容と分量 Homework

Students are encouraged to read the textbook and relevant materials ahead of time. Students are required to submit assigned homework.

成績評価の基準と方法 Grading System

The attendance rate must be over 70% to be qualified to take the final project. Evaluations will be made based on (1) learning attitude (20%), (2) quiz and homework scores (30%) and final project scores (50%). Quizzes and homework will be used to evaluate the level of understanding of each class and to aid understanding on separation principles, and the final project will be used to evaluate the applied skills.

テキスト・教科書 Textbooks

1. Separation Process Principles: With Applications Using Process Simulators, 4th Edition／J. D. Seader, Ernest J. Henley, D. Keith Roper：John Wiley & Sons, Inc., 2016
2. Product and Process Design Principles: Synthesis, Analysis and Evaluation, 4th Edition／Warren D. Seider, Daniel R. Lewin, J. D. Seader, Soemantri Widagdo, Rafiqul Gani, Ka Ming Ng：Wiley, 2016

講義指定図書 Reading List

現代化学工学／橋本健治、荻野文丸　編：産業図書, 2001

参照ホームページ Websites

https://hokkaidosummerinstitute.oia.hokudai.ac.jp/en/courses/CourseDetail=G065

研究室のホームページ Websites of Laboratory

備考 Additional Information

Prerequisite courses include undergraduate-level mathematics, transport phenomena, thermodynamics, statistical thermodynamics, and separation process

It is desirable for students to be able to understand numerical methods to solve differential equations.

科目名 Course Title	先端総合化学特論Ⅱ[Modern Trends in Chemical Sciences and Engineering II]		
講義題目 Subtitle	Leading and Advanced Materials Chemistry and Engineering IA - 2023[Leading and Advanced Materials Chemistry and Engineering IA - 2023]		
責任教員 Instructor	島田　敏宏 [SHIMADA Toshihiro] (大学院工学研究院)		
担当教員 Other Instructors			
科目種別 Course Type			
開講年度 Year	2023	**時間割番号 Course Number**	095128
期間 Semester	Intensive	**単位数 Number of Credits**	1
授業形態 Type of Class	Lecture	**対象年次 Year of Eligible Student**	～
対象学科・クラス Eligible Department/Class			
ナンバリングコード Numbering Code	CHEM_REQEL 7121		
補足事項 Other Information			
授業実施方式 Class Method			

キーワード Key Words

materials informatics, python

授業の目標 Course Objectives

The course provides lectures combined with exercises. In the lecture, basic knowledge of statistical methods and machine learning for materials research. In the exercises, we start from basic python programming and instruct how to use various libraries including tensorflow, scikit learn, stan, GPy etc. and databases.

到達目標 Course Goals

1. Understanding the basics of data science and machine learning, especially about terminology.
2. Learning how to use libraries and databases for python.
3. Practical usage of packages for materials informatics.

授業計画 Course Schedule

1. Neural networks
2. Rdkit library for chemicals
3. Machine learning for molecules
4. Sckit learn - library for machine learning
5. Reinforced learning toward protein-folding analysis
6. Genetic algorithm
7. Bayesian concept
8. Interpritation of machine learning results

準備学習 (予習・復習)等の内容と分量 Homework

Requirement: personal computer equipped with a keyboard and internet connection
Homework: After each day, homework will be assigned.

成績評価の基準と方法 Grading System

After each day, homework will be assigned. The answer and final report will be used for grading.

他学部履修の条件 Other Faculty Requirements

テキスト・教科書 Textbooks

None

講義指定図書 Reading List

Any textbooks or websites on python language

参照ホームページ Websites

This course will be provided as part of the Hokkaido Summer Institute., For more information (invited lecturers, course details, etc.), please visit the website below:, https://hokkaidosummerinstitute.oia.hokudai.ac.jp/en/courses/CourseDetail=G053

研究室のホームページ Websites of Laboratory

https://www.eng.hokudai.ac.jp/labo/kotai/en/index.html
https://www.eng.hokudai.ac.jp/labo/inorgsyn/cover-e.htm

備考 Additional Information

Required Equipment for a class (Laptop, etc.)
A computer with python installed. Instruction of installation will be given to registered students prior to the course.The participants may be contacted in advance for preparation of python language.

科目名 Course Title	先端総合化学特論Ⅱ[Modern Trends in Chemical Sciences and Engineering II]		
講義題目 Subtitle	Leading and Advanced Materials Chemistry and Engineering IB - 2023[Leading and Advanced Materials Chemistry and Engineering IB - 2023]		
責任教員 Instructor	三浦　章 [MIURA Akira] (大学院工学研究院)		
担当教員 Other Instructors	Wenhao SUN (University of Michigan)		
科目種別 Course Type			
開講年度 Year	2023	**時間割番号 Course Number**	095129
期間 Semester	Intensive	**単位数 Number of Credits**	1
授業形態 Type of Class	Lecture	**対象年次 Year of Eligible Student**	～
対象学科・クラス Eligible Department/Class			
ナンバリングコード Numbering Code	CHEM_REQEL 7121		
補足事項 Other Information			
授業実施方式 Class Method			

キーワード Key Words

Materials Chemistry, Python, Machine Learning

授業の目標 Course Objectives

Students will learn how to use Python to access big data from existing materials databases and how to design and execute a data-driven research project in MSE. State-of-the-art methods in statistical analysis supervised and unsupervised machine learning, and data visualization will be covered.

到達目標 Course Goals

The students understand the basics and hands-on experience of informatics in chemistry and materials science. The students can use their laptops to the cloud and start from the basics of python, and eventually become used to libraries and databases for chemical/materials informatics.

授業計画 Course Schedule

1) Introduction + Classic Examples: Periodic Table, Pettifor Maps, Ashby Diagrams, Ternary Structure Maps.
2) Recent Examples: Survey of Big-Data Materials Science Publications
3) Data Exploration: Interactive Python Data Visualization (Plotly, Bokeh)
4) Unsupervised Machine Learning: Clustering, Dimensionality Reduction
5) Supervised Machine Learning: Classification, Regression
6) Execution: Database Infrastructure. API/REST interfaces. Python Data Visualization
7) High-Throughput Computation, Computational Materials Design
8) Collaboration between experimentalists and theorists

準備学習（予習・復習）等の内容と分量 Homework

1-5 hours of practice and homework using Python

成績評価の基準と方法 Grading System

Evaluated by submitted reports

他学部履修の条件 Other Faculty Requirements

テキスト・教科書 Textbooks

講義指定図書 Reading List

参照ホームページ Websites

https://hokkaidosummerinstitute.oia.hokudai.ac.jp/en/courses/CourseDetail=G054

研究室のホームページ Websites of Laboratory

備考 Additional Information

科目名 Course Title	先端総合化学特論Ⅱ[Modern Trends in Chemical Sciences and Engineering II]		
講義題目 Subtitle	Leading and Advanced Materials Chemistry and Engineering II - 2023[Leading and Advanced Materials Chemistry and Engineering II - 2023]		
責任教員 Instructor	村越　敬 [MURAKOSHI Kei] (大学院理学研究院)		
担当教員 Other Instructors	Peng ZHENG (Nanjing University)		
科目種別 Course Type			
開講年度 Year	2023	**時間割番号 Course Number**	095130
期間 Semester	Intensive	**単位数 Number of Credits**	1
授業形態 Type of Class	Lecture	**対象年次 Year of Eligible Student**	～
対象学科・クラス Eligible Department/Class			
ナンバリングコード Numbering Code	CHEM_REQEL 7121		
補足事項 Other Information			
授業実施方式 Class Method			

キーワード Key Words

Single-molecule force spectroscopy, atomic force microscopy, molecular dynamics simulations, protein (un)folding, protein-protein interaction

授業の目標 Course Objectives

This course is designed to acquire basic knowledge and recent advance in the field of atomic force microscopy (AFM)-based single-molecule force spectroscopy (SMFS) for biomolecular interaction, including the general introduction of AFM, force spectroscopy and molecule dynamics (MD) simulation. It will focus on the application of AFM-SMFS to study protein (un)folding and protein-protein interactions, such as the folding of metalloprotein and viral adhesion of SARS-CoV-2. MD simulation which can provide molecular insight for protein unfolding and unbinding will be briefly introduced as well.

到達目標 Course Goals

You will be able to;
1. discuss about the basic knowledge about AFM and single-molecule force spectroscopy
2. give a presentation about the state-of-art force spectroscope techniques using AFM
3. understand the effect of mutations of SARS-CoV-2 on its transmission by attending the course.

授業計画 Course Schedule

(1) Basics of AFM and AFM imagining
(2) Different types of single molecule force spectroscopy and AFM-SMFS
(3) AFM-SMFS studies of protein (un)folding
(4) AFM-SMFS studies of protein-protein interaction
(5) MD simulations for AFM-SMFS studies
This course provides overviews of recent research on some topics from (1) to (5).

準備学習（予習・復習）等の内容と分量 Homework

To read text books for basic principle of atomic force microscopy or some chapters of protein science at undergraduate level is highly recommended.

成績評価の基準と方法 Grading System

Assignment on a specified subject regarding to "Recent advance of AFM-based single-molecule force spectroscopy " (60%).
In addition, we also consider it as the important factor for assessment how actively students participate in each class (40%).

他学部履修の条件 Other Faculty Requirements

テキスト・教科書 Textbooks

講義指定図書 Reading List

参照ホームページ Websites

https://hokkaidosummerinstitute.oia.hokudai.ac.jp/en/courses/CourseDetail=G055

研究室のホームページ Websites of Laboratory

https://hysz.nju.edu.cn/pengzhenglab/main.htm

備考 Additional Information

Other Instructor: Prof.Peng ZHENG (Nanjing University)

科目名 Course Title	先端総合化学特論Ⅱ[Modern Trends in Chemical Sciences and Engineering II]		
講義題目 Subtitle	Leading and Advanced Materials Chemistry and Engineering IIIA – 2023[Leading and Advanced Materials Chemistry and Engineering IIIA – 2023]		
責任教員 Instructor	村越　敬 [MURAKOSHI Kei] (大学院理学研究院)		
担当教員 Other Instructors	YAMAURA Kazunari (NIMS), TSUJIMOTO Yoshihiro (NIMS)		
科目種別 Course Type			
開講年度 Year	2023	**時間割番号 Course Number**	095131
期間 Semester	Intensive	**単位数 Number of Credits**	1
授業形態 Type of Class	Lecture	**対象年次 Year of Eligible Student**	～
対象学科・クラス Eligible Department/Class			
ナンバリングコード Numbering Code	CHEM_REQEL 7121		
補足事項 Other Information			
授業実施方式 Class Method			

キーワード Key Words

Inorganic synthesis, phase equilibrium, magnetic materials, superconductors, dielectrics

授業の目標 Course Objectives

To gain a deeper understanding of solid-state compounds, a broad knowledge of crystallography, electromagnetism, quantum chemistry and condensed matter physics is required. This lecture aims to provide students with a general knowledge and understanding of these fields, while introducing the basic knowledge and concepts of each field. The basic understanding of solid-state compounds acquired in this lecture will help the student to acquire the knowledge and understanding necessary to devote themselves to research activities in the future. In particular, solid-state compounds related to electrical devices, and power and energy, such as dielectrics, magnetic materials, semiconductors, superconductors, and thermoelectric materials, will be introduced.

到達目標 Course Goals

You will be able to
(1) Explain the fundamental properties of solid-state compounds.
(2) Explain the crystal structures of solid-state compounds and their synthesis methods.
(3) Explain the outline of electromagnetic properties of solid-state compounds.
(4) Explain the outline of applications of solid-state compounds.

授業計画 Course Schedule

(1) Crystallography of solid-state compounds
(2) Fundamentals of solid-state synthesis, phase equilibria
(3) Laws and concepts underlying solid-state compounds
(4) Phenomenology of magnetic solid-state compounds
(5) Phenomenology of superconducting solid-state compounds
(6) Phenomenology of dielectric solid-state compounds
(7) Phenomenology of thermoelectric solid-state compounds
This course provides overviews of recent research on some topics from (4) to (7).

準備学習（予習・復習）等の内容と分量 Homework

Reading textbooks on solid state physics and inorganic chemistry at undergraduate level is strongly recommended.

成績評価の基準と方法 Grading System

Assignments on some specified topics in solid state chemistry (60%).
Students will also be assessed on how actively they participated in each class (40%).

他学部履修の条件 Other Faculty Requirements

テキスト・教科書 Textbooks

講義指定図書 Reading List

参照ホームページ Websites

https://hokkaidosummerinstitute.oia.hokudai.ac.jp/en/courses/CourseDetail=G056

研究室のホームページ Websites of Laboratory

https://www.nims.go.jp/eng/research/group/quantum-solid-state/index.html

備考 Additional Information

科目名 Course Title	先端総合化学特論Ⅱ[Modern Trends in Chemical Sciences and Engineering II]		
講義題目 Subtitle	Instrumentation Chemistry[Instrumentation Chemistry]		
責任教員 Instructor	長谷川　靖哉 [HASEGAWA Yasuchika] (大学院工学研究院)		
担当教員 Other Instructors			
科目種別 Course Type			
開講年度 Year	2023	**時間割番号 Course Number**	095132
期間 Semester	Intensive	**単位数 Number of Credits**	1
授業形態 Type of Class	Lecture	**対象年次 Year of Eligible Student**	～
対象学科・クラス Eligible Department/Class			
ナンバリングコード Numbering Code	CHEM_REQEL 7121		
補足事項 Other Information			
授業実施方式 Class Method			

キーワード Key Words

Chemical Information, elemental analysis, conditional analysis, structural analysis in nano- and micro-area.

授業の目標 Course Objectives

Grounding in physical, organic and inorganic chemistry.
In this course, instrumentation chemistry containing elemental analysis, configurational analysis, structural analysis in nano- and micro-area are introduced. Based on their studies, students learn fundamental knowledges and various information about chemical analysis of organic and inorganic materials.

到達目標 Course Goals

Students learn principle, variety and characterization of instrumentation chemistry for material analysis. Based on instrumentation chemistry containing elemental analysis, configurational analysis, structural analysis in nano- and micro-area, students make the most of their knowledges for construction of their chemical research.

授業計画 Course Schedule

1-2. introduction of instrumentation chemistry: importance for structural analysis on the material surface, classification of chemical instruments, grounding in high vacuum engineering
3. configurational analysis (TEM, SEM, AFM, STM)
4. elemental analysis (AES, EPMA, XPS, XRF)
5. structural analysis (XRD, EXAFS, HEED, LEED, SAXS)
6. photo-physical analysis (UV-Vis absorption spectra, fluorescence and phosphorescence spectra, emission lifetime, Raman spectra)
7. MS spectral analysis (EI-MS, CI-MS, ESI-MS, MALDI-MS, SIMS)
8. examination

準備学習（予習・復習）等の内容と分量 Homework

Pre-examination for review of instrumentation chemistry

成績評価の基準と方法 Grading System

The attendance rate must be over 70% to be qualified to take the final exam. Evaluations will be made based on (1) learning attitude (20%), (2) exercise (10%), (3) final examination scores (70%).

他学部履修の条件 Other Faculty Requirements

テキスト・教科書 Textbooks

講義指定図書 Reading List

参照ホームページ Websites

This course will be provided as part of the Hokkaido Summer Institute., For more information (invited lecturers, course details, etc.), please visit the website below:, https://hokkaidosummerinstitute.oia.hokudai.ac.jp/en/courses/CourseDetail=G057

研究室のホームページ Websites of Laboratory

https://www.eng.hokudai.ac.jp/labo/amc/en/index.html

備考 Additional Information

科目名 Course Title	先端総合化学特論Ⅱ[Modern Trends in Chemical Sciences and Engineering II]		
講義題目 Subtitle	Funcitonal Solid State Materials Chemistry[Funcitonal Solid State Materials Chemistry]		
責任教員 Instructor	島田　敏宏 [SHIMADA Toshihiro] (大学院工学研究院)		
担当教員 Other Instructors			
科目種別 Course Type			
開講年度 Year	2023	**時間割番号 Course Number**	095133
期間 Semester	Intensive	**単位数 Number of Credits**	1
授業形態 Type of Class	Lecture	**対象年次 Year of Eligible Student**	～
対象学科・クラス Eligible Department/Class			
ナンバリングコード Numbering Code	CHEM_REQEL 7121		
補足事項 Other Information			
授業実施方式 Class Method			

キーワード Key Words

electronic materials and devices, thermoelectrics, solar cells, hard materials, solid state physics

授業の目標 Course Objectives

The first goal is to understand the ″heart″ of chemistry and physics of solid state functional materials and obtain the ability to design and crate new materials. The second goal is to understand what is written in literature with theoretical description. The lecture and the homeworks will be organized to achieve this goal.

到達目標 Course Goals

By the end of this course you will be able to
1. Explain how the devices explained in the lecture works.
2. Obtain basic knowledge of solid state materials.
3. Read advanced literature about the related topics.

授業計画 Course Schedule

Topics other than the following list can also be lectured according to request.
1. Introduction to solid state chemistry / physics and thermoelectricity
2. Semiconductors focused on solar cells
3. Transparent conductors (oxides, nanowires, graphene)
4. Advanced ligand field theory and basics of photophysics – lasers, nonlinear optics, optical fibers
5. Interfaces: work function and chemistry of semiconductor junction devices
6. Phase memory materials (DVD-R/W, shape memory alloys)
7. Ferroelectrics and liquid crystal
8. Thermography and strongly correlated electron systems
Related theoretical concepts will be introduced every time.

準備学習（予習・復習）等の内容と分量 Homework

Preparation: read the handout posted on the website (URL will be given at the first lecture).
Homework: solve the problem given in the lecture and write a brief final report.

成績評価の基準と方法 Grading System

Grading is based on the quiz given at each lecture and the final report.

他学部履修の条件 Other Faculty Requirements

テキスト・教科書 Textbooks

Handout will be given prior to the lecture via website

講義指定図書 Reading List

参照ホームページ Websites

This course will be provided as part of the Hokkaido Summer Institute., For more information (invited lecturers, course details, etc.), please visit the website below:, https://hokkaidosummerinstitute.oia.hokudai.ac.jp/en/courses/CourseDetail=G058

研究室のホームページ Websites of Laboratory

https://www.eng.hokudai.ac.jp/labo/kotai/en/index.html

備考 Additional Information

科目名 Course Title	先端総合化学特論Ⅱ[Modern Trends in Chemical Sciences and Engineering II]		
講義題目 Subtitle	Leading and Advanced Biological and Polymer Chemistry and Engineering IA – 2023[Leading and Advanced Biological and Polymer Chemistry and Engineering IA – 2023]		
責任教員 Instructor	坂口　和靖 [SAKAGUCHI Kazuyasu] (大学院理学研究院)		
担当教員 Other Instructors	James G. OMICHINSKI (University of Montreal), KAMADA Rui (理学研究院), NAKAGAWA Natsumi (理学研究院)		
科目種別 Course Type			
開講年度 Year	2023	**時間割番号 Course Number**	095134
期間 Semester	Intensive	**単位数 Number of Credits**	1
授業形態 Type of Class	Lecture	**対象年次 Year of Eligible Student**	～
対象学科・クラス Eligible Department/Class			
ナンバリングコード Numbering Code	CHEM_REQEL 7121		
補足事項 Other Information			
授業実施方式 Class Method			

キーワード Key Words

metal-binding proteins, zinc, mercury resistance, arsenic, stress granules, zinc fingers, p53, PML nuclear bodies, SUMO1, SUMO-SIM interactions, MerA, MerB, environmental niches

授業の目標 Course Objectives

1. To establish the importance of regulating precise metal concentrations in different cellular compartments and how these are determined experimentally
2. To establish how to accurately assess the affinity of protein-metal interactions
3. To discuss the importance of zinc in regulating cellular responses to stress
4. To introduce compounds that can alter intracellular metal concentrations and discuss the potential of therapeutic applications of metal containing compounds.
5. To discuss how the environmental niche of the organism has influenced the evolution of mercury resistance in microorganisms in extreme environments.

到達目標 Course Goals

1. To achieve an appreciation the role of biological metals in regulating cellular functions as well as how toxic metals can bind to macromolecules and disrupt biological metals.
2. To appreciate the importance of zinc-binding sites in regulating the structure, activity and function of proteins.
3. To appreciate the potential of metal-based therapeutics in treatment of diseases such as cancer
4. To appreciate how microbial organisms have evolved to adapt to high concentrations of toxic metals in their environment

授業計画 Course Schedule

Lecture 1: Fundamental concepts in metals in biological system
1) Biologically important metals and toxic metals
2) Metal concentrations in cells
3) Quantifying metal-protein interactions

Lecture 2: The role of zinc in regulating the formation of membrane-less bodies in response to stress.
1) The over-abundance of zinc-binding proteins in the proteome
2) The importance of zinc in stress granule formation
3) The role of zinc in regulating SUMO1 binding in PML nuclear bodies

Lecture 3: Metals that stabilize the structure of p53.
1) Zinc binding to the DNA-binding domain of p53
2) Stabilization of variant p53 proteins by arsenic trioxide
3) Metal binding to the p53 tetramerization domain

Lecture 4: The importance of the environmental in the evolution of enzymes involved in bacterial resistance to mercury.
1) Mercury resistant bacteria and the Mer enzymes MerA and MerB
2) Structure and Mechanism of Carbon-Hg bond cleavage by MerB
3) The role of the environmental niche in the transfer of the mercury ion product from MerB to MerA

準備学習 (予習・復習)等の内容と分量 Homework

Read the articles in the "Reading List"
Reading List
Lecture 1:
1) doi.org/10.1016/B978-0-444-64225-7.00001-8
2) doi.org/10.1093/jxb/erab481
3) doi.org/10.1016/j.cub.2021.03.054

Lecture 2:
1) 10.1038/cddiscovery.2017.71
2) doi.org/10.1093/nar/gkac620
3) doi.org/10.1016/j.celrep.2017.12.036

Lecture 3:
1) doi.org/10.1016/j.ccell.2020.11.013
2) doi.org/10.1016/j.celrep.2022.110622
3) 0.3389/fmolb.2022.895887
4) 10.1038/s41598-017-01442-8

Lecture 4:
1) doi.org/10.1016/j.envres.2017.08.051
2) doi.org/10.1021/acsenvironau.1c00022
3) doi.org/10.1021/jacs.6b11327
4) doi.org/10.1021/es400527m

成績評価の基準と方法 Grading System

Assignment on specified topics regarding "metal binding" and "mercury resistance" (60%); Student participation in class (40%)

他学部履修の条件 Other Faculty Requirements

テキスト・教科書 Textbooks

None

講義指定図書 Reading List

Lecture 1:
1) doi.org/10.1016/B978-0-444-64225-7.00001-8
2) doi.org/10.1093/jxb/erab481
3) doi.org/10.1016/j.cub.2021.03.054

Lecture 2:
1) 10.1038/cddiscovery.2017.71
2) doi.org/10.1093/nar/gkac620
3) doi.org/10.1016/j.celrep.2017.12.036

Lecture 3:
1) doi.org/10.1016/j.ccell.2020.11.013
2) doi.org/10.1016/j.celrep.2022.110622
3) 0.3389/fmolb.2022.895887
4) 10.1038/s41598-017-01442-8

Lecture 4:
1) doi.org/10.1016/j.envres.2017.08.051
2) doi.org/10.1021/acsenvironau.1c00022
3) doi.org/10.1021/jacs.6b11327
4) doi.org/10.1021/es400527m

参照ホームページ Websites

https://hokkaidosummerinstitute.oia.hokudai.ac.jp/en/courses/CourseDetail=G047

研究室のホームページ Websites of Laboratory

備考 Additional Information

Other Instructor: James G. Omichinski (University of Montreal)

科目名 Course Title	先端総合化学特論Ⅱ[Modern Trends in Chemical Sciences and Engineering II]		
講義題目 Subtitle	Leading and Advanced Biological and Polymer Chemistry and Engineering IB - 2023[Leading and Advanced Biological and Polymer Chemistry and Engineering IB - 2023]		
責任教員 Instructor	忠永　清治 [TADANAGA Kiyoharu] (大学院工学研究院)		
担当教員 Other Instructors	Harald GROGER (Bielefeld University), MIURA Akira (工学研究院)		
科目種別 Course Type			
開講年度 Year	2023	**時間割番号 Course Number**	095135
期間 Semester	Intensive	**単位数 Number of Credits**	1
授業形態 Type of Class	Lecture	**対象年次 Year of Eligible Student**	～
対象学科・クラス Eligible Department/Class			
ナンバリングコード Numbering Code	CHEM_REQEL 7121		
補足事項 Other Information			
授業実施方式 Class Method			

キーワード Key Words

Biocatalysis, Enzyme, Enzyme catalysis in organic synthesis, Sustainable Aviation Fuel

授業の目標 Course Objectives

This course will be provided as part of the Hokkaido Summer Institute.
This lecture aims to deepen the understanding of basics in biocatalysis and chemoenzyme synthesis.
The lecture will cover basics in biocatalysis, practical aspects of biocatalysis, mechanisms of biocatalytic reaactions, synthetic applications of enzyme catalysis in organic synthesis, and industrial applications of biocatalysis in the chemical and pharmaceutical industry.

到達目標 Course Goals

By understanding the fundamentals of biocatalysis and chemoenzyme synthesis and learning about its applications, students will gain a deeper understanding of the role that biocatalysis and chemoenzyme synthesis play in chmical synthesis, and will be able to introduce new perspectives to their research activities.

授業計画 Course Schedule

0. Guidance of Lectures
1. Basics in biocatalysis
2. Practical aspects of biocatalysis
3. Selected mechanisms of biocatalytic reaactions
4. Synthetic applications of enzyme catalysis in organic synthesis
5. Industrial applications of biocatalysis in the chemical and pharmaceutical industry

準備学習 (予習・復習)等の内容と分量 Homework

Review the distributed documents and contents in the lectures, and ask any questions at the next class.

成績評価の基準と方法 Grading System

Your attitude in classes (20%) and reports (80%) will affect your final grade.

他学部履修の条件 Other Faculty Requirements

テキスト・教科書 Textbooks

No textbook required. Handouts will be distributed.

講義指定図書 Reading List

Enzyme Catalysis in Organic Synthesis,Third Edition／Editors: Karlheinz Drauz, Harald Groeger, Oliver May：Wiley-VCH, 2012

参照ホームページ Websites

https://hokkaidosummerinstitute.oia.hokudai.ac.jp/en/courses/CourseDetail=G048

研究室のホームページ Websites of Laboratory

https://wwwhomes.uni-bielefeld.de/oc1-groeger/HG/index.html

備考 Additional Information

This course will be provided as part of the Hokkaido Summer Institute.
Prof. Harald Gröger of Bielefeld University, Germany will also be in charge of this lecture.

科目名 Course Title	先端総合化学特論II[Modern Trends in Chemical Sciences and Engineering II]		
講義題目 Subtitle	Leading and Advanced Biological and Polymer Chemistry and Engineering II – 2023[Leading and Advanced Biological and Polymer Chemistry and Engineering II – 2023]		
責任教員 Instructor	佐藤　敏文 [SATOH Toshifumi] (大学院工学研究院)		
担当教員 Other Instructors	Cheng-Liang LIU (National Taiwan University), ISONO Takuya (工学研究院)		
科目種別 Course Type			
開講年度 Year	2023	**時間割番号 Course Number**	095136
期間 Semester	Intensive	**単位数 Number of Credits**	1
授業形態 Type of Class	Lecture	**対象年次 Year of Eligible Student**	～
対象学科・クラス Eligible Department/Class			
ナンバリングコード Numbering Code	CHEM_REQEL 7121		
補足事項 Other Information			
授業実施方式 Class Method			

キーワード Key Words

Organic semiconductor, Solution-processable, Organic thermoelectric material

授業の目標 Course Objectives

Organic and polymeric electronics/optoelectronics materials are defined broadly as carbon-based materials that can transport charge in liquid-supported and solid systems. Two classes of these organic-based materials have emerged: small molecules and polymers. This course covers the molecular properties and microstructural characterization of organic semiconductors and charge generation/transport properties. Furthermore, we will evaluate how these materials can be implemented in organic light emitting diodes (OLEDs), organic photovoltaics (OPVs), and organic thin film transistors (OTFTs). In this way, we aim to train the students of this course to establish the relationship between molecular design, molecular transport phenomena, and macroscopic device response.

到達目標 Course Goals

This course will help students with no or limited prior background in this field to acquire a general and overall understanding of organic electronics, especially basic theory, applications, challenges, and recent developments, etc.

授業計画 Course Schedule

1. Lecture: History of organic conjugated polymers
2. Lecture: Design and synthesis of organic conjugated polymers
3. Lecture: Organic light emitting diode
4. Lecture: Organic transistor
5. Lecture: Organic photovoltaic
6. Seminar: Development of Organic Thermoelectric Materials and Device

Organic thermoelectric materials can directly transform the waste heat into electrical power without causing any pollution, but their development is limited due to poor performance, especially low conductivity. In my talk, we outline the design strategies which aim to develop high-performing organic semiconductors and their materials in organic thermoelectrics. A series of solution-processed organic semiconducting molecules are reported. These results indicate that these materials can be modulated through successive changes in conjugation length/side chain substituent length and molecular interaction based on a combination of molecular design and solution-processing techniques. Doping organic semiconductors, conjugated polymer composites, and gels with ionic salt or redox couples are used to achieve enhanced thermoelectric performance. Flexible/wearable thermoelectric generator based on these materials will be demonstrated.

準備学習（予習・復習）等の内容と分量 Homework

Final report regarding to "Design, Synthesis and Applications of Organic Thermoelectric Materials".

成績評価の基準と方法 Grading System

Your grade will be determined by how well you demonstrate your achievement of the course goals through
1. Participation to the discussion (10%)
2. Final report regarding to "Design, Synthesis and Applications of Organic Thermoelectric Materials" (90%)

他学部履修の条件 Other Faculty Requirements

テキスト・教科書 Textbooks

Lecture notes in PDF files will be provided.
PDF ファイルの講義ノートを提供します。

講義指定図書 Reading List

https://pubs.acs.org/doi/10.1021/acs.macromol.2c00957
https://onlinelibrary.wiley.com/doi/10.1002/adfm.202200880

参照ホームページ Websites

https://pubs.acs.org/doi/10.1021/acs.macromol.2c00957
https://onlinelibrary.wiley.com/doi/10.1002/adfm.202200880

https://hokkaidosummerinstitute.oia.hokudai.ac.jp/en/courses/CourseDetail=G049

研究室のホームページ Websites of Laboratory

http://www.mse.ntu.edu.tw/index.php?option=com_zoo&task=item&item_id=215&Itemid=896&lang=en
https://poly-ac.eng.hokudai.ac.jp/index_e.html

備考 Additional Information

Other Instructor: Prof. Cheng-Liang LIU (National Taiwan University)
The class is opened on campus and/or in real-time web system.
Please carefully see ELMS.

科目名 Course Title	先端総合化学特論Ⅱ[Modern Trends in Chemical Sciences and Engineering II]		
講義題目 Subtitle	Advanced Applied Biochemistry[Advanced Applied Biochemistry]		
責任教員 Instructor	松本　謙一郎 [MATSUMOTO Kenichiro] (大学院工学研究院)		
担当教員 Other Instructors	HACHISUKA Shinichi (工学研究院), FUJITA Masahiro (RIKEN)		
科目種別 Course Type			
開講年度 Year	2023	**時間割番号 Course Number**	095137
期間 Semester	Intensive	**単位数 Number of Credits**	1
授業形態 Type of Class	Lecture	**対象年次 Year of Eligible Student**	～
対象学科・クラス Eligible Department/Class			
ナンバリングコード Numbering Code	CHEM_REQEL 7121		
補足事項 Other Information			
授業実施方式 Class Method			

キーワード Key Words

Genetic information, protein structure, molecular mechanism, biosynthetic mechanism, animal cells, secondary metabolites, biopolymers, bioremediation, physical chemistry

授業の目標 Course Objectives

To learn synthesis, structure, function, and novel engineering subjects on of biomolecules in the fields of life science, information, medicine, and environment.

到達目標 Course Goals

Students are expected to understand deeply the topics of genetic information, protein structure, animal cell cultivation, secondary metabolites, biopolymers, and clean environments in the fields of life science, information, medicine, and environment.

授業計画 Course Schedule

1-4: Structure, function and analytical methods of RNA and other biomolecules
5-8: Strategies of metabolic pathways, and principles of enzymatic reactions

準備学習（予習・復習）等の内容と分量 Homework

Students review the lecture contents by the next time. Students submit a report after the lecture.

成績評価の基準と方法 Grading System

Active class participation and reports
The attendance rate must be over 70% to be qualified to be graded.

他学部履修の条件 Other Faculty Requirements

テキスト・教科書 Textbooks

講義指定図書 Reading List

参照ホームページ Websites

This course will be provided as part of the Hokkaido Summer Institute., For more information (invited lecturers, course details, etc.), please visit the website below:, https://hokkaidosummerinstitute.oia.hokudai.ac.jp/en/courses/CourseDetail=G052

研究室のホームページ Websites of Laboratory

https://biosynchem.eng.hokudai.ac.jp/

備考 Additional Information

科目名 Course Title	先端総合化学特論Ⅱ[Modern Trends in Chemical Sciences and Engineering II]		
講義題目 Subtitle	Introduction to Basic Biological Chemistry[Introduction to Basic Biological Chemistry]		
責任教員 Instructor	村上　洋太 [MURAKAMI Yota] (大学院理学研究院)		
担当教員 Other Instructors	TAKAOKA Akinori (遺伝子病制御研究所), MOTEGI Fumio (遺伝子病制御研究所)		
科目種別 Course Type			
開講年度 Year	2023	**時間割番号 Course Number**	095138
期間 Semester	Intensive	**単位数 Number of Credits**	1
授業形態 Type of Class	Lecture	**対象年次 Year of Eligible Student**	～
対象学科・クラス Eligible Department/Class			
ナンバリングコード Numbering Code	CHEM_REQEL 7121		
補足事項 Other Information			
授業実施方式 Class Method			

キーワード Key Words

cell growth and differentiation, gene expression, epigenetics, oncogene, immunity, infectious disease, cellular asymmetry

授業の目標 Course Objectives

The class focuses on fundamental aspects of molecular mechanisms that underlie basic biological phenomena such as cell growth, cell differentiation, immunity and cellular asymmetry. How disorder of the regulatory mechanism causes diseases including cancer and infectious disease will be discussed. In addition, various technologies for imaging dynamic molecular behavior in living cells will be also discussed.

到達目標 Course Goals

Students to be able to understand the basic regulatory mechanisms of gene expression, cell growth and immune system and developing mechanisms for the related diseases.

授業計画 Course Schedule

Day 1: Prof. Fumio Motegi
Interior design of cellular asymmetry
Day 2: Prof. Akinori Takaoka
Molecular signalings in host defense systemProf.
Day 3, 4: Yota Murakami
Regulation of Gene Expression for Cell Differentiation

準備学習（予習・復習）等の内容と分量 Homework

Review the contents of each lecture by the next time.

成績評価の基準と方法 Grading System

Report of the task (100%)

他学部履修の条件 Other Faculty Requirements

テキスト・教科書 Textbooks

講義指定図書 Reading List

参照ホームページ Websites

This course will be provided as part of the Hokkaido Summer Institute., For more information (invited lecturers, course details, etc.), please visit the website below:, https://hokkaidosummerinstitute.oia.hokudai.ac.jp/en/courses/CourseDetail=G050

研究室のホームページ Websites of Laboratory

備考 Additional Information

科目名 Course Title	総合化学特別研究第二[Research in Chemical Sciences and Engineering II]		
講義題目 Subtitle			
責任教員 Instructor	村上　洋太 [MURAKAMI Yota] (大学院理学研究院)		
担当教員 Other Instructors			
科目種別 Course Type			
開講年度 Year	2023	**時間割番号 Course Number**	095151
期間 Semester	Irregular	**単位数 Number of Credits**	1
授業形態 Type of Class	Lecture	**対象年次 Year of Eligible Student**	～
対象学科・クラス Eligible Department/Class			
ナンバリングコード Numbering Code	CHEM_REQEL 7131		
補足事項 Other Information			
授業実施方式 Class Method			

キーワード Key Words

Advanced Chemistry, Special Topics in Chemistry, Various Fields of Chemistry

授業の目標 Course Objectives

In this course, foreign researchers from abroad give a lecture in chemistry. This course will provide students with an overview of advanced researches in chemistry.

到達目標 Course Goals

Students should acquire an international sense in chemical researches, as well as the ability for discussion in English which should be required at the international conference.

授業計画 Course Schedule

This course is given by a lot of guest researchers who visit laboratories in the Graduate School of Chemical Sciences and Engineering in Hokkaido University. The schedule will be informed every time when the lecture is open.

準備学習（予習・復習）等の内容と分量 Homework

Assignment is required for every lecture.

成績評価の基準と方法 Grading System

Class participation (more than 7 lectures) and report.

他学部履修の条件 Other Faculty Requirements

テキスト・教科書 Textbooks

講義指定図書 Reading List

参照ホームページ Websites

研究室のホームページ Websites of Laboratory

備考 Additional Information

科目名 Course Title	総合化学研究インターンシップ[Internship]		
講義題目 Subtitle	ショート・ビジット[Short Visit]		
責任教員 Instructor	仙北　久典 [SENBOKU Hisanori] (大学院工学研究院)		
担当教員 Other Instructors			
科目種別 Course Type			
開講年度 Year	2023	**時間割番号 Course Number**	095161
期間 Semester	Fall	**単位数 Number of Credits**	1
授業形態 Type of Class	Internship	**対象年次 Year of Eligible Student**	～
対象学科・クラス Eligible Department/Class			
ナンバリングコード Numbering Code	CHEM_REQEL 7141		
補足事項 Other Information			
授業実施方式 Class Method			

キーワード Key Words

Internship

授業の目標 Course Objectives

For overseas internship, students develop global vision by their experience overseas, gain expertise and experimental techniques which seem to be hard to obtain in Japan.

到達目標 Course Goals

For overseas internship, students start to contact with where to do internship, then improve skills of communication, language, research practice, research network and community formation etc, so that they can raise consciousness as an engineer or a researcher.

Students should try not to keep the experience at only level of basic studies, try to apply the experience to collaborative researches with a practical level in the future.

授業計画 Course Schedule

The program will be generally conducted following the schedule below.

1. Announcement
2. Application (not equal to Registration)
3. Preparation
4. Internship for about between two weeks and two months
5. Submission of a report for the internship, presentation

準備学習（予習・復習）等の内容と分量 Homework

Students need to do preliminary search and to prepare ecperiments in advance.

成績評価の基準と方法 Grading System

Basically, students must submit a report and do a presentation in English language.

They will be evaluated by the above elements.

他学部履修の条件 Other Faculty Requirements

テキスト・教科書 Textbooks

使用しない

講義指定図書 Reading List

使用しない

参照ホームページ Websites

研究室のホームページ Websites of Laboratory

備考 Additional Information

科目名 Course Title	総合化学研究インターンシップ[Internship]		
講義題目 Subtitle	ALP インターンシップ[ALP Internship]		
責任教員 Instructor	仙北　久典 [SENBOKU Hisanori] (大学院工学研究院)		
担当教員 Other Instructors			
科目種別 Course Type			
開講年度 Year	2023	**時間割番号 Course Number**	095162
期間 Semester	Fall	**単位数 Number of Credits**	1
授業形態 Type of Class	Internship	**対象年次 Year of Eligible Student**	～
対象学科・クラス Eligible Department/Class			
ナンバリングコード Numbering Code	CHEM_REQEL 7142		
補足事項 Other Information			
授業実施方式 Class Method			

キーワード Key Words

Internship (domestic and oversea)

授業の目標 Course Objectives

ALP Corporate Internship: Students improve their skill and knowledge by being engaged in an actual work relating their future career.

ALP Overseas Internship: For overseas internship, students develop global vision by their experience overseas, gain expertise and experimental techniques which seem to be hard to obtain in Japan.

到達目標 Course Goals

Students start to contact with where to do internship, then improve skills of communication, language, research practice, research network and community formation etc, so that they can raise consciousness as an engineer or a researcher.

For overseas internship, students should try not to keep the experience at only level of basic studies, try to apply the experience to collaborative researches with a practical level in the future.

授業計画 Course Schedule

ALP Corporate Internship:

· Period of Internship: As a rule, the internship period is more than 2 weeks within 12 months.
· Posts: Domestic posts may consist of corporate research institutions or plant.
· In principle, deadlines for submissions are four weeks prior to departure.
· Obtain the Personal Accident Insurance for Students Pursuing Education and Research (PAS) prior to travel.

ALP Overseas Internship:

· Period of Internship: As a rule, the internship period is more than 1 month within 12 months.
· Posts: Overseas posts will mainly consist of university research institutions or corporation.
· In principle, deadlines for submissions are six weeks prior to departure.
· Obtain travel insurance prior to travel.

Students are required to submit a report within one month of completing the internship.

準備学習 (予習・復習)等の内容と分量 Homework

Students need to do preliminary search and to prepare experiments in advance.

成績評価の基準と方法 Grading System

Basically, students must submit a report and do a presentation (in English language for overseas internship).
They will be evaluated by the above elements.

他学部履修の条件 Other Faculty Requirements

Only ALP students can take this course.

テキスト・教科書 Textbooks

使用しない。

講義指定図書 Reading List

使用しない。

参照ホームページ Websites

https://phdiscover.jp/hu/alp/

研究室のホームページ Websites of Laboratory

備考 Additional Information

科目名 Course Title	総合化学研究インターンシップ[Internship]		
講義題目 Subtitle	ジョブ型研究インターンシップ[Cooperative Education through Research Internship]		
責任教員 Instructor	仙北　久典 [SENBOKU Hisanori] (大学院工学研究院)		
担当教員 Other Instructors			
科目種別 Course Type			
開講年度 Year	2023	**時間割番号 Course Number**	095163
期間 Semester	Intensive	**単位数 Number of Credits**	1
授業形態 Type of Class	Internship	**対象年次 Year of Eligible Student**	～
対象学科・クラス Eligible Department/Class			
ナンバリングコード Numbering Code	CHEM_REQEL 7142		
補足事項 Other Information			
授業実施方式 Class Method			

キーワード Key Words

Domestic internship

授業の目標 Course Objectives

Students improve their skill and knowledge by being engaged in an actual work relating their future career.

到達目標 Course Goals

Students start to contact with where to do internship, then improve skills of communication, language, research practice, research network and community formation etc, so that they can raise consciousness as an engineer or a researcher.

授業計画 Course Schedule

The program will be generally conducted following the schedule below.

1. Announcement
2. Application (not equal to Registration)
3. Preparation
4. Internship for about between two weeks and two months
5. Submission of a report for the internship

準備学習（予習・復習）等の内容と分量 Homework

Students need to do preliminary search and to prepare ecperiments in advance.

成績評価の基準と方法 Grading System

Basically, students must submit a report and do a presentation.
They will be evaluated by the above elements.

他学部履修の条件 Other Faculty Requirements

テキスト・教科書 Textbooks

使用しない

講義指定図書 Reading List

使用しない

参照ホームページ Websites

https://coopj-intern.com/

研究室のホームページ Websites of Laboratory

備考 Additional Information