| Anan College | | | Course of Applied Chemical Engineering | | | Year | 2024 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Department Goals | | | | | | | | | | | | | | | |
| Course Category | | Course Title | Course Code | Credit Type | Credits | Class Hours per Week | | | | | | | | Instructor | Division in Learning |
| | | | | | | Adv. 1st Y | | | | Adv. 2nd Y | | | | | |
| | | | | | | 1st | | 2nd | | 1st | | 2nd | | | |
| | | | | | | 1Q | 2Q | 3Q | 4Q | 1Q | 2Q | 3Q | 4Q | | |
| AZ | Compulsory | Instrumental Analysis | 5516Z01 | Academic Credit | 2 | 2 | | | | | | | | Yamada Yohei | |
| AZ | Elective | Electronic Device Engineering | 5596E01 | Academic Credit | 2 | | | 2 | | | | | | Hasegawa Tatsuo | |
| AZ | Elective | Electrical Circuits and Analysis | 5596E03 | Academic Credit | 2 | 2 | | | | | | | | Nakamura Yuichi | |
| AZ | Elective | Material Processing | 5596M03 | Academic Credit | 2 | 2 | | | | | | | | Yasuda Takeshi | |
| AZ | Elective | Simulation Engineering | 5596M04 | Academic Credit | 2 | | | 2 | | | | | | Matsuura Fuminori | |
| Specialized | Compulsory | Synthetic Organic Chemistry | 5516Z02 | Academic Credit | 2 | 2 | | | | | | | | Sugiyama Yuuki | |
| Specialized | Compulsory | Advanced Physical Chemistry | 5516Z03 | Academic Credit | 2 | 2 | | | | | | | | Konishi Tomoya | |
| Specialized | Elective | Environmental Chemistry | 5596101 | | 2 | 2 | | | | | | | | Ota Naotomo | |
| Specialized | Elective | Solid State Chemistry | 5596Z04 | Academic Credit | 2 | 2 | | | | | | | | Konishi Tomoya | |
| Specialized | Compulsory | Experiments in Applied Chemistry | 5517J01 | Academic Credit | 2 | | | | | 6 | | | | Otani Takashi,Sugiyama Yuuki, Ueda Kohei, Ezure Ryosuke | |
| Specialized | Compulsory | Synthetic Organic Chemistry | 5517Z02 | | 2 | | | | | 4 | | | | Sugiyama Yuuki | |
| Specialized | Compulsory | Advanced Physical Chemistry | 5517Z03 | Academic Credit | 2 | | | | | 2 | | | | Konishi Tomoya | |
| Specialized | Elective | Environmental Chemistry | 5597101 | Academic Credit | 2 | | | | | 2 | | | | Ota Naotomo | |
| Specialized | Elective | Composite Materials | 5597C04 | Academic Credit | 2 | | | | | 2 | | | | Kadono Takuma | |
| Specialized | Elective | Mathematics of Electronics and Information | 5597E02 | Academic Credit | 2 | | | | | 2 | | | | Sugino Ryuzaburo | |

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Specialized | Elective | Semiconductor Material Properties | 5597E04 | Academic Credit | 2 | | | | | | | 2 | | Hasegawa Tatsuo | |
| Specialized | Elective | Signal Processing Engineering | 5597I03 | Academic Credit | 2 | | | | | 2 | | | | Yasuno Emiko | |
| Specialized | Elective | Strength and Fracture of Materials | 5597M02 | Academic Credit | 2 | | | | | 2 | | | | Okumoto Yoshihiro | |
| Specialized | Elective | Solid State Chemistry | 5597Z04 | | 2 | | | | | 4 | | | | Konishi Tomoya | |

| Anan College | Year | 2024 | Course Title | Instrumental Analysis |
|---|---|---|---|---|

## Course Information

| | | | |
|---|---|---|---|
| Course Code | 5516Z01 | Course Category | AZ / Compulsory |
| Class Format | Lecture | Credits | Academic Credit: 2 |
| Department | Course of Applied Chemical Engineering | Student Grade | Adv. 1st |
| Term | First Semester | Classes per Week | 前期:2 |
| Textbook and/or Teaching Materials | エキスパート応用化学テキストシリーズ　機器分析　大谷肇 編　講談社（ISBN978-4-06-156807-5） | | |
| Instructor | Yamada Yohei | | |

## Course Objectives

After taking this course, you will be able to
1. explain the interaction between electromagnetic waves and materials.
2. explain the measurement principles of the analytical instruments covered in the lecture.
3. discuss and devise analytical methods according to the sample to be measured and the information to be obtained.
4. explain to others the principles of the instruments used in one's own research and the information obtained.

## Rubric

| | Ideal Level | Standard Level | Unacceptable Level |
|---|---|---|---|
| 1. Explain the interaction between electromagnetic waves and matter | You are able to use the equations relating wavelength, frequency, and energy of electromagnetic waves, accurately. You are able to explain at least three specific examples of interactions between electromagnetic waves and matter (electronic transitions, vibrational transitions, etc.). | You are able to use the equations relating wavelength, frequency, and energy of electromagnetic waves. You are able to explain at least two specific examples of interactions between electromagnetic waves and matter (electronic transitions, vibrational transitions, etc.). | If you read textbooks, you are able to use the equations relating wavelength, frequency, and energy of electromagnetic waves. You are able to explain at least two specific examples of interactions between electromagnetic waves and matter (electronic transitions, vibrational transitions, etc.). |
| 2. To be able to explain the measurement principles of the analytical instruments covered in the lecture. | You are able to explain at least six measurement principles of various analytical instruments covered in the textbook. You are able to explain the characteristics of each instrument and how to use them. | You are able to explain at least four measurement principles of various analytical instruments covered in the textbook. You are able to explain the characteristics of each instrument and how to use them. | If you read textbooks, you are able to explain at least four measurement principles of various analytical instruments covered in the textbook. You are able to explain the characteristics of each instrument and how to use them. |
| 3. Discuss and devise analytical methods according to the sample to be measured and the information to be obtained. | You are able to suggest analytical methods according to the sample and the information to be obtained.<br>You are able to image sample preparation. | You are able to suggest analytical methods according to the sample and the information to be obtained. | If you read textbooks, You are able to suggest analytical methods according to the sample and the information to be obtained. |
| 4. Be able to explain to others the principles of the equipment used in his/her research and the information obtained. | You are able to do presentation of your research and explain analytical instruments using in your research. Also, you are able to ask question for research of others, at good pace. | You are able to do presentation of your research and explain analytical instruments using in your research. Also, you are able to ask question for research of others. | You are able to do presentation of your research and explain analytical instruments using in your research. |

## Assigned Department Objectives

## Teaching Method

| | |
|---|---|
| Outline | Analytical chemistry is the study of the composition and content of samples and the analysis of their chemical state and existence. Instrumental analysis plays a central role in analytical chemistry and is indispensable in all human activities, including substance development, quality control, environmental investigation, and medical care. In general, analytical instruments are classified based on their principles into electromagnetic analysis, electrical analysis, separation analysis, and others (thermal analysis, mass spectrometry). First, students will learn about the principles and equipment configuration of these analytical instruments. Students will also learn what kind of information can be obtained from the results obtained from these analytical instruments. |
| Style | Basically classroom learning, but there are also laboratory exercises. |
| Notice | |

## Characteristics of Class / Division in Learning

| | | | |
|---|---|---|---|
| ☐ Active Learning | ☐ Aided by ICT | ☐ Applicable to Remote Class | ☐ Instructor Professionally Experienced |

## Course Plan

| | | | Theme | Goals |
|---|---|---|---|---|
| 1st Semester | 1st Quarter | 1st | Introduction to Instrumental Analysis, Interaction of Electromagnetic Waves and Materials | You are able to explain the principles of the equipment, how to prepare samples, and how to view the data obtained. |
| | | 2nd | Interaction of electromagnetic waves with matter, UV-Vis | You are able to explain the principles of the equipment, how to prepare samples, and how to view the data obtained. |
| | | 3rd | fluorospectrophotometer | You are able to explain the principles of the equipment, how to prepare samples, and how to view the data obtained. |

| | | | | |
|---|---|---|---|---|
| | | 4th | AAS | You are able to explain the principles of the equipment, how to prepare samples, and how to view the data obtained. |
| | | 5th | ICP-AES, ICP-MS | You are able to explain the principles of the equipment, how to prepare samples, and how to view the data obtained. |
| | | 6th | experimental design for analysis of mineral water by using ICP-AES | experimental design for analysis of mineral water by using ICP-AES. |
| | | 7th | Experiment | preparation of standard solution for analysis of mineral water. |
| | | 8th | Experiment | ICP-AES measurement |
| | 2nd Quarter | 9th | Data handling<br>of the experiment by Excel | Data handling<br>of the experiment by Excel |
| | | 10th | FT-IR | You are able to explain the principles of the equipment, how to prepare samples, and how to view the data obtained. |
| | | 11th | FT-IR, Raman spectrometry | You are able to explain the principles of the equipment, how to prepare samples, and how to view the data obtained. |
| | | 12th | XRD, XRF | You are able to explain the principles of the equipment, how to prepare samples, and how to view the data obtained. |
| | | 13th | Presentation of the students | Students will present their own research and the analytical instruments they use. |
| | | 14th | Presentation of the students | Students will present their own research and the analytical instruments they use. |
| | | 15th | Presentation of the students | Students will present their own research and the analytical instruments they use. |
| | | 16th | final exam | final exam |

Evaluation Method and Weight (%)

| | Examination | Presentation | reports | Total |
|---|---|---|---|---|
| Subtotal | 50 | 20 | 30 | 100 |
| Basic Proficiency | 50 | 20 | 30 | 100 |
| Specialized Proficiency | 0 | 0 | 0 | 0 |
| Cross Area Proficiency | 0 | 0 | 0 | 0 |

| Anan College | Year | 2024 | Course Title | Electronic Device Engineering |
|---|---|---|---|---|

## Course Information

| | | | |
|---|---|---|---|
| Course Code | 5596E01 | Course Category | AZ / Elective |
| Class Format | | Credits | Academic Credit: 2 |
| Department | Course of Applied Chemical Engineering | Student Grade | Adv. 1st |
| Term | Second Semester | Classes per Week | 後期:2 |
| Textbook and/or Teaching Materials | 基礎から学ぶ半導体電子デバイス（森北出版） | | |
| Instructor | Hasegawa Tatsuo | | |

## Course Objectives

1. 半導体のエネルギーバンド図を説明でき、キャリア密度に関する諸式を導出できる。
2. pn接合ダイオードの特性をエネルギーバンド図を用いて説明でき、動作に関わる諸量を求めることができる。
3. 金属と半導体の接合の特性をエネルギーバンド図を用いて説明でき、動作に関わる諸量を求めることができる。
4. トランジスタ、サイリスタの動作原理をエネルギーバンド図を用いて説明できる。
5. JFET、MOSFETの動作原理をエネルギーバンド図を用いて説明できる。

## Rubric

| | 理想的な到達レベルの目安 | 標準的な到達レベルの目安 | 最低限の到達レベルの目安(不可) |
|---|---|---|---|
| 到達目標1 | 半導体のエネルギーバンド図を説明でき、キャリア密度に関する諸式を導出できる。 | 半導体のエネルギーバンド図を説明でき、キャリア密度について説明できる。 | 半導体のエネルギーバンド図を説明できる。 |
| 到達目標2 | pn接合ダイオードの特性をエネルギーバンド図を用いて説明でき、動作に関わる諸量を求めることができる。 | pn接合ダイオードの特性をエネルギーバンド図を用いて説明できる。 | pn接合ダイオードの特性を説明できる。 |
| 到達目標3 | 金属と半導体の接合の特性をエネルギーバンド図を用いて説明でき、動作に関わる諸量を求めることができる。 | 金属と半導体の接合の特性をエネルギーバンド図を用いて説明できる。 | 金属と半導体の接合の特性を説明できる。 |
| 到達目標4 | トランジスタ、サイリスタの動作原理をエネルギーバンド図を用いて説明できる。 | トランジスタ、サイリスタの動作原理を説明できる。 | トランジスタ、サイリスタの基本特性を説明できる。 |
| 到達目標5 | JFET、MOSFETの動作原理をエネルギーバンド図を用いて説明できる。 | JFET、MOSFETの動作原理を説明できる。 | JFET、MOSFETの基本特性を説明できる。 |

## Assigned Department Objectives

## Teaching Method

| | |
|---|---|
| Outline | 半導体の基本的性質およびキャリア輸送についてエネルギーバンドモデルを用いて学習し、pn接合ダイオード、ショットキー接合ダイオード、バイポーラトランジスタ、サイリスタ、電界効果トランジスタなど、さまざまな電子デバイスの構造・特性・動作原理について理解することを目的とする。 |
| Style | 講義形式を中心に授業を進める。<br>【授業時間30時間＋自学自習時間60時間】 |
| Notice | |

## Characteristics of Class / Division in Learning

| | | | |
|---|---|---|---|
| ☐ Active Learning | ☑ Aided by ICT | ☐ Applicable to Remote Class | ☐ Instructor Professionally Experienced |

## Course Plan

| | | | Theme | Goals |
|---|---|---|---|---|
| 2nd Semester | 3rd Quarter | 1st | 半導体の基礎 | 半導体の定義を説明できる。<br>孤立原子、結晶のエネルギー構造を説明できる。 |
| | | 2nd | 半導体の基礎 | 真性半導体、p型・n型の不純物半導体について説明できる。 |
| | | 3rd | 半導体中のキャリア密度 | 真性半導体のキャリア密度に関する諸式を導出できる。<br>真性、不純物半導体のキャリア密度の図を説明できる。 |
| | | 4th | 半導体中のキャリア密度<br>半導体中のキャリア輸送現象 | 絶縁体、半導体、導体のエネルギーバンドを説明できる。<br>ドリフト電流と拡散電流を説明できる。 |
| | | 5th | pn接合ダイオード | pn接合ダイオードの特性をエネルギーバンド図を用いて説明できる。 |
| | | 6th | pn接合ダイオード | pn接合ダイオードの特性に関する諸式をポアソン方程式より導出できる。 |
| | | 7th | pn接合ダイオード | pn接合ダイオードの電圧-電流特性の式を導出できる。 |
| | | 8th | 【中間試験】 | |
| | 4th Quarter | 9th | 金属と半導体の接合による整流特性 | 金属と半導体の接合の特性をエネルギーバンド図を用いて説明できる。 |
| | | 10th | 金属と半導体の接合による整流特性 | 金属と半導体の接合の特性をエネルギーバンド図を用いて説明できる。 |
| | | 11th | 金属と半導体の接合による整流特性 | pn接合ダイオードの特性に関する諸式をポアソン方程式より導出できる。 |

| | | | | |
|---|---|---|---|---|
| | | 12th | バイポーラトランジスタ | バイポーラトランジスタの特性をエネルギーバンド図を用いて説明できる。 |
| | | 13th | バイポーラトランジスタ | サイリスタの特性をエネルギーバンド図を用いて説明できる。 |
| | | 14th | 接合型電界効果トランジスタ（JFET） | 接合型FETの特性を構造図を用いて説明できる。 |
| | | 15th | MOS型電界効果トランジスタ（MOSFET） | MOS形FETの特性を構造図とエネルギーバンド図を用いて説明できる。 |
| | | 16th | 【学年末試験、答案返却】 | |

Evaluation Method and Weight (%)

| | 定期試験 | 小テスト | ポートフォリオ | 発表・取り組み姿勢 | その他 | Total |
|---|---|---|---|---|---|---|
| Subtotal | 80 | 0 | 20 | 0 | 0 | 100 |
| 基礎的能力 | 40 | 0 | 10 | 0 | 0 | 50 |
| 専門的能力 | 40 | 0 | 10 | 0 | 0 | 50 |
| 分野横断的能力 | 0 | 0 | 0 | 0 | 0 | 0 |

| Anan College | Year | 2024 | Course Title | Electrical Circuits and Analysis |
|---|---|---|---|---|

## Course Information

| | | | |
|---|---|---|---|
| Course Code | 5596E03 | Course Category | AZ / Elective |
| Class Format | Lecture | Credits | Academic Credit: 2 |
| Department | Course of Applied Chemical Engineering | Student Grade | Adv. 1st |
| Term | First Semester | Classes per Week | 前期:2 |
| Textbook and/or Teaching Materials | | | |
| Instructor | Nakamura Yuichi | | |

## Course Objectives

1. Able to explain the characteristics and functions of basic elements.
2. Able to derive circuit equations for basic circuits and explain dynamic characteristics.
3. Can explain how to derive and solve circuit equations for circuits containing L and C.
4. Understand the concept of system equations and be able to express system equations corresponding to circuits.
5. Able to solve system equations and explain the dynamic characteristics of circuits.

## Rubric

| | Ideal Level | Standard Level | Minimum Attainment Level |
|---|---|---|---|
| Achievement 1 | Able to explain in detail the characteristics and effects of basic elements using mathematical formulas, etc. | Able to explain the characteristics and effects of basic elements using formulas. | Able to explain the characteristics and actions of basic elements. |
| Achievement 2 | Able to systematically derive circuit equations for basic circuits. Also, be able to solve it and explain its dynamic characteristics. | Able to derive circuit equations for basic circuits. Also, be able to explain the steps to solve an equation. | Able to derive circuit equations for simple circuits. |
| Achievement 3 | Able to derive circuit equations expressed as higher-order differentials. Also, be able to concretely solve the problem. | Able to derive circuit equations expressed up to second-order differentials. Also, be able to explain the solution. | Able to derive circuit equations expressed as first-order differentials. Also, be able to explain the solution. |
| Achievement 4 | Understand the concept of system equations and be able to express system equations corresponding to various circuits. | Understand the concept of system equations and be able to express system equations that correspond to basic circuits. | Understand the concept of system equations and be able to express system equations that correspond to simple circuits. |
| Achievement 5 | Able to solve various system equations and explain the dynamic characteristics of circuits in detail. | Able to solve basic system equations and outline the dynamic characteristics of a circuit. | Able to solve simple system equations and provide an overview of the dynamic characteristics of a circuit. |

## Assigned Department Objectives

## Teaching Method

| | |
|---|---|
| Outline | Transient phenomena for circuits with various configurations are analyzed using system state equations. The goal is to learn about multiple types of analysis methods and understand the characteristics and methods of each, so that you can select the most suitable method for your purpose. |
| Style | Learn about the concepts and methods for analyzing the dynamic characteristics of electrical circuits. Exercises and report assignments will also be conducted to help students understand the content of the class. |
| Notice | The content of this lecture is a method that can be commonly applied to the analysis of linear dynamical systems. By becoming familiar with the notation and analysis procedures used here, students will develop skills that can be applied to more practical system analysis. |

## Characteristics of Class / Division in Learning

| | | | |
|---|---|---|---|
| ☐ Active Learning | ☑ Aided by ICT | ☐ Applicable to Remote Class | ☐ Instructor Professionally Experienced |

## Course Plan

| | | | Theme | Goals |
|---|---|---|---|---|
| 1st Semester | 1st Quarter | 1st | 1. Dynamic characteristics of basic circuits (1) Dynamic element | Able to derive circuit equations for basic circuits and explain dynamic characteristics. - Able to explain the individual characteristics and actions of dynamic elements. |
| | | 2nd | 1. Dynamic characteristics of basic circuits (2) Circuit equation | Able to derive circuit equations for basic circuits and explain dynamic characteristics. - Circuit equations can be found for basic circuits. |
| | | 3rd | 1. Dynamic characteristics of basic circuits (3) Dynamic characteristics | Able to derive circuit equations for basic circuits and explain dynamic characteristics. - Able to solve circuit equations of basic circuits and explain dynamic characteristics. |
| | | 4th | 1. Dynamic characteristics of basic circuits (3) Dynamic characteristics | Able to derive circuit equations for basic circuits and explain dynamic characteristics. - Able to solve circuit equations of basic circuits and explain dynamic characteristics. |
| | | 5th | 2. Dynamic analysis method (1) Ordinary differential equations and their solutions | Able to explain how to derive and solve circuit equations for circuits containing L and C. - Understand constant coefficient ordinary differential equations and be able to explain the steps to solve them. |

| | | | | |
|---|---|---|---|---|
| | | 6th | 2. Dynamic analysis method<br>(1) Ordinary differential equations and their solutions | Able to explain how to derive and solve circuit equations for circuits containing L and C.<br>- Understand constant coefficient ordinary differential equations and be able to explain the steps to solve them. |
| | | 7th | 2. Dynamic analysis method<br>(1) Ordinary differential equations and their solutions | Able to explain how to derive and solve circuit equations for circuits containing L and C.<br>- Understand constant coefficient ordinary differential equations and be able to explain the steps to solve them. |
| | | 8th | [Midterm Exam] | Check your understanding of the lesson content up to the midterm exam. |
| | 2nd Quarter | 9th | 3. System equations and their solutions<br>(1) Representation of system equations | Understand the concept of system equations and be able to specifically derive and solve them.<br>- Understand the concept of system equations and be able to derive them for a given circuit. |
| | | 10th | 3. System equations and their solutions<br>(1) Representation of system equations | Understand the concept of system equations and be able to specifically derive and solve them.<br>- Understand the concept of system equations and be able to derive them for a given circuit. |
| | | 11th | 3. System equations and their solutions<br>(2) Exponential function of matrix and its properties | Understand the concept of system equations and be able to specifically derive and solve them.<br>- Able to explain the exponential function of the matrix used to solve system equations and its properties. |
| | | 12th | 3. System equations and their solutions<br>(2) Exponential function of matrix and its properties | Understand the concept of system equations and be able to specifically derive and solve them.<br>- Able to explain the exponential function of the matrix used to solve system equations and its properties. |
| | | 13th | 3. System equations and their solutions<br>(3) Solution of system equations | Understand the concept of system equations and be able to specifically derive and solve them.<br>- Able to specifically derive the derived system equation. |
| | | 14th | 3. System equations and their solutions<br>(3) Solution of system equations | Understand the concept of system equations and be able to specifically derive and solve them.<br>- Able to specifically derive the derived system equation. |
| | | 15th | 3. System equations and their solutions<br>(3) Solution of system equations | Understand the concept of system equations and be able to specifically derive and solve them.<br>- Able to specifically derive the derived system equation. |
| | | 16th | [Final exam]<br>[Answer return time] | Check your understanding of the lesson content. |

Evaluation Method and Weight (%)

| | Examination | Report/Assignment | Total |
|---|---|---|---|
| Subtotal | 80 | 20 | 100 |
| Basic Proficiency | 30 | 5 | 35 |
| Specialized Proficiency | 40 | 10 | 50 |
| Cross Area Proficiency | 10 | 5 | 15 |

| Anan College | Year | 2024 | Course Title | Material Processing |
|---|---|---|---|---|

## Course Information

| | | | |
|---|---|---|---|
| Course Code | 5596M03 | Course Category | AZ / Elective |
| Class Format | Lecture | Credits | Academic Credit: 2 |
| Department | Course of Applied Chemical Engineering | Student Grade | Adv. 1st |
| Term | First Semester | Classes per Week | 前期:2 |
| Textbook and/or Teaching Materials | Materials will be distributed as needed. | | |
| Instructor | Yasuda Takeshi | | |

## Course Objectives

1. Student be able to understand and explain various processing methods for metallic materials and their characteristics and relevance.
2. Student be able to understand and explain various molding methods for ceramics, resins, and composite materials, and their characteristics.
3. Student be able to understand and explain heat treatment and surface treatment, their necessity and effects.
4. Student be able to understand and explain various joining methods and their characteristics.

## Rubric

| | Ideal Level | Standard Level | Minimum Level |
|---|---|---|---|
| Achievement 1 | Student be able to understand and explain various processing methods of metallic materials and their characteristics and relevance. | Student be able to understand and explain various processing methods for metallic materials. | Student understand various processing methods for metal materials. |
| Achievement 2 | Student be able to understand and explain various molding methods for ceramics and resins/composites and their characteristics. | Student be able to understand and explain various forming methods for ceramics and resins/composites. | Student understand various molding methods for ceramics, resins and composites. |
| Achievement 3 | Student be able to understand and explain the necessity and effects of heat treatment and surface treatment. | Student be able to understand and explain heat treatment and surface treatment. | Student understand heat treatment and surface treatment heat treatments. |
| Achievement 4 | Student be able to understand and explain various joining methods and their characteristics. | Student be able to understand and explain various joining methods. | Student understand various joining methods. |

## Assigned Department Objectives

## Teaching Method

| | |
|---|---|
| Outline | Metallic materials (especially steel), ceramics, and resins, which are widely utilized in industrial products, are processed into various shapes according to their applications. As engineers and designers involved in manufacturing, it is necessary to understand the phenomena and characteristics of various materials during processing in order to select appropriate material processing methods. In this course, students will acquire basic knowledge of various processing and forming methods for metallic materials, ceramics, and resins, as well as heat treatment and surface treatment of some materials. |
| Style | Classes will be conducted in a lecture style. Reports will be required as pre- and post-assessments.<br>[30 hours of class time + 60 hours of self-study] |
| Notice | |

## Characteristics of Class / Division in Learning

| | | | |
|---|---|---|---|
| ☐ Active Learning | ☐ Aided by ICT | ☐ Applicable to Remote Class | ☐ Instructor Professionally Experienced |

## Course Plan

| | | | Theme | Goals |
|---|---|---|---|---|
| 1st Semester | 1st Quarter | 1st | Overall view of material processing methods | Student be able to explain an overview of this course and an view overall how materials are processed. |
| | | 2nd | Processing methods for metallic materials | Student be able to explain various processing methods for metallic materials. |
| | | 3rd | Processing methods for metallic materials | Student be able to explain various processing methods for metallic materials. |
| | | 4th | Ceramics forming methods | Student be able to explain ceramics forming methods. |
| | | 5th | Molding methods for resins and composites | Student be able to explain molding methods for resins and composites. |
| | | 6th | Basics of heat treatment | Student be able to explain the basics of heat treatment of steel materials. |
| | | 7th | Basics of heat treatment | Student be able to explain the basics of heat treatment of steel materials. |
| | | 8th | Heat treatment in actual | Student be able to explain heat treatment in actual. |
| | 2nd Quarter | 9th | Midterm examination | |
| | | 10th | Surface Treatment | Student be able to explain various surface treatment methods. |

| | | | | |
|---|---|---|---|---|
| | | 11th | Surface Treatment | Student be able to explain various surface treatment methods. |
| | | 12th | Mechanical bonding | Student be able to explain various mechanical bonding. |
| | | 13th | Adhesion | Student be able to explain about adhesion. |
| | | 14th | Liquid phase bonding and solid phase bonding | Student be able to explain various methods of liquid-phase bonding and solid-phase bonding. |
| | | 15th | Liquid phase bonding and solid phase bonding | Student be able to explain various methods of liquid-phase bonding and solid-phase bonding. |
| | | 16th | Final examination and return exam. paper | |

Evaluation Method and Weight (%)

| | Midterm/Final exam | Quiz | Portfolio | Presentation/Attitude | Portfolio | Other | Total |
|---|---|---|---|---|---|---|---|
| Subtotal | 80 | 0 | 20 | 0 | 0 | 0 | 100 |
| Basic Proficiency | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Specialized Proficiency | 60 | 0 | 20 | 0 | 0 | 0 | 80 |
| Cross Area Proficiency | 20 | 0 | 0 | 0 | 0 | 0 | 20 |

| Anan College | Year | 2024 | Course Title | Simulation Engineering |
|---|---|---|---|---|

## Course Information

| | | | |
|---|---|---|---|
| Course Code | 5596M04 | Course Category | AZ / Elective |
| Class Format | Lecture | Credits | Academic Credit: 2 |
| Department | Course of Applied Chemical Engineering | Student Grade | Adv. 1st |
| Term | Second Semester | Classes per Week | 後期:2 |
| Textbook and/or Teaching Materials | Pythonによる数値計算とシミュレーション（オーム社） | | |
| Instructor | Matsuura Fuminori | | |

## Course Objectives

1. Can perform modeling with 3D CAD and carry out linear stress analysis, fluid analysis, and heat transfer analysis.
2. Can create a program that simulates the motion of a particle based on ordinary differential equations.

## Rubric

| | Ideal Level | Standard Level | Unacceptable Level |
|---|---|---|---|
| SolidWorks Simulation | Can perform element division considering analysis accuracy and conduct linear stress, fluid, and heat transfer analyses. | Can model complex parts with 3D-CAD and perform linear stress, fluid, and heat transfer analyses. | Can model simple parts with 3D-CAD and perform linear stress, fluid, and heat transfer analyses. |
| Creating Own Numerical Simulation Code | Can add additional features to the code listed in the textbook. | Can create simulation code with functions equivalent to the code listed in the textbook. | Cannot implement functions equivalent to the code listed in the textbook. |

## Assigned Department Objectives

## Teaching Method

| | |
|---|---|
| Outline | Numerical analysis methods such as the finite element method have become powerful tools for all engineering fields. In this lecture, we utilize analysis software linked with 3D CAD to perform stress analysis, heat transfer analysis, and fluid analysis. In the latter part, students will acquire the basics of computational mechanics and learn about physical simulations based on ordinary differential equations, simulations using cellular automata, and stochastic simulations using random numbers. |
| Style | The first half of the course focuses on learning what can be simulated with analysis using 3D CAD software. In the second half, students create programs for numerical calculation. Although program examples are provided in Python 3, students are allowed to implement in any programming language they are proficient in. As this course offers academic credits, submission of reports as pre- and post-study activities is mandatory.<br>【Lecture hours: 31 hours + Self-study hours: 60 hours】 |
| Notice | Proficiency in operating 3D CAD software and programming languages is desirable. |

## Characteristics of Class / Division in Learning

| | | | |
|---|---|---|---|
| ☐ Active Learning | ☐ Aided by ICT | ☐ Applicable to Remote Class | ☐ Instructor Professionally Experienced |

## Course Plan

| | | | Theme | Goals |
|---|---|---|---|---|
| 2nd Semester | 3rd Quarter | 1st | Model Creation and Mass Properties | Can model a member, apply materials, and investigate mass properties. |
| | | 2nd | Stress Analysis | Able to perform linear stress analysis. |
| | | 3rd | Heat Transfer Analysis | Can calculate the steady-state temperature distribution of a member. |
| | | 4th | Heat Transfer Analysis | Can calculate the transient temperature distribution of a member. |
| | | 5th | Fluid Analysis | Can calculate the velocity and pressure distribution of an external flow fluid. |
| | | 6th | Fluid Analysis | Can calculate the velocity and pressure distribution of an internal flow fluid. |
| | | 7th | Midterm Exam | Practical exam using SolidWorks. |
| | | 8th | Fundamentals of Numerical Calculation | Can perform square root calculations through numerical calculation and explain numerical calculation and errors. |
| | 4th Quarter | 9th | Physical Simulation Based on Ordinary Differential Equations | Can create simulation code for free fall and landing spacecraft using Euler's method. |
| | | 10th | Physical Simulation Based on Ordinary Differential Equations | Can create simulation code for 2D motion based on potential. |
| | | 11th | Simulation Using Cellular Automata | Can create simulation code using 1D cellular automata. |
| | | 12th | Simulation Using Cellular Automata | Can create simulation code for traffic flow and the Game of Life. |
| | | 13th | Stochastic Simulation Using Random Numbers | Can explain pseudo-random numbers and numerical integration.<br>Can create simulation code for the knapsack problem. |
| | | 14th | Stochastic Simulation Using Random Numbers | Can create simulation code for a random walk. |
| | | 15th | Final Exam | |
| | | 16th | | |

## Evaluation Method and Weight (%)

| | Examination | Presentation | Mutual Evaluations between students | Behavior | Portfolio | Other | Total |
|---|---|---|---|---|---|---|---|
| Subtotal | 10 | 0 | 0 | 0 | 90 | 0 | 100 |
| Basic Proficiency | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Specialized Proficiency | 10 | 0 | 0 | 0 | 90 | 0 | 100 |
| Cross Area Proficiency | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

| Anan College | Year | 2024 | Course Title | Advanced Physical Chemistry |
|---|---|---|---|---|

## Course Information

| | | | |
|---|---|---|---|
| Course Code | 5516Z03 | Course Category | Specialized / Compulsory |
| Class Format | Lecture | Credits | Academic Credit: 2 |
| Department | Course of Applied Chemical Engineering | Student Grade | Adv. 1st |
| Term | First Semester | Classes per Week | 前期:2 |
| Textbook and/or Teaching Materials | 平山令明「はじめての量子化学」講談社ブルーバックス / 染川賢一「有機分子の分子軌道計算と活用」九州大学出版会 | | |
| Instructor | Konishi Tomoya | | |

## Course Objectives

1. Explains the concept and principle of molecular orbital method.
2. Uses molecular orbital calculation software.
3. Discusses various properties and reactions of molecules using molecular orbital calculation.

## Rubric

| | Ideal Level | Standard Level | Acceptable Level |
|---|---|---|---|
| Achievement 1 | Explains the calculation method of molecular orbital method. | Discusses the reactivity of molecules by molecular orbital method. | Explains molecular orbitals. |
| Achievement 2 | Calculates charge distribution and electron density by molecular orbital method. | Discusses the reactivity of molecules by molecular orbital method. | Calculates molecular conformation by molecular orbital method. |
| Achievement 3 | Discusses the reactivity of molecules by molecular orbital method. | Discusses the reactivity of molecules by molecular orbital method. | Discusses the stability of molecules by molecular orbital method. |

## Assigned Department Objectives

## Teaching Method

| | |
|---|---|
| Outline | We have so far learned about the various physical properties exhibited by materials and that "physical properties" are determined by the "composition" and "structure" of a material. Why is that? The key is the Schrödinger's equation Hψ=Eψ. In this lecture, through the molecular orbital method, we will understand that the electronic state of a molecule is determined by its "composition" and "structure," and that physical properties can be explained in principle by them. After reviewing the concept of molecular orbital, specific quantum chemical calculation methods (Hartree-Fock method, variational method, and self-consistency method) will be introduced. Next, students will perform actual molecular orbital calculations on several molecules and discuss their conformation, polarity, acidity, color, reactivity, and so on. As a practical application, students will measure the infrared absorption spectra of organic polymers and compare them with the results calculated by the molecular orbital method. |
| Style | Students will learn through lectures and practical training. The laboratory will be conducted in a BYOD style, so bring your own laptop computer and earphones. Hands-on learning will be conducted using molecular structure modeling software and quantum chemical calculation software installed on each student's laptop. The periodic examination will include a practical test on the quantum chemical calculation software. |
| Notice | Students are required to read the sections of the textbook related to the contents of each week's class in advance.<br>Syllabus-designated reference book: 藤永茂「入門分子軌道法」講談社 |

## Characteristics of Class / Division in Learning

| | | | |
|---|---|---|---|
| ☐ Active Learning | ☑ Aided by ICT | ☑ Applicable to Remote Class | ☐ Instructor Professionally Experienced |

## Course Plan

| | | | Theme | Goals |
|---|---|---|---|---|
| 1st Semester | 1st Quarter | 1st | Lecture: The Origin of Atoms | 1. Explains atomic structure and electron configuration. 2. Explains wavefunction and Schrödinger equation. 3. Explains quantum numbers and their constitutive principles. |
| | | 2nd | Lecture: From Atoms to Molecules (1) | 1. Explains molecular orbitals. 2. Explains how to derive molecular orbitals. 3. Derives molecular orbitals of hydrogen molecules. |
| | | 3rd | Exercise: From Atoms to Molecules (2) | 1. Uses quantum chemical calculation software. 2. Calculates molecular orbitals of hydrogen molecules. 3. Displays molecular orbitals of hydrogen molecules. |
| | | 4th | Lecture: What is obtained from molecular orbital method (1) | 1. Explains many-body problems. 2. Explains Hartree equation. 3. Explains variational and self-consistency methods. |
| | | 5th | Exercise: What we can obtain from molecular orbital method (2) | 1. Calculate the conformation of ethane. 2. Calculates molecular orbitals of ethane. 3. Calculates electron density and heat of formation of ethane. |
| | | 6th | Lecture: What is required from Molecular Orbital Method (3) | 1. Explains Slater determinant and Hartree-Fock equation. 2. Explains the LCAO approximation and the Hartree-Fock-Roothaan equation. 3. Explains the difference between non-empirical and semi-empirical molecular orbital methods. |
| | | 7th | Exercise: Knowing the structure of molecules (1) | 1. Explains the Z-matrix. 2. Performs structural optimization calculations and explains the delocalization of pi electrons by structural optimization calculation. 3. Performs conformational analysis of molecules. |

| | | | | |
|---|---|---|---|---|
| | | 8th | Lecture/Exercise: Knowing the Structure of Molecules (2) | 1. Calculates heat of formation of a molecule and discusses its stability 2. Calculates orbital energy of molecules and discusses reactivity. 3. Calculate electrostatic potential of molecules and discusses polarity. |
| | 2nd Quarter | 9th | Lecture/Exercise: Distribution of electrons determines molecular properties (1) | 1. Evaluates differences in acidity of ethanol, phenol, and acetic acid. 2. Calculates intramolecular charge distribution. 3. Discusses interactions between molecules. |
| | | 10th | Lecture/Exercise: Distribution of electrons determines properties of molecules (2) | 1. Explains the effects of solvents. 2. Calculates the change in chemical structure of glycine by solvent. 3. Calculates and explains the function of Grignard reagent. |
| | | 11th | Lecture/Exercise: Color of molecules (1) | 1. Explains electron correlation. 2. Explains the configuration interaction (CI) method. 3. Calculates excited states and electronic spectra of molecules. |
| | | 12th | Exercise: Knowing the color of molecules (2) | 1. Draws and modifies molecules with complex structures. 2. Evaluates changes in molecular structure and their effects on electronic spectra. 3. Predicts changes in indicator color by calculation. |
| | | 13th | Lecture/Exercise: Predicting chemical reactions (1) | 1. Evaluates the stability of carbocations. 2. Evaluate the distribution of frontier orbitals on each atom. 3. Predicts reactivity from the distribution of frontier orbitals. |
| | | 14th | Exercise: Predicting chemical reactions (2) | 1. Calculates infrared spectra and vibrational modes. 2. Performs TS optimization and IRC calculations for SN2 reactions and predicts the direction of the reaction. 3. Evaluates substituent effects in SN2 reactions. |
| | | 15th | Exercise: Predicting chemical reactions (3) | 1. Explains frontier orbital theory and Woodward-Hoffman rule. 2. Explains and calculates stereospecificity of electron cyclic reactions. 3. Explains and calculates the endo rule of the Diels-Alder reaction. |
| | | 16th | [Return of final exam] | |

Evaluation Method and Weight (%)

| | Examination | Portfolio | Total |
|---|---|---|---|
| Subtotal | 70 | 30 | 100 |
| Basic Proficiency | 35 | 15 | 50 |
| Specialized Proficiency | 35 | 15 | 50 |

| Anan College | Year | 2024 | Course Title | Environmental Chemistry |
|---|---|---|---|---|

## Course Information

| | | | |
|---|---|---|---|
| Course Code | 5596101 | Course Category | Specialized / Elective |
| Class Format | Lecture | Credits | : 2 |
| Department | Course of Applied Chemical Engineering | Student Grade | Adv. 1st |
| Term | First Semester | Classes per Week | 前期:2 |
| Textbook and/or Teaching Materials | 環境と化学，萩野ら，東京化学同人 | | |
| Instructor | Ota Naotomo | | |

## Course Objectives

1.Explain air and water pollution and environmental protection technologies.
2. To be able to explain about climate change and preservation of ozone layer from chemical point of view.
3. To be able to explain about energy and waste recycling in relation to chemistry.
4. To be able to explain the generation of useful compounds by green chemistry and environmental problems related to plastics.

## Rubric

| | Ideal Level | Standard Level | minimum Level |
|---|---|---|---|
| Achievement 1 | Explain in detail about air and water pollution and environmental protection technologies without looking at the material. | Explain air and water pollution and environmental protection technologies without looking at the material. | Explain air and water pollution and environmental protection technologies with reference to materials. |
| Achievement 2 | To be able to explain in detail about climate change and ozone layer conservation from a chemical point of view without looking at materials. | To be able to explain about climate change and ozone layer conservation from a chemical point of view without looking at materials. | To be able to explain about climate change and ozone layer conservation from a chemical point of view with reference to materials. |
| Achievement 3 | Explain in detail the relationship between energy and waste recycling and chemistry without looking at materials. | Explain energy and waste recycling in relation to chemistry without looking at materials. | Explain energy and waste recycling in relation to chemistry with reference to materials. |
| Achievement 4 | To be able to explain in detail the generation of useful compounds by green chemistry and environmental issues related to plastics without looking at materials. | To be able to explain the generation of useful compounds by green chemistry and environmental issues related to plastics without looking at materials. | To be able to explain the generation of useful compounds by green chemistry and environmental issues related to plastics with reference to materials. |

## Assigned Department Objectives

## Teaching Method

| | |
|---|---|
| Outline | Based on the philosophy of "green chemistry," which is the basis of environmentally friendly manufacturing in the field of chemistry, students learn the relationship between various environmental problems and chemistry, and the class is taught from the viewpoint of how to build an environmentally friendly and sustainable society. |
| Style | Students will be given a quiz to check their preparation, presentations by students, and reports (30 hours of class time + 60 hours of self-study time). |
| Notice | |

## Characteristics of Class / Division in Learning

| | | | |
|---|---|---|---|
| ☐ Active Learning | ☐ Aided by ICT | ☐ Applicable to Remote Class | ☐ Instructor Professionally Experienced |

## Course Plan

| | | | Theme | Goals |
|---|---|---|---|---|
| 1st Semester | 1st Quarter | 1st | What is Green Chemistry? | Can explain the philosophy of green chemistry |
| | | 2nd | Clean air | To be able to explain the formation of the atmosphere, air pollutants and acid rain |
| | | 3rd | Clean air | Explain air pollution trends and countermeasures |
| | | 4th | Valuable water resources | Explain the properties of water and its importance as a resource |
| | | 5th | Valuable water resources | Can explain about water purification and water environment conservation |
| | | 6th | Chemistry of Climate Change | Can explain global warming chemically |
| | | 7th | Chemistry of Climate Change | Explain the current state of climate change due to human activities and global warming countermeasures |
| | | 8th | Protect the Ozone Layer | Explain the function and destruction of the ozone layer |
| | 2nd Quarter | 9th | Protect the Ozone Layer | Explain the function and destruction of the ozone layer |
| | | 10th | Take care of your energy | Can explain about human society and energy |
| | | 11th | Take care of your energy | Can explain about renewable energy |
| | | 12th | Create useful substances | Explain chemical synthesis and greenness |
| | | 13th | Create useful substances | Explain the role of green chemistry in chemical synthesis |
| | | 14th | Polymer Chemistry | Can explain about bioplastics |

| | | | | |
|---|---|---|---|---|
| | | 15th | Waste Recycling | To be able to explain about recycling and recycling-oriented society |
| | | 16th | | |

Evaluation Method and Weight (%)

| | Examination | quiz | Mutual Evaluations between students | Behavior | Portfolio | Other | Total |
|---|---|---|---|---|---|---|---|
| Subtotal | 0 | 50 | 0 | 0 | 50 | 0 | 100 |
| Basic Proficiency | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Specialized Proficiency | 0 | 50 | 0 | 0 | 50 | 0 | 100 |
| Cross Area Proficiency | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

| Anan College | Year | 2024 | Course Title | Experiments in Applied Chemistry |
|---|---|---|---|---|

## Course Information

| | | | |
|---|---|---|---|
| Course Code | 5517J01 | Course Category | Specialized / Compulsory |
| Class Format | Experiment / Practical training | Credits | Academic Credit: 2 |
| Department | Course of Applied Chemical Engineering | Student Grade | Adv. 2nd |
| Term | First Semester | Classes per Week | 前期:6 |
| Textbook and/or Teaching Materials | Experiment description designated by each instructor / Bibliography assigned by each instructor | | |
| Instructor | Otani Takashi,Sugiyama Yuuki,Ueda Kohei,Ezure Ryosuke | | |

## Course Objectives

1. The students will acquire the basic experimental techniques appropriate to the purpose of the experiment and experiment.
2. The students consider the results of experiments and solve problems from an engineering perspective.

## Rubric

| | Ideal Level | Standard Level | Minimum Level |
|---|---|---|---|
| Objective 1 | Acquire basic experimental techniques for each topic and carry out experiments efficiently by applying their unique innovations. | Acquire basic experimental techniques for each topic and carry out experiments. | Acquire a minimum of basic experimental techniques for each topic and carry out experiments. |
| Objective 2 | Consider the results of experiments from an engineering perspective and solve given not only problems but also problems that they have discovered on their own. | Consider the results of experiments from an engineering perspective, and understand and solve given problems. | Consider the results of the experiment from an engineering point of view and manage to solve the given problem. |

## Assigned Department Objectives

## Teaching Method

| | |
|---|---|
| Outline | The program's objective is to cultivate the ability to think creatively, find and solve practical problems, and promote complex technological development that leads to "monozukuri" (manufacturing). |
| Style | Theme 1: Synthetic Inorganic Material experiment (1-7 weeks)<br>Theme 2: Synthetic organic chemistry experiment (8-15 weeks)<br>[90 hours of class time] |
| Notice | One theme will be conducted over 7-8 weeks. During the experiment, students must pay close attention to safety and follow the instructions of the instructor in charge. |

## Characteristics of Class / Division in Learning

| | | | |
|---|---|---|---|
| ☐ Active Learning | ☑ Aided by ICT | ☐ Applicable to Remote Class | ☐ Instructor Professionally Experienced |

## Course Plan

| | | | Theme | Goals |
|---|---|---|---|---|
| 1st Semester | 1st Quarter | 1st | Theme 1: Synthetic Inorganic Material experiment | (1) Understand how to prepare powder samples by the sol-gel method, and be able to read the experimental section in English and understand the experimental procedure accurately. |
| | | 2nd | Theme 1: Synthetic Inorganic Material experiment | (2) Prepare TiO2 powder by weighing, stirring, and centrifuging. |
| | | 3rd | Theme 1: Synthetic Inorganic Material experiment | (3) Sinter the powder. |
| | | 4th | Theme 1: Synthetic Inorganic Material experiment | (4) Measure the xrd of the powder |
| | | 5th | Theme 1: Synthetic Inorganic Material experiment | (5) FE-SEM observation |
| | | 6th | Theme 1: Synthetic Inorganic Material experiment | (6) FT-IR measurement |
| | | 7th | Theme 1: Synthetic Inorganic Material experiment | (7) Summarize the entire experiment in a report by reflecting on it. |
| | | 8th | Theme 2: Synthetic organic chemistry experiments | (8) Understand the Diels-Alder reaction, read the experimental section in English, and understand the experimental procedure accurately. |
| | 2nd Quarter | 9th | Theme 2: Synthetic organic chemistry experiments | (9) In carrying out the Diels-Alder reaction, cyclopentadiene is distilled. |
| | | 10th | Theme 2: Synthetic organic chemistry experiments | (10) Carry out the Diels-Alder reaction. |
| | | 11th | Theme 2: Synthetic organic chemistry experiments | (11) Purify adducts. |
| | | 12th | Theme 2: Synthetic organic chemistry experiments | (12) Analyze the NMR of the adducts. |
| | | 13th | Theme 2: Synthetic organic chemistry experiments | (13) Determine the steric structure of the adduct. |
| | | 14th | Theme 2: Synthetic organic chemistry experiments | (14) Explain the steric structure and endo rule of adducts using orbital theory. |
| | | 15th | Theme 2: Synthetic organic chemistry experiments | (15) Summarize the entire experiment in a report by reflecting on it. |
| | | 16th | | |

## Evaluation Method and Weight (%)

| | Examination | Quiz | Portfolio | Presentation and Attitude | Other | Total |
|---|---|---|---|---|---|---|
| Subtotal | 0 | 0 | 100 | 0 | 0 | 100 |
| Basic Proficiency | 0 | 0 | 0 | 0 | 0 | 0 |
| Specialized Proficiency | 0 | 0 | 80 | 0 | 0 | 80 |
| Cross Area Proficiency | 0 | 0 | 20 | 0 | 0 | 20 |

| Anan College | Year | 2024 | Course Title | Advanced Physical Chemistry |
|---|---|---|---|---|

## Course Information

| | | | |
|---|---|---|---|
| Course Code | 5517Z03 | Course Category | Specialized / Compulsory |
| Class Format | Lecture | Credits | Academic Credit: 2 |
| Department | Course of Applied Chemical Engineering | Student Grade | Adv. 2nd |
| Term | First Semester | Classes per Week | 前期:2 |
| Textbook and/or Teaching Materials | 平山令明「はじめての量子化学」講談社ブルーバックス / 染川賢一「有機分子の分子軌道計算と活用」九州大学出版会 | | |
| Instructor | Konishi Tomoya | | |

## Course Objectives

1. Explains the concept and principle of molecular orbital method.
2. Uses molecular orbital calculation software.
3. Discusses various properties and reactions of molecules using molecular orbital calculation.

## Rubric

| | Ideal Level | Standard Level | Acceptable Level |
|---|---|---|---|
| Achievement 1 | Explains the calculation method of molecular orbital method. | Discusses the reactivity of molecules by molecular orbital method. | Explains molecular orbitals. |
| Achievement 2 | Calculates charge distribution and electron density by molecular orbital method. | Discusses the reactivity of molecules by molecular orbital method. | Calculates molecular conformation by molecular orbital method. |
| Achievement 3 | Discusses the reactivity of molecules by molecular orbital method. | Discusses the reactivity of molecules by molecular orbital method. | Discusses the stability of molecules by molecular orbital method. |

## Assigned Department Objectives

## Teaching Method

| | |
|---|---|
| Outline | We have so far learned about the various physical properties exhibited by materials and that "physical properties" are determined by the "composition" and "structure" of a material. Why is that? The key is the Schrödinger's equation Hψ=Eψ. In this lecture, through the molecular orbital method, we will understand that the electronic state of a molecule is determined by its "composition" and "structure," and that physical properties can be explained in principle by them. After reviewing the concept of molecular orbital, specific quantum chemical calculation methods (Hartree-Fock method, variational method, and self-consistency method) will be introduced. Next, students will perform actual molecular orbital calculations on several molecules and discuss their conformation, polarity, acidity, color, reactivity, and so on. As a practical application, students will measure the infrared absorption spectra of organic polymers and compare them with the results calculated by the molecular orbital method. |
| Style | Students will learn through lectures and practical training. The laboratory will be conducted in a BYOD style, so bring your own laptop computer and earphones. Hands-on learning will be conducted using molecular structure modeling software and quantum chemical calculation software installed on each student's laptop. The periodic examination will include a practical test on the quantum chemical calculation software. |
| Notice | Students are required to read the sections of the textbook related to the contents of each week's class in advance.<br>Syllabus-designated reference book: 藤永茂「入門分子軌道法」講談社 |

## Characteristics of Class / Division in Learning

| | | | |
|---|---|---|---|
| ☐ Active Learning | ☑ Aided by ICT | ☑ Applicable to Remote Class | ☐ Instructor Professionally Experienced |

## Course Plan

| | | | Theme | Goals |
|---|---|---|---|---|
| 1st Semester | 1st Quarter | 1st | Lecture: The Origin of Atoms | 1. Explains atomic structure and electron configuration. 2. Explains wavefunction and Schrödinger equation. 3. Explains quantum numbers and their constitutive principles. |
| | | 2nd | Lecture: From Atoms to Molecules (1) | 1. Explains molecular orbitals. 2. Explains how to derive molecular orbitals. 3. Derives molecular orbitals of hydrogen molecules. |
| | | 3rd | Exercise: From Atoms to Molecules (2) | 1. Uses quantum chemical calculation software. 2. Calculates molecular orbitals of hydrogen molecules. 3. Displays molecular orbitals of hydrogen molecules. |
| | | 4th | Lecture: What is obtained from molecular orbital method (1) | 1. Explains many-body problems. 2. Explains Hartree equation. 3. Explains variational and self-consistency methods. |
| | | 5th | Exercise: What we can obtain from molecular orbital method (2) | 1. Calculate the conformation of ethane. 2. Calculates molecular orbitals of ethane. 3. Calculates electron density and heat of formation of ethane. |
| | | 6th | Lecture: What is required from Molecular Orbital Method (3) | 1. Explains Slater determinant and Hartree-Fock equation. 2. Explains the LCAO approximation and the Hartree-Fock-Roothaan equation. 3. Explains the difference between non-empirical and semi-empirical molecular orbital methods. |
| | | 7th | Exercise: Knowing the structure of molecules (1) | 1. Explains the Z-matrix. 2. Performs structural optimization calculations and explains the delocalization of pi electrons by structural optimization calculation. 3. Performs conformational analysis of molecules. |

| | | | | |
|---|---|---|---|---|
| | | 8th | Lecture/Exercise: Knowing the Structure of Molecules (2) | 1. Calculates heat of formation of a molecule and discusses its stability 2. Calculates orbital energy of molecules and discusses reactivity. 3. Calculate electrostatic potential of molecules and discusses polarity. |
| | 2nd Quarter | 9th | Lecture/Exercise: Distribution of electrons determines molecular properties (1) | 1. Evaluates differences in acidity of ethanol, phenol, and acetic acid. 2. Calculates intramolecular charge distribution. 3. Discusses interactions between molecules. |
| | | 10th | Lecture/Exercise: Distribution of electrons determines properties of molecules (2) | 1. Explains the effects of solvents. 2. Calculates the change in chemical structure of glycine by solvent. 3. Calculates and explains the function of Grignard reagent. |
| | | 11th | Lecture/Exercise: Color of molecules (1) | 1. Explains electron correlation. 2. Explains the configuration interaction (CI) method. 3. Calculates excited states and electronic spectra of molecules. |
| | | 12th | Exercise: Knowing the color of molecules (2) | 1. Draws and modifies molecules with complex structures. 2. Evaluates changes in molecular structure and their effects on electronic spectra. 3. Predicts changes in indicator color by calculation. |
| | | 13th | Lecture/Exercise: Predicting chemical reactions (1) | 1. Evaluates the stability of carbocations. 2. Evaluate the distribution of frontier orbitals on each atom. 3. Predicts reactivity from the distribution of frontier orbitals. |
| | | 14th | Exercise: Predicting chemical reactions (2) | 1. Calculates infrared spectra and vibrational modes. 2. Performs TS optimization and IRC calculations for SN2 reactions and predicts the direction of the reaction. 3. Evaluates substituent effects in SN2 reactions. |
| | | 15th | Exercise: Predicting chemical reactions (3) | 1. Explains frontier orbital theory and Woodward-Hoffman rule. 2. Explains and calculates stereospecificity of electron cyclic reactions. 3. Explains and calculates the endo rule of the Diels-Alder reaction. |
| | | 16th | [Return of final exam] | |

Evaluation Method and Weight (%)

| | Examination | Portfolio | Total |
|---|---|---|---|
| Subtotal | 70 | 30 | 100 |
| Basic Proficiency | 35 | 15 | 50 |
| Specialized Proficiency | 35 | 15 | 50 |

| Anan College | Year | 2024 | Course Title | Environmental Chemistry |
|---|---|---|---|---|

## Course Information

| | | | |
|---|---|---|---|
| Course Code | 5597101 | Course Category | Specialized / Elective |
| Class Format | Lecture | Credits | Academic Credit: 2 |
| Department | Course of Applied Chemical Engineering | Student Grade | Adv. 2nd |
| Term | First Semester | Classes per Week | 前期:2 |
| Textbook and/or Teaching Materials | 環境と化学，萩野ら，東京化学同人 | | |
| Instructor | Ota Naotomo | | |

## Course Objectives

1.Explain air and water pollution and environmental protection technologies.
2. To be able to explain about climate change and preservation of ozone layer from chemical point of view.
3. To be able to explain about energy and waste recycling in relation to chemistry.
4. To be able to explain the generation of useful compounds by green chemistry and environmental problems related to plastics.

## Rubric

| | Ideal Level | Standard Level | minimum Level |
|---|---|---|---|
| Achievement 1 | Explain in detail about air and water pollution and environmental protection technologies without looking at the material. | Explain air and water pollution and environmental protection technologies without looking at the material. | Explain air and water pollution and environmental protection technologies with reference to materials. |
| Achievement 2 | To be able to explain in detail about climate change and ozone layer conservation from a chemical point of view without looking at materials. | To be able to explain about climate change and ozone layer conservation from a chemical point of view without looking at materials. | To be able to explain about climate change and ozone layer conservation from a chemical point of view with reference to materials. |
| Achievement 3 | Explain in detail the relationship between energy and waste recycling and chemistry without looking at materials. | Explain energy and waste recycling in relation to chemistry without looking at materials. | Explain energy and waste recycling in relation to chemistry with reference to materials. |
| Achievement 4 | To be able to explain in detail the generation of useful compounds by green chemistry and environmental issues related to plastics without looking at materials. | To be able to explain the generation of useful compounds by green chemistry and environmental issues related to plastics without looking at materials. | To be able to explain the generation of useful compounds by green chemistry and environmental issues related to plastics with reference to materials. |

## Assigned Department Objectives

## Teaching Method

| | |
|---|---|
| Outline | Based on the philosophy of "green chemistry," which is the basis of environmentally friendly manufacturing in the field of chemistry, students learn the relationship between various environmental problems and chemistry, and the class is taught from the viewpoint of how to build an environmentally friendly and sustainable society. |
| Style | Students will be given a quiz to check their preparation, presentations by students, and reports (30 hours of class time + 60 hours of self-study time). |
| Notice | |

## Characteristics of Class / Division in Learning

| | | | |
|---|---|---|---|
| ☐ Active Learning | ☐ Aided by ICT | ☐ Applicable to Remote Class | ☐ Instructor Professionally Experienced |

## Course Plan

| | | | Theme | Goals |
|---|---|---|---|---|
| 1st Semester | 1st Quarter | 1st | What is Green Chemistry? | Can explain the philosophy of green chemistry |
| | | 2nd | Clean air | To be able to explain the formation of the atmosphere, air pollutants and acid rain |
| | | 3rd | Clean air | Explain air pollution trends and countermeasures |
| | | 4th | Valuable water resources | Explain the properties of water and its importance as a resource |
| | | 5th | Valuable water resources | Can explain about water purification and water environment conservation |
| | | 6th | Chemistry of Climate Change | Can explain global warming chemically |
| | | 7th | Chemistry of Climate Change | Explain the current state of climate change due to human activities and global warming countermeasures |
| | | 8th | Protect the Ozone Layer | Explain the function and destruction of the ozone layer |
| | 2nd Quarter | 9th | Protect the Ozone Layer | Explain the function and destruction of the ozone layer |
| | | 10th | Take care of your energy | Can explain about human society and energy |
| | | 11th | Take care of your energy | Can explain about renewable energy |
| | | 12th | Create useful substances | Explain chemical synthesis and greenness |
| | | 13th | Create useful substances | Explain the role of green chemistry in chemical synthesis |
| | | 14th | Polymer Chemistry | Can explain about bioplastics |

| | | | | |
|---|---|---|---|---|
| | | 15th | Waste Recycling | To be able to explain about recycling and recycling-oriented society |
| | | 16th | | |

Evaluation Method and Weight (%)

| | Examination | quiz | Mutual Evaluations between students | Behavior | Portfolio | Other | Total |
|---|---|---|---|---|---|---|---|
| Subtotal | 0 | 50 | 0 | 0 | 50 | 0 | 100 |
| Basic Proficiency | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Specialized Proficiency | 0 | 50 | 0 | 0 | 50 | 0 | 100 |
| Cross Area Proficiency | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

| Anan College | Year | 2024 | Course Title | Composite Materials |
|---|---|---|---|---|

## Course Information

| | | | |
|---|---|---|---|
| Course Code | 5597C04 | Course Category | Specialized / Elective |
| Class Format | Lecture | Credits | Academic Credit: 2 |
| Department | Course of Applied Chemical Engineering | Student Grade | Adv. 2nd |
| Term | First Semester | Classes per Week | 前期:2 |
| Textbook and/or Teaching Materials | FRP Basics（KORONA PUBLISHING CO., LTD） | | |
| Instructor | Kadono Takuma | | |

## Course Objectives

1. Able to understand the knowledge and technology related to various composite materials and explain their basics.
2. Able to understand the definition, uses, materials, molding methods, characteristics, and design methods of FRP (fiber reinforced plastics), and explain their basics.
3. Able to understand the knowledge and technology related to high-performance and multi-functional concrete using various reinforcing materials and admixtures, and explain the basics.

## Rubric

| | Ideal Level | Standard Level | Minimum Level |
|---|---|---|---|
| Achievement 1 | Able to understand the knowledge and technology of various composite materials, and explain the basics, pose problems, and make suggestions regarding them. | Able to understand the knowledge and technology of various composite materials and explain the basics about them. | Able to explain the basics of knowledge and technology for various composite materials. |
| Achievement 2 | Able to understand definitions, uses, materials, molding methods, characteristics and design methods related to FRP, and explain the basics, pose problems, and make suggestions regarding them. | Able to understand the definitions, uses, materials, molding methods, characteristics and design methods of FRP, and explain their basics. | Able to explain the basics of FRP definitions, applications, materials, molding methods, properties and design methods. |
| Achievement 3 | Able to understand the knowledge and technology of concrete that can be made high performance and multifunctional with various reinforcing materials and admixtures, and explain the basics, raise problems, and make proposals regarding them. | Able to understand the knowledge and technology of concrete that can be made high performance and multi-functional with various reinforcing materials and admixtures, and explain the basic matters related to them. | Able to explain the basics of knowledge and technology related to concrete, which can be enhanced and multifunctional with various reinforcing materials and admixtures. |

## Assigned Department Objectives

## Teaching Method

| | |
|---|---|
| Outline | The students of this course will can learn various composite materials used as structural materials and functional materials, FRP that is a composite material with a wide range of applications, and concrete that uses various materials to improve performance and increase functionality.<br>The students of this course will will be able to acquire knowledge and skills regarding the materials used, molding methods, properties, design methods, and applications, and improve your technical skills in design, construction, and maintenance that are suitable for society and the environment. |
| Style | 【31 class hours + final exam + 60 self-study hours】 Since this course is a credit course, it is necessary to submit assignments for pre- and post-learning. |
| Notice | This subject is included in Group V of Specialized Fields, which is a requirement for completing the JABBE-accredited Creative Technology System Engineering program. This class is a lecture that uses textbooks, handouts, videos, etc., so please do not miss class. Concrete, the most widely used industrial material in the world, is a classic and cutting-edge composite material. Before participating in these concrete classes, please use the textbooks on construction materials and concrete structures in the construction course and understand the basics in advance. |

## Characteristics of Class / Division in Learning

| | | | |
|---|---|---|---|
| ☐ Active Learning | ☐ Aided by ICT | ☐ Applicable to Remote Class | ☐ Instructor Professionally Experienced |

## Course Plan

| | | | Theme | Goals |
|---|---|---|---|---|
| 1st Semester | 1st Quarter | 1st | Guidance / Various composite materials | Able to understand the objectives, significance, plans, precautions, etc. of the class, and explain them. / Able to describe types of composite materials, materials used, molding methods, properties, design methods, applications, etc. |
| | | 2nd | Various composite materials | Able to describe types of composite materials, materials used, molding methods, properties, design methods, applications, etc. |
| | | 3rd | Various composite materials | Able to describe types of composite materials, materials used, molding methods, properties, design methods, applications, etc. |
| | | 4th | Various composite materials | Able to describe types of composite materials, materials used, molding methods, properties, design methods, applications, etc. |

| | | | | |
|---|---|---|---|---|
| | | 5th | Various composite materials | Able to describe types of composite materials, materials used, molding methods, properties, design methods, applications, etc. |
| | | 6th | FRP | Able to explain the definition of FRP, use, material, molding method, characteristics, design method, etc. |
| | | 7th | FRP | Able to explain the definition of FRP, use, material, molding method, characteristics, design method, etc. |
| | | 8th | FRP | Able to explain the definition of FRP, use, material, molding method, characteristics, design method, etc. |
| | 2nd Quarter | 9th | Midterm exam | |
| | | 10th | Return of exam papers / FRP | Able to explain the definition of FRP, use, material, molding method, characteristics, design method, etc. |
| | | 11th | FRP | Able to explain the definition of FRP, use, material, molding method, characteristics, design method, etc. |
| | | 12th | FRP | Able to explain the definition of FRP, use, material, molding method, characteristics, design method, etc. |
| | | 13th | High Performance Concrete / Multifunctional Concrete | Able to explain the types, characteristics, and uses of various reinforcing materials and admixtures for concrete, and explain the characteristics and applications of high-performance concrete and multifunctional concrete using these. |
| | | 14th | High Performance Concrete / Multifunctional Concrete | Able to explain the types, characteristics, and uses of various reinforcing materials and admixtures for concrete, and explain the characteristics and applications of high-performance concrete and multifunctional concrete using these. |
| | | 15th | High Performance Concrete / Multifunctional Concrete | Able to explain the types, characteristics, and uses of various reinforcing materials and admixtures for concrete, and explain the characteristics and applications of high-performance concrete and multifunctional concrete using these. |
| | | 16th | (Final exam) Return of exam papers | |

Evaluation Method and Weight (%)

| | Examination | Presentation | Mutual Evaluations between students | Behavior | Portfolio | Other | Total |
|---|---|---|---|---|---|---|---|
| Subtotal | 60 | 0 | 0 | 0 | 40 | 0 | 100 |
| Basic Proficiency | 10 | 0 | 0 | 0 | 10 | 0 | 20 |
| Specialized Proficiency | 30 | 0 | 0 | 0 | 20 | 0 | 50 |
| Cross Area Proficiency | 20 | 0 | 0 | 0 | 10 | 0 | 30 |

| Anan College | Year | 2024 | Course Title | Mathematics of Electronics and Information |
|---|---|---|---|---|

## Course Information

| | | | |
|---|---|---|---|
| Course Code | 5597E02 | Course Category | Specialized / Elective |
| Class Format | Lecture | Credits | Academic Credit: 2 |
| Department | Course of Applied Chemical Engineering | Student Grade | Adv. 2nd |
| Term | First Semester | Classes per Week | 前期:2 |
| Textbook and/or Teaching Materials | Enshu to Ouyo Bibunhouteishiki, Saiensu Sha | | |
| Instructor | Sugino Ryuzaburo | | |

## Course Objectives

1. We can understand Furier series and its transformation, and compute of its fundamental computation.
2. We can understand Laplace transformation and operational calsulus, and compute of its fundamental computaion.
3. We can understand the construction method of differental equation , and compute of its fundamental problems.

## Rubric

| | Ideal Level | Standard Level | Unacceptable Level |
|---|---|---|---|
| Achievement 1 | We can understand Fourier series an its tranformations and apply these for the various problems. | We can understand Fourier series an its tranformations and compute these for the fundamental problems. | We can understand Fourier series an its tranformations, and compute of its elementary problems. |
| Achievement 2 | We can understand Laplace transformations and the operation method and apply these for the fundamental problems. | We can understand Laplace transformations and the operation method and compute the fundamental problems. | We can understand understand Laplace transformations and the operation method and compute of its elementary problems. |
| Achievement 3 | We can understand the construction method of differentail equation and apply these for the fundamental problems. | We can understand the construction method of differentail equation and compute the fundamental problems. | We can understand the construction method of differentail equation and compute of its elementary problems. |

## Assigned Department Objectives

## Teaching Method

| | |
|---|---|
| Outline | We are to make a concentration for our class and use the knowledges and techniques about basic mathematics to construction of understanding of Fourier and Laplace transeformation and building up the solutions of ordinary and partial differential equations. |
| Style | Our class is construction of the next three phases.<br>1. Review the important facts from the previous class.<br>2. Lecture about the new section.<br>3. Short exercises. |
| Notice | Please make a good preparation and self-review.<br>You will build up the good style to do homework of the previous class. |

## Characteristics of Class / Division in Learning

| | | | |
|---|---|---|---|
| ☐ Active Learning | ☐ Aided by ICT | ☐ Applicable to Remote Class | ☐ Instructor Professionally Experienced |

## Course Plan

| | | | Theme | Goals |
|---|---|---|---|---|
| 1st Semester | 1st Quarter | 1st | Fourier Series | We can understand Fourier series and compute its fundamental problems. |
| | | 2nd | Fourier Series | We can understand the applications of Fourier series and compute its fundamental problems. |
| | | 3rd | Fourier Series | We can understand complex Fourier series and compute its fundamental problems. |
| | | 4th | Fourier Series | We can understand Fourier transeformation and compute its fundamental problems. |
| | | 5th | Fourier Series | We can understand Fourier intergrals and compute its fundamental problems. |
| | | 6th | Fourier Analysis | We can understand the frequency analysis using Fourier transeformation and compute its fundamental problems. |
| | | 7th | Fourier Analysis | We can understand the Fourier analysis of differential equation and compute its fundamental problems. |
| | | 8th | Mid-term examination | |
| | 2nd Quarter | 9th | Laplace Transeformation | We can understand Laplace transeformation and compute its fundamental problems. |
| | | 10th | Laplace Transeformation | We can understand the applications of Laplace transformation and compute its fundamental problems. |
| | | 11th | Laplace Transeformation | We can understand the basis and dimension of subspace and compute its fundamental problems. |
| | | 12th | Differential Equation and Its Function Space | We can understand the linear mapping of vector space and compute its fundamental problems. |

| | | | | |
|---|---|---|---|---|
| | | 13th | Differential Equation and Its Function Space | We can understand the change of basis and representation matrix and compute its fundamental problems. |
| | | 14th | The Solutions of Partial Differential Equation | We can understand the construction method of partial differentail equation and explain of it. |
| | | 15th | The Solutions of Partial Differential Equation | We can compute the fundamental applicated problems using construction method of partial differential equation's solutions. |
| | | 16th | Final examination | |

Evaluation Method and Weight (%)

| | Examination | Presentation | Mutual Evaluations between students | Behavior | Portfolio | Other | Total |
|---|---|---|---|---|---|---|---|
| Subtotal | 60 | 0 | 0 | 0 | 40 | 0 | 100 |
| Basic Proficiency | 30 | 0 | 0 | 0 | 20 | 0 | 50 |
| Specialized Proficiency | 20 | 0 | 0 | 0 | 10 | 0 | 30 |
| Cross Area Proficiency | 10 | 0 | 0 | 0 | 10 | 0 | 20 |

| Anan College | Year | 2024 | Course Title | Semiconductor Material Properties |
|---|---|---|---|---|

## Course Information

| | | | |
|---|---|---|---|
| Course Code | 5597E04 | Course Category | Specialized / Elective |
| Class Format | Lecture | Credits | Academic Credit: 2 |
| Department | Course of Applied Chemical Engineering | Student Grade | Adv. 2nd |
| Term | Second Semester | Classes per Week | 後期:2 |
| Textbook and/or Teaching Materials | 電子物性　松澤・高橋・斉藤　共著（森北出版） | | |
| Instructor | Hasegawa Tatsuo | | |

## Course Objectives

1．固体のバンド構造について説明できる。
2．半導体中のキャリア密度の温度変化について説明できる。
3．３種類の電気分極の機構について説明できる。
4．磁性の発現機構について説明できる。

## Rubric

| | 理想的な到達レベル(優) | 標準的な到達レベル(良) | 最低限の到達レベル(可) |
|---|---|---|---|
| 到達目標1 | 固体のバンド構造について説明でき、ブロッホの定理を用いてその電子状態を記述することができる。 | 固体のバンド構造を、周期ポテンシャルと関連付けて説明できる。 | 固体のバンド構造に関する考え方を理解することができる。 |
| 到達目標2 | 真性半導体と不純物半導体のキャリア密度の温度変化について、フェルミ分布関数を用いて説明できる。 | 真性半導体と不純物半導体のキャリア密度の温度変化について、定性的な説明をすることができる。 | 半導体中のキャリアに関する考え方を理解することができる。 |
| 到達目標3 | ３種類の電気分極の機構について、定量的な説明をすることができる。 | ３種類の電気分極の機構について、定性的な説明をすることができる。 | 電気分極に関する考え方を理解することができる。 |
| 到達目標4 | 原子の磁気モーメントや伝導電子を考慮して、磁性の発現機構について定量的に説明できる。 | 磁性の発現機構について、定性的な説明をすることができる。 | 磁性に関する考え方を理解することができる。 |

## Assigned Department Objectives

## Teaching Method

| | |
|---|---|
| Outline | 身の回りの様々な物質、また製造業で使われる材料が示す物理的・化学的な諸物性のほとんどは、物質中の電子の振る舞いに起因したものである。本講義は量子力学を出発点として、最も基本的な性質について述べていき、将来のより発展した学修のための基礎を身に着けることを目的としている。なお、この科目は企業で半導体の要素技術の開発を担当していた教員が、その経験を活かし、様々な物質の特性について講義形式で授業を行うものである。 |
| Style | 講義形式で授業を行っていく。内容としては、先ず量子力学の基礎的な事柄を学んだ後、エネルギーバンド構造と半導体を学び、その後誘電体、磁性体へと進んでいく。この科目は学修単位科目のため、事前事後学習としてレポート等を実施します<br>【授業時間３０時間＋自学自習時間６０時間】 |
| Notice | 本講義を履修するためには、微分方程式や線形代数に関する知識が不可欠です。また、内容が多いため、講義中に演習問題を解く時間が無く、演習は課題として提出してもらいます。内容の理解のために、課題は他の多くの書物を参照して、自分で解決してください。 |

## Characteristics of Class / Division in Learning

| | | | |
|---|---|---|---|
| ☐ Active Learning | ☐ Aided by ICT | ☐ Applicable to Remote Class | ☐ Instructor Professionally Experienced |

## Course Plan

| | | | Theme | Goals |
|---|---|---|---|---|
| 2nd Semester | 3rd Quarter | 1st | 物質の粒子性と波動性、不確定性原理 | 物質の粒子性と波動性、及び不確定性原理について説明できる。 |
| | | 2nd | 井戸型ポテンシャルの波動関数 | １次元井戸型ポテンシャルにおけるシュレーディンガー方程式の解を求めることができる。 |
| | | 3rd | トンネル効果 | １次元系において、矩形のポテンシャル障壁におけるトンネル確率を求めることができる。 |
| | | 4th | 水素原子のエネルギー準位 | クーロンポテンシャルにおけるシュレーディンガー方程式の解が、３つの量子数で表されることを理解できる。 |
| | | 5th | 金属の自由電子論 | 変数分離法により、３次元系の自由電子の波動関数、及び状態密度を求めることができる。 |
| | | 6th | フェルミ・ディラック分布関数 | フェルミ・ディラック分布関数について説明できる。 |
| | | 7th | 金属の電子密度分布とフェルミレベル | 電子密度とフェルミレベル、フェルミ波数、フェルミ温度との関係を導くことができる。 |
| | | 8th | 中間試験 | |
| | 4th Quarter | 9th | 周期ポテンシャルにおけるエネルギー分散 | クローニッヒ・ペニーのモデルにおけるエネルギー分散の様子について理解できる。 |
| | | 10th | 結晶内における電子の運動とバンド理論 | 効質量、及びバンド理論の考え方について理解できる。 |
| | | 11th | 真性半導体 | 電子密度・正孔密度の温度依存性を導出できる。 |
| | | 12th | 不純物半導体 | n型・p型半導体の特徴について説明できる。 |
| | | 13th | 誘電体 | 電子分極、イオン分極、配向分極について理解できる。 |

| | | | | |
|---|---|---|---|---|
| | | 14th | 原子の磁気モーメント | 軌道磁気モーメントとスピン磁気モーメントについて説明できる。 |
| | | 15th | 磁性体の分類 | 常磁性、反磁性、強磁性、反強磁性の特徴について理解できる。 |
| | | 16th | 期末試験返却 | |

Evaluation Method and Weight (%)

| | 定期試験 | 小テスト | ポートフォリオ | 発表・取り組み姿勢 | その他 | Total |
|---|---|---|---|---|---|---|
| Subtotal | 60 | 0 | 40 | 0 | 0 | 100 |
| 基礎的能力 | 20 | 0 | 10 | 0 | 0 | 30 |
| 専門的能力 | 40 | 0 | 30 | 0 | 0 | 70 |
| 分野横断的能力 | 0 | 0 | 0 | 0 | 0 | 0 |

| Anan College | Year | 2024 | Course Title | Signal Processing Engineering |
|---|---|---|---|---|

## Course Information

| | | | |
|---|---|---|---|
| Course Code | 5597I03 | Course Category | Specialized / Elective |
| Class Format | Lecture | Credits | Academic Credit: 2 |
| Department | Course of Applied Chemical Engineering | Student Grade | Adv. 2nd |
| Term | First Semester | Classes per Week | 前期:2 |
| Textbook and/or Teaching Materials | 信号処理入門（オーム社） | | |
| Instructor | Yasuno Emiko | | |

## Course Objectives

1．アナログ信号とディジタル信号について、基本的事項を理解し、説明できる。
2．相関関数の定義を理解し、簡単な計算ができる。
3．フーリエ級数展開の基本事項を理解し、基本的な関数のフーリエ級数展開ができる。
4．フーリエ変換の定義を理解し、説明できる。

## Rubric

| | 理想的な到達レベルの目安 | 標準的な到達レベルの目安 | 最低限の到達レベルの目安(可) |
|---|---|---|---|
| 到達目標1 | アナログ信号とディジタル信号について説明でき、実際の問題に適用できる。 | アナログ信号とディジタル信号について、説明できる。 | アナログ信号とディジタル信号について、基本的事項を理解し、説明できる。 |
| 到達目標2 | 相関関数の定義を理解し、簡単な計算ができ、課題解決に応用できる。 | 相関関数の定義を理解し、計算ができる。 | 相関関数の定義を理解し、簡単な計算ができる。 |
| 到達目標3 | フーリエ級数展開を理解し、フーリエ級数展開ができる。 | フーリエ級数展開の理解し、基本的な関数のフーリエ級数展開ができる。 | フーリエ級数展開の基本事項を理解し、基本的な関数のフーリエ級数展開ができる。 |
| 到達目標4 | フーリエ変換の定義を理解し、課題解決に応用できる。 | フーリエ変換の定義を理解し、説明できる。 | フーリエ変換の定義を説明できる。 |

## Assigned Department Objectives

## Teaching Method

| | |
|---|---|
| Outline | 自然現象には不規則に変動するものがきわめて多い。本講義では、そこに埋もれている信号の性質を解析したり、抽出処理するための基礎的信号処理技法を修得することを目標とする。 |
| Style | 授業は講義形式で行います。授業を受ける際には、予習と復習をしたうえで授業に臨むと理解が深まります。<br>【授業時間31時間＋自学自習時間60時間】<br>この科目は学修単位科目のため、事前・事後学修としてレポート等を実施します。 |
| Notice | 単に講義を受講するだけでなく、レポート等の演習にも積極的に取り組んでください。 |

## Characteristics of Class / Division in Learning

| | | | |
|---|---|---|---|
| □ Active Learning | □ Aided by ICT | □ Applicable to Remote Class | □ Instructor Professionally Experienced |

## Course Plan

| | | | Theme | Goals |
|---|---|---|---|---|
| 1st Semester | 1st Quarter | 1st | 信号処理とは<br>・信号の種類<br>・アナログ信号とディジタル信号<br>・サンプリング問題 | アナログ信号とディジタル信号について説明できる。 |
| | | 2nd | 信号処理の例<br>・波形の平滑化<br>・雑音の圧縮 | 波形の平滑化、雑音の圧縮について説明できる。 |
| | | 3rd | 数学の準備体操<br>・信号の表現 | 正規直交基について正しく理解し、計算によって値を求めることができる。 |
| | | 4th | ・多次元ベクトル空間から関数空間へ | 多次元ベクトル空間から関数空間への拡張について理解できる。 |
| | | 5th | ・正規直交関数系 | 正規直交関数形について正しく理解し、計算によって値を求めることができる。 |
| | | 6th | 相関関数<br>・正規直交関数系関数の類似性<br>・相互相関関数 | 相互相関関数について正しく理解し、計算によって値を求めることができる。 |
| | | 7th | ・自己相関関数 | 自己相関関数について正しく理解し、計算によって値を求めることができる。 |
| | | 8th | 演習 | 演習問題を解くことができる。 |
| | 2nd Quarter | 9th | 中間試験 | |
| | | 10th | フーリエ級数展開<br>・フーリエ級数展開とは | フーリエ級数展開について理解し、与えられた式を展開することができる。 |
| | | 11th | ・偶関数と奇関数<br>・周期が２πでない場合 | 偶関数と奇関数について説明できる。 |
| | | 12th | ・複素フーリエ級数展開を導く | 複素フーリエ級数展開を導くことができる。 |
| | | 13th | ・フーリエ級数展開の実例<br>・パーシバルの定理 | フーリエ級数展開の実例について理解し、説明と計算ができる。 |
| | | 14th | ・フーリエ級数展開の重要な性質 | フーリエ級数展開の重要な性質について理解し、説明できる。 |

| | | | | |
|---|---|---|---|---|
| | | 15th | フーリエ変換<br>・フーリエ級数展開からフーリエ変換へ<br>・フーリエ変換の性質 | フーリエ変換の性質について理解し、説明できる。 |
| | | 16th | 答案返却 | |

Evaluation Method and Weight (%)

| | 定期試験 | 小テスト | ポートフォリオ | 発表・取り組み姿勢 | その他 | Total |
|---|---|---|---|---|---|---|
| Subtotal | 70 | 0 | 30 | 0 | 0 | 100 |
| 基礎的能力 | 30 | 0 | 15 | 0 | 0 | 45 |
| 専門的能力 | 40 | 0 | 15 | 0 | 0 | 55 |
| 分野横断的能力 | 0 | 0 | 0 | 0 | 0 | 0 |

| Anan College | Year | 2024 | Course Title | Strength and Fracture of Materials |
|---|---|---|---|---|

## Course Information

| | | | |
|---|---|---|---|
| Course Code | 5597M02 | Course Category | Specialized / Elective |
| Class Format | Lecture | Credits | Academic Credit: 2 |
| Department | Course of Applied Chemical Engineering | Student Grade | Adv. 2nd |
| Term | First Semester | Classes per Week | 前期:2 |
| Textbook and/or Teaching Materials | 金属の強度と破壊　ＰＯＤ版（森北出版）/百万人の金属学（アグネ技術センター）、材料の科学と工学１～４（培風館） | | |
| Instructor | Okumoto Yoshihiro | | |

## Course Objectives

１．弾性変形と塑性変形が区別でき、説明できる。
２．金属の理論的強度について概算できる。
３．金属の破壊現象について説明できる。

## Rubric

| | 理想的な到達レベルの目安 | 標準的な到達レベルの目安 | 最低限の到達レベルの目安(可) |
|---|---|---|---|
| 到達目標1 | 弾性変形と塑性変形が区別でき、図表等を作成し説明でる。 | 弾性変形と塑性変形が区別でき、口頭で説明できる。 | 弾性変形と塑性変形が区別できる。 |
| 到達目標2 | 金属の理論的強度を考える際のモデリングが理解でき、概算できる。 | 金属の理論的強度を考える際のモデリングが理解でき、口頭で説明できる。 | 金属の理論的強度を考える際のモデリングが理解できい。 |
| 到達目標3 | 金属の破壊現象について、具体例を与えられたときに解析できる。 | 金属の破壊現象について、理解した上で、分類・説明できる。 | 金属の破壊現象について理解できない。 |

## Assigned Department Objectives

## Teaching Method

| | |
|---|---|
| Outline | 本講義では材料の強さに着目し、原子レベルでのミクロな視点から材料の破壊現象を読み取る力を養成する。なお、本講義で対象とする材料は金属に限定する。 |
| Style | 教科書にしたがって講義を進めていきます。必要な計算問題等については追加します。講義でやりきれなかった内容についてはmanabaを使って伝達します。<br>【授業時間30時間＋自学自習時間60時間】 |
| Notice | 化学、材料工学を今まで学んできて、材料学と物質の強さとの結びつきについてまとめて考える機会がなかったかもしれない。材料の微視的構造を考慮に入れて材料の破壊の原理について学ぶことは必ずや物質の強度を理解する際に役立つと思われる。なお、基本的な力学的項目は本科で学んでいるものとして進めていく。 |

## Characteristics of Class / Division in Learning

| | | | |
|---|---|---|---|
| ☑ Active Learning | ☐ Aided by ICT | ☑ Applicable to Remote Class | ☐ Instructor Professionally Experienced |

## Course Plan

| | | | Theme | Goals |
|---|---|---|---|---|
| 1st Semester | 1st Quarter | 1st | 0.講義ガイダンス | 金属についてこれまで学んできたことを整理できる。 |
| | | 2nd | １.]原子結合から見た弾性変形 | 弾性変形の微視的モデルを理解できる。 |
| | | 3rd | 2.破壊力学概説　理論的引張り強さ | 理論的引張り強さの導出過程を理解できる。 |
| | | 4th | 2.破壊力学概説　破壊靭性（１） | 破壊靭性の概念を理解できる。 |
| | | 5th | 2.破壊力学概説　破壊靭性（２） | 破壊靭性の概念を理解できる。 |
| | | 6th | 2.破壊力学概説　破壊靭性（３） | 破壊靭性の測定方法が理解できる。 |
| | | 7th | 3.疲労破壊 | BCC金属における疲労破壊現象が理解できる。 |
| | | 8th | 中間試験 | 60点以上 |
| | 2nd Quarter | 9th | 4.金属の塑性変形　理論的せん断強さ | 理論的せん断強さの導出過程を理解できる。 |
| | | 10th | 4.金属の塑性変形　転位論の導入 | 転位の存在が理解できる。 |
| | | 11th | 5.塑性変形における温度の影響（１） | 活性化エネルギーの概念が理解できる。 |
| | | 12th | 5.塑性変形における温度の影響（２） | クリープ寿命が計算できる。 |
| | | 13th | 6.固体内の拡散 | 拡散の法則に基づく計算ができる。 |
| | | 14th | 7.金属の強化メカニズム（１） | 加工硬化と固溶強化が理解できる。 |
| | | 15th | 7.金属の強化メカニズム（２） | マルテンサイト変態強化が理解できる。 |
| | | 16th | 期末試験の返却 | – |

## Evaluation Method and Weight (%)

| | 定期試験 | 小テスト | ポートフォリオ | 発表・取り組み姿勢 | その他 | Total |
|---|---|---|---|---|---|---|
| Subtotal | 70 | 20 | 10 | 0 | 0 | 100 |
| 基礎的能力 | 0 | 0 | 0 | 0 | 0 | 0 |
| 専門的能力 | 70 | 20 | 10 | 0 | 0 | 100 |
| 分野横断的能力 | 0 | 0 | 0 | 0 | 0 | 0 |