Computer Literacy and Programming (2.0credits) (コンピュータ・リテラシー及びプログラミング)

Course Type	Basic Specialized Courses	
Class Format	Lecture	
Course Name	Department of Materials Science and Engineering	
Starts 1	1 Spring Semester	
Elective/Compulsory	Compulsory	
Lecturer	Yuhki TSUKADA Associate Professor	MATSUOKA Tatsurou Associate Professor

●Course Purpose

This course deals with basic knowledge about Python programming. It also enhances students' skill in Python programming for scientific computation.

By the end of the course, students should be able to do the following:
(1) Obtain basic knowledge about Python programming,
(2) Debug and run a program,
(3) Develop a program code for a scientific computation.

●Prerequisite Subjects

●Course Topics

1. Style guide for Python code
2. Data types
3. Flow control
4. Functions
5. Libraries
6. List and array
7. Data visualization
8. Data input/data output

●Textbook

●Additional Reading

●Grade Assessment

Reports: 50%
Term-end examination: 50%

●Notes

●Contacting Faculty

Crystal Physics (2.0credits) (結晶物理学)

Course Type	Basic Specialized Courses
Class Format	Lecture
Course Name	Department of Materials Science and Engineering
Starts 1	1 Autumn Semester
Elective/Compulsory	Compulsory
Lecturer	Takahisa YAMAMOTO Professor

●Course Purpose

Various materials have been devised so that the functions such as electrical, magnetic, mechanical strength characteristics and so on can be adapted to the application. It is a well-known fact that the bonding state (electronic state) between atoms or ions constituting the material is closely related to the appearance of the function of the material. In order to understand such bonding state, we must understand how atoms and ions are arranged. And this understanding becomes basic knowledge to know the function of the material.Many of the materials consist of a structure in which atoms and ions are correctly arranged under a certain rule. This structure is called a crystal structure, and the academic field which classifies and understands it is called crystallography. Crystallography is essential knowledge for understanding the functional characteristics of materials and it becomes basic knowledge necessary for many lectures to be learned from now. In this lecture, from the fundamentals corresponding to the foundation of crystallography, the formation of crystal structure, the concept of Brabais lattice, Miller indices for crystal lattice planes, orientation axes, stereographic projection method, the concept of reciprocal lattice, the fundamentals of diffraction phenomena necessary to analyze crystal structure and X-rays diffraction and so on. In addition, I will touch on the concept of incomplete crystal structure. Also, consideration is given so that important keywords in various lectures related to materials to be learned in the future can be reviewed in this lecture.

●Prerequisite Subjects

Infinitesimal calculus I, Liner algebra I, Basic Chemistry I

●Course Topics

This lecture will be given in Japanese

●Textbook

●Additional Reading

●Grade Assessment

examination and reports The qualifying marks is 70%

●Notes

●Contacting Faculty

As required Takahisa Yamamoto, Bldg. Eng.5 Room313, Tel:789-3348e-mail:yamamoto.takahisa@material.nagoya-u.ac.jp

Physical Chemistry 1 (2.0credits) (物理化学1)

Course Type	Basic Specialized Courses	
Class Format	Lecture	
Course Name	Department of Materials Science and Engineering	
Starts 1	1 Autumn Semester	
Elective/Compulsory	Compulsory	
Lecturer	Toshiyuki KOYAMA Professor	Tetsuya Yamamoto Associate Professor

●Course Purpose

Objective of the present subject is to construct the fundamental basis of materials science and engineering through the exercise on the standpoint of physical chemistry. The key subjects are the properties of gases and the three laws of thermodynamics in the textbook "Atkins' Physical Chemistry".

●Prerequisite Subjects

Basic chemistry 1, Basic chemistry 2

●Course Topics

1. Exercise of basic chemistry 1
2. The perfect gas
3. Real gases
4. Internal energy and work
5. Enthalpy
6. State functions and exact differentials
7. Entropy
8. The Carnot cycle
9. Entropy changes accompanying specfic process
10. The third law
11. The Helmholtz and Gibbs energy
12. Combining the first and second laws
13. Thermodynamic relations
14. The fugacity
15. Mathematical bases of thermidynamics

Read the relevant textbook before each class. After the lecture, solve the textbook exercises and chapter end problems by yourself.

●Textbook

Atkins' Physical Chemistry(10th Revised edition), Oxford University Press.
Student Solutions Manual to Accompany Atkins' Physical Chemistry TENTH EDITION, Oxford University Press

●Additional Reading

We will introduce them appropriately as the lecture progresses.

●Grade Assessment

Final examination, you have to get the score above 60 pct.

●Notes

No registration requirements are required.
Implementation policy with respect to Corona virus infection: Please refer to the NUCT for the details of this course.

●Contacting Faculty

By e-mail
Tetsuya Yamamoto: yamamoto.tetsuya@material.nagoya-u.ac.jp

Chemical Processes Engineering (2.0credits) (化学プロセス工学)

Course Type	Basic Specialized Courses
Class Format	Lecture
Course Name	Department of Materials Science and Engineering
Starts 1	1 Autumn Semester
Elective/Compulsory	Compulsory
Lecturer	Yoshihiro KOJIMA Associate Professor

●Course Purpose

An outline of history of chemical industry and role of chemical engineering in the industry will be lectured and students will learn quantitative handling of chemical process units. Through exercises on the units, skill of solving chemical engineering problems will be enhanced.

●Prerequisite Subjects

Fundamentals of Chemistry II, Physical Chemistry 1

●Course Topics

1Introduction (History of chemical industry)
2Unit and dimension
3 Process variables
4 Material balance
5 Heat balance
6 Phase equilibrium
7 Chemical equilibrium
8 Unit operation

Assignments will be given and your reports will be collected in the next class.

●Textbook

Appropriate handouts will be given in the class.

●Additional Reading

Elementary principles of chemical processes, R. Felder and R. Rousseau, Wiley(2000)
Kagaku Kougaku Binran (Maruzen Co.Ltd.)

●Grade Assessment

Examinations (midterm exam(40%), final exam(40%)) and papers(20%): More than 60 scores on the basis of 100 are acceptable.

●Notes

No registration requirements are required.

●Contacting Faculty

Questions are better to ask after the class.

Mechanics of Materials (2.0credits) (材料力学)

Course Type	Basic Specialized Courses
Class Format	Lecture
Course Name	Department of Materials Science and Engineering
Starts 1	2 Spring Semester
Elective/Compulsory	Compulsory
Lecturer	Makoto KOBASHI Professor

●Course Purpose

This course aims to introduce the fundamental concepts of mechanics of deformablesolids to students, with an emphasis on mechanical design. Understanding the specialfeature of the strength of materials of obtaining an approximate solution by easycalculation leads to the knowledge acquirement used as the basic of a design of machineparts or structures. A good knowledge in Mechanics of Materials not only enables the engineer to design reliable components economically, but it will also enable theengineer to assess whether an existing design of a component is reasonable or not.

●Prerequisite Subjects

Obtaining credit in "mathematics" is preferred.

●Course Topics

1. Uniaxal stress condition
Stresses and strains
Safety factor
Rahmen
Temperature effects and thermal stress

2. Combined stresses and plane stress conditions
Hooke's law

3. Torsion
Torsion of circular bars
Torsion of thin-walled bars

4. Bending of beams
Shear force and bending moment diagrams
Deflection of beams

5. Energy principles
Strain energy
Castigliano’s theorems

6. Stability and buckling

●Textbook

Kougaku-kiso Zairyo-rikigaku; Masaichiro Seike

●Additional Reading

The printed handouts of the PPT slides will be distributed.

●Grade Assessment

Written examination and home work reports

●Notes

●Contacting Faculty

e-mail: kobashi.makoto[at]material.nagoya-u.ac.jp

Materials Quantum Engineering (2.0credits) (マテリアル量子工学)

Course Type	Basic Specialized Courses
Class Format	Lecture
Course Name	Department of Materials Science and Engineering
Starts 1	2 Spring Semester
Elective/Compulsory	Compulsory
Lecturer	MihoTAGAWA Associate Professor

●Course Purpose

Quantum mechanics is a physical science dealing with the behaviour of matter and energy on the scale of atoms and subatomic particles.This course deals with the basis of quantum mechanics: history, basic concept, theoretical backgrounds and analytical approaches.

By the end of the course, students should be able to solve problems related to the following:
Wave–particle duality
OperatorEigenvalueEigenfunction
Schrödinger equation
Expectation of physical quantities
Uncertainty principle
One-dimensional well type potential deep endlessly
Angular momentum
Electronic state of hydrogen atom
Electronic states of multi-electron atoms
Harmonic oscillator

●Prerequisite Subjects

●Course Topics

●Textbook

●Additional Reading

●Grade Assessment

●Notes

●Contacting Faculty

Materials Solid State Physics (2.0credits) (マテリアル固体物理1)

Course Type	Basic Specialized Courses	
Class Format	Lecture	
Course Name	Department of Materials Science and Engineering	
Starts 1	2 Spring Semester	
Elective/Compulsory	Compulsory	
Lecturer	Takahiro ITOH Associate Professor	Yasuyoshi KUROKAWA Associate Professor

●Course Purpose

To develop new materials supporting modern science technology, understanding of microscopic properties of electrons and/or spins in solid is essentially important. In this lecture, we study variety of the crystal binding which is related to the electronic properties of materials. Furthermore, we study about crystal vibrations and phonons with introduction of statistical mechanics which are related to the thermodynamic and optical properties of materials.

In this class, the goal is for the students to obtain the following knowledge and skills at the end of the class.

1. Understand and explain the types and characteristics of atomic and ionic bonds.
2. Understand and explain fermions and bosons.
3. Understand and explain Fermi-Dirac statistics and Bose-Einstein statistics, which are the basis of statistical mechanics.
4. Understand and explain the basics of the free electron model.
5. Understand and explain lattice vibrations (phonons).

●Prerequisite Subjects

Crystal Physics, Calculus I, II, Linear Algebra I, II, Basic Chemistry I, II

●Course Topics

1. Crystal Binding
 1-1. Covalent crystals
 1-2. Ionic crystals
 1-3. Metals
 1-4. Crystals of inert gases
 1-5. Hydrogen bonds
2. Introduction of Statistical Mechanics
 2-1. Fermion and Boson
 2-2. Grand canonical ensemble
 2-3. Fermi-Dirac statistics
 2-4. Bose-Einstein statistics
3. Free Electron Model
 3-1. Density of states
 3-2. Electron Energy Distribution Function
 3-3. Electron density in metal
4. Crystal Vibrations: Phonons
 4-1. Vibrations of crystals with monatomic basis
 4-2. Two atoms per primitive basis
 4-3. Acoustical mode and optical mode
 4-4. Three-dimensional lattice
 4-5. Phonons: Quantization of crystal vibrations

* Before every class, read the specified textbook "Elementary Solid State Physics (in Japanese)".
* The quizzes at the end of the class are related to the regular exam, so review them.

●Textbook

Elementary Solid State Physics (Kodansha)[in Japanese] Chapter 5-7 & 9

●Additional Reading

Introduction to Solid State Physics (WILEY, Charles Kittel)

●Grade Assessment

Your overall grade in the class will be decided based on the following:
- Quiz at the end of every class: 20%
- Term-middle and term-end examination: 80%

Based on the sum of these, a grade of C or higher is considered a pass.

It is considered a pass if the basic questions can be handled correctly for the following contents. If you can handle more difficult questions, your grades will be reflected accordingly.

1. Types and characteristics of bonding of atoms and ions
2. Fermion and Boson
3. Fermi-Dirac and Bose-Einstein statistics as the basis of statistical mechanics
4. Basics of the free electron model
5. Lattice vibration (phonon)

●Notes

Ideally, students should be taking / taken Crystal Physics, Calculus I, II, Linear Algebra I, II, Basic Chemistry I, II, but it is possible to take this course without it.

●Contacting Faculty

at end of lecture or e-mail

ito.takahiro@material.nagoya-u.ac.jp
kurokawa.yasuyoshi@material.nagoya-u.ac.jp

Mathematics I and Tutorial (2.5credits) (数学1及び演習)

Course Type	Basic Specialized Courses	
Class Format	Lecture and Exercise	
Course Name	Department of Materials Science and Engineering	
Starts 1	2 Spring Semester	
Elective/Compulsory	Compulsory	
Lecturer	Noriyuki KOBAYASHI Associate Professor	Yasuhito MUKAI Associate Professor

●Course Purpose

This course deals with the basic concepts and principles of elementary differential equations and vector analysis for the application to engineering. In order to solve many problems in engineering, vector analysis such as coordinate transformation, vector field, line integral is required. In addition, in order to deal quantitatively the half-life of radioactive substances, vibration, electric circuit, and atomic diffusion, it is necessary to master the differential equation. Therefore, in this class, we aim to learn vector analysis and ordinary differential equations and learn to use those knowledge for solving practical engineering problems through exercises.

●Prerequisite Subjects

Differential and integral calculus I, II
Linear algebra I, II
Mechanics I, II
Electromagnetism I

●Course Topics

1. Vector analysis
(a) Vector algebra
(b) Curves and Plane curves
(c) Differential invariant
(d) Integral theorems
(e) Tensor algebra introduction

2. Ordinary differential equations
(a) First order differential equation
(b) Second order differential equation
(c) Power series solution
(d) Higher order differential equation, First order simultaneous differential equation
(e) Bessel's differential equation, Bessel's function

●Textbook

●Additional Reading

Introduced if necessary.

●Grade Assessment

Your overall grade in the class will be decided based on the following:
- Class attendance and short reports in class: 20%
- Mid-term examination: 40%
- Term-end examination: 40%

●Notes

No registration requirements required.
If you have questions in a remote lecture, use the function "Message" of NUCT.

●Contacting Faculty

Questions will be accepted in a lecture room after each lecture or by e-mail.
kobayashi.noriyuki@material.nagoya-u.ac.jp
mukai.yasuhito@material.nagoya-u.ac.jp

Design and Drawing (2.0credits) (設計製図)

Course Type	Basic Specialized Courses		
Class Format	Lecture		
Course Name	Department of Materials Science and Engineering		
Starts 1	2 Spring Semester		
Elective/Compulsory	Compulsory		
Lecturer	Nobuki YUKAWA Associate Professor	"Takashi ITOH" Associate Professor	Eiji ABE Assistant Professor

●Course Purpose

In this class, a lecture that includes simple mechanical drafting training, basic concepts of mechanical design, CAD (computer-aided design), and practice using a personal computer are given.
Tours of machine workshop are also conducted to develop basic knowledge in design.

●Prerequisite Subjects

Mechanics of material

●Course Topics

1, Guidance and intruduction
2. Basic computer operations(Computer exercise)
3. Basics of drafting, freehand drawings
4. Bolt drawing(Computer exercise)
5. Tolerance, Fit (Lecture)
6. Design of shaft coupling (Lecture)
7. Design of shaft coupling (Computer exercise)
8. Assignment review

●Textbook

Mechanical Drawing 3rd ed.Jikkyo Shuppan)

●Additional Reading

Reference materials will be distributed through NUCT

●Grade Assessment

Reports and the final exam.

●Notes

●Contacting Faculty

Eiji Abe (Department of Mechanical Engineering, Research Center for Materials Backcasting Technology)
5 Bld. room 203, Tel: 052-789-3572, abe.eiji@material.nagoya-u.ac.jp

Physical Chemistry 2 (2.0credits) (物理化学2)

Course Type	Basic Specialized Courses
Class Format	Lecture
Course Name	Department of Materials Science and Engineering
Starts 1	2 Spring Semester
Elective/Compulsory	Compulsory
Lecturer	Hiroaki MATSUMIYA Associate Professor

●Course Purpose

Lectures are given mainly on Physical Chemistry, which is the essential knowledge to materials science and engineering, to afford students a better understanding of chemical thermodynamics.

Performance targets:
(1) The essential knowledge such as the phase rule, the phase diagrams, the chemical potentials, free energies, and so on can be understood and explained.
(2) The above-mentioned essential knowledge can be utilized to understand physical phenomena and chemical reactions in which materials are involved from physicochemical viewpoints.

●Prerequisite Subjects

Fundamentals of Chemistry II, Physical Chemistry 1

●Course Topics

1. Physical transformations of pure substances
 Phase diagrams of pure substances / Thermodynamic aspects of phase transitions
2. Simple mixtures
 Thermodynamic description of mixtures / Properties of solutions / Activites / Gas-liquid and liquid-liquid phase diagrams
3. Chemical equilibrium
 Equilibrium constant / Response of equilibria to the conditions / Electrochemical cells / Electrode potentials

●Textbook

P. Atkins and J. de Paula, Atkins' Physical Chemistry, 10th edition, Oxford University Press.

●Additional Reading

Specified as needed during the class

●Grade Assessment

Both of report and examination are evaluated for the grade judgement. To pass, students must earn at least 60 points out of 100.

Criteria:
(1) The essential knowledge such as the phase rule, the phase diagrams, the chemical potentials, free energies, and so on can be understood and explained.
(2) The above-mentioned essential knowledge can be utilized to understand physical phenomena and chemical reactions in which materials are involved from physicochemical viewpoints.

●Notes

●Contacting Faculty

During the class, the teacher's office during work hour or e-mail

matsumiya.hiroaki@material.nagoya-u.ac.jp

Introduction to Instrumental Analysis (2.0credits) (機器分析概論)

Course Type	Basic Specialized Courses		
Class Format	Lecture		
Course Name	Department of Materials Science and Engineering		
Starts 1	2 Spring Semester		
Elective/Compulsory	Compulsory		
Lecturer	Hiroaki MATSUMIYA Associate Professor	Takahisa YAMAMOTO Professor	Takahiro ITOH Associate Professor
	Shinichiro FUSE Professor	MihoTAGAWA Associate Professor	

●Course Purpose

This course provides a clear introduction to the principles and practices underpinning modern instrumental analysis. Through the course, students will develop an understanding of the fundamentals of instrumental analysis and various applications of cutting-edge techniques in materials science and engineering.

●Prerequisite Subjects

●Course Topics

●Textbook

●Additional Reading

●Grade Assessment

●Notes

●Contacting Faculty

Strength and Fracture of Materials (2.0credits) (材料強度学)

Course Type	Basic Specialized Courses
Class Format	Lecture
Course Name	Department of Materials Science and Engineering
Starts 1	2 Autumn Semester
Elective/Compulsory	Compulsory
Lecturer	Naoki TAKATA Associate Professor

●Course Purpose

At the beginning of the lecture, wide variety of structure materials will be introduced. Students will study fundamental properties required for structure
materials. Students also learn elastic and plastic deformation behavior of metallic materials, strengthening mechanisms and fundamentals of creep at elevated temperatures of metals and alloys.

●Prerequisite Subjects

●Course Topics

0. Online guidance for this class
1. Elastic and plastic deformation
2. Theoretical strength
3. Plastic deformation of single-crystal metals
4. Plastic deformation of polycrystalline metals
5. Strengthening of metals
6. Creep at high temperatures

Some exercises will be given after finishing up each chapter.

●Textbook

Handouts will be distributed at every sections in this lecture.

●Additional Reading

Materials science and engineering, W.D.Callister Jr., Wiley

●Grade Assessment

Attendance, Reports, Examinations at the term end.
Record more than or equal to C grade is qualified.

●Notes

It is better to take a class of "solid mechanics" before taking this class.

●Contacting Faculty

Face-to-face discussions after class or exchanging e-mails through web.
Contact address: takata.naoki@material.nagoya-u.ac.jp (N. Takata)

Materials Solid State Physics with Exercises (2.5credits) (マテリアル固体物理2及び演習)

Course Type	Basic Specialized Courses
Class Format	Lecture and Exercise
Course Name	Department of Materials Science and Engineering
Starts 1	2 Autumn Semester
Elective/Compulsory	Compulsory
Lecturer	Noritaka Usami Professor Yasuyoshi KUROKAWA Associate Professor

●Course Purpose

Solid state physics is a fundamental discipline to understand the structure, state and properties of materials. In this lecture, based on the contents learned in "Material Solid State Physics 1", we will study the thermal properties of solids, free electron theory, band theory, electric conduction in solids. The purpose is to deepen understanding of the role of electrons in the development of various properties of solids through classes and exercises.

In this lecture, students are expected to obtain the following knowledge and skills at the end of the lecture.

1. Understand and explain the thermal properties of solids.
2. Understand free electron theory and explain the state and behavior of free electrons in metals and semiconductors.
3. Understand band theory and explain the differences between energy bands in metals, semiconductors, and insulators.
4. Understand electric conduction in solids and explain the electrical properties of metals and semiconductors.

●Prerequisite Subjects

●Course Topics

●Textbook

Elementary Solid State Physics (Kodansha)[in Japanese] Chapter 8-11 & 14(14.1-14.3)

●Additional Reading

●Grade Assessment

●Notes

No registration requirements are imposed.
[Implementation policy of classes related to dealing with new coronavirus infections] Refer to NUCT.

●Contacting Faculty

Introduction to Advanced Materials Engineering 1 (1.0credits) (先端マテリアル工学概論1)

Course Type	Basic Specialized Courses		
Class Format	Lecture		
Course Name	Department of Materials Science and Engineering		
Starts 1	2 Autumn Semester		
Elective/Compulsory	Compulsory		
Lecturer	Associated Faculty	Associated Faculty	Associated Faculty

●Course Purpose

Materials science and engineering contain many concepts: extraction of resources, purification of raw materials, design and manufacturing of products, treatment and recycling of waste, etc. To develop the materials in practical use, different academic knowledges are essential. This course introduces a wide variety of researches progressing in the laboratories of the Department of Materials Engineering. Through the course, students are expected to acquire a fundamental academic understanding of materials and their practical applications.

●Prerequisite Subjects

Each subject studied in the spring and autumn semesters of the first grade and in the spring semester of the second grade.

●Course Topics

Introductory talk on the current research topics, including the underlying sciences, of the Department of Materials Science and Engineering.

1. Computational materials design
2. Advanced measurement and analysis
3. Nanostructure design
4. Advanced process engineering
5. Materials creation engineering
6. Chemical systems engineering
7. Materials chemistry

●Textbook

Textbooks are not specified, but materials will be distributed as needed in class.

●Additional Reading

Specified as needed during the class

●Grade Assessment

Reports and quizes are evaluated for the grade judgement. To pass, students must earn at least 60 points out of 100. It is required to explain a fundamental academic knowledge of materials and their practical applications (extraction of resources, purification of raw materials, design and manufacturing of products, treatment and recycling of waste).

●Notes

No requirements for taking this class.

●Contacting Faculty

During the class or at the office upon resevation.

Mathematics II and Tutorial (2.5credits) (数学2及び演習)

Course Type	Basic Specialized Courses	
Class Format	Lecture and Exercise	
Course Name	Department of Materials Science and Engineering	
Starts 1	2 Autumn Semester	
Elective/Compulsory	Compulsory	
Lecturer	Yoshifumi TAKASHIMA Professor	"Takashi ITOH" Associate Professor

●Course Purpose

This lecture gives mathematical knowledge to understand physical and chemical phenomena appearing in the engineering field.
Students are expected to achieve the following contents through this lecture and exercise.
1. The general solution of the differential equation can be derived using the Laplace transform.
2. Various periodic changes can be expressed using a Fourier series.
3. Explain the Fourier integration and the Fourier transform.
4. A general solution of the partial differential equation can be derived based on the variable separation method.
5. Various physical phenomena can be described and explaned using partial differential equations.

●Prerequisite Subjects

Calculus, Linear algebra, Mechanics, Electromagnetism

●Course Topics

Partial differential equation, Fourier expansion, Fourier transformation, Laplace transformation, special functions

●Textbook

Advanced engineering mathematics tenth edition, Erwin Kreyszig (John-Willey Sons,Inc.)

●Additional Reading

Reference books will be introduced in the lecture.

●Grade Assessment

Examination:80%, Exercises:20%
Total points of 60% is required at the least.

●Notes

●Contacting Faculty

In case of questions: Make contact to
Prof. Takashima: takasima(at)nusr.nagoya-u.ac.jp
Assoc. Prof. Itoh: itoh.takashi(at)material.nagoya-u.ac.jp
** Please replace (at) with @.

Advanced Processes Engineering 1 (2.0credits) (先端プロセス工学1)

Course Type	Basic Specialized Courses		
Class Format	Lecture		
Course Name	Department of Materials Science and Engineering		
Starts 1	2 Autumn Semester		
Elective/Compulsory	Compulsory		
Lecturer	Masaki MIZUGUCHI Professor	Yoshitaka ADACHI Professor	Naoki TAKATA Associate Professor

●Course Purpose

This lecture will explain the material process from the following three viewpoints.

<0> Online guidance
<1> Heat treatment process (Naoki TAKATA Associate Professor)
<2> Thermo-mechanical treatment process (Yoshitaka ADACHI Professor)
<3> Thin-film growth process (Masaki MIZUGUCHI Professor)

<1>The lecturer intends to introduce critical issues on heat treatment processes to control microstructure of metals in terms of physical metallurgy. Based on above knowledge, the students will be guided to understand correlation between heat treatment process, microstructure and properties and also to get some insights on strengthening mechanism of metallic materials.

<2> Tissue control of structural materials is done by combining processing and heat treatment. While processing and heat treatment are performed independently, thermo-mechanical treatment is a treatment aiming at a synergistic effect of processing and heat treatment. In this lecture, we focus on phase transformation, recrystallization behavior and synergistic effect of processing and explain it easily.

<3> The purpose of this lecture is to understand fundamental processes for the crystal growth of thin films mainly by the solid-phase growth. Processes and mechanism during the thin-film growth will be discussed. Fabrication methods, properties and application of various functional thin films will be also introduced.

●Prerequisite Subjects

Metallurgy, Strength and Fracture of Materials, Physical Chemistry, Electrochemistry, Inorganic Chemistry

●Course Topics

<1>Heat treatment process (4 times)
1. phase diagram
2. Phase transformation in Heat treatment process
3. Principle in Strengthening by Heat treatment process (2 times)

<2> Thermo-mechanical treatment process (4 times)
1. Ordinary hot processing
2. Controlled rolling / accelerated cooling
3. Quenching / tempering
4. Ausforming
5. Austempering
6. Marquenching
7. Martempering
8. Patenting

<3> Thin-film growth process (4 times)
1. Thermodynamics, nucleation, and surface energy
2. Crystal structure, surface kinetics, and epitaxial growth

3. Fabrication methods, properties and application of various functional thin film materials

●Textbook

There are no textbooks prescribed. Handouts will be distributed at every sections in this lecture

●Additional Reading

Heat treatment process
Materials Science and Engineering 8th edition, William D. Callister and David G. Rethwisch, Wiley (2011)
Thin-film growth process
Utau Nishinaga: "Crystal Growth"

●Grade Assessment

Reports at the term end.
Record more than or equal to 60/100 is qualified.

●Notes

No requirement for taking this class.

●Contacting Faculty

Face-to-face discussions after class or exchanging e-mails through web.
Contact address:

takata.naoki@material.nagoya-u.ac.jp ((1) N. Takata)
adachi.yoshitaka@material.nagoya-u.ac.jp ((2) Y. Adachi)
mizuguchi.masaki@material.nagoya-u.ac.jp ((3) M. Mizuguchi)

Physical Chemistry 3 with Exercises (2.5credits) (物理化学3及び演習)

Course Type	Basic Specialized Courses		
Class Format	Lecture and Exercise		
Course Name	Department of Materials Science and Engineering		
Starts 1	2 Autumn Semester		
Elective/Compulsory	Compulsory		
Lecturer	Nagahiro Saito Professor	Junko HIEDA Associate Professor	Ryouichi ICHINO Professor
	YutakaMATSUO Professor		

●Course Purpose

In addition to viewpoints on phase change and thermodynamics of chemical reactions of substances which is acquired in Basic Chemistry II and III, Physical Chemistry 1 and Physical Chemistry 2,
in Physical Chemistry 3 and exercises, students will aquire the viewpoint of understanding by atoms and molecules (Interface Chemistry:Intermolecular force/ aggregation/ adsorption) and the viewpoint of understanding by chemical reactions dynamically (the first step in reaction kinetics).

●Prerequisite Subjects

Physical Chemistry 1, 2, Fundamentals of Chemistry I, II

●Course Topics

Lectures and exercises will be given on the following topics in the textbook.

[Chapter 16 Molecular interactions]
Van der Waals interaction (dipole, London force), hydrogen bond, hydrophobic interaction, Agglutination, liquid, interfacial tension

[Chapter 17 Macromolecules and Self-assembly (C, D Only)]
Micelle, vesicle, molecular membrane, colloid, electric double layer, zeta potential

[Chapter 22 Processes on solid surfaces (A, B Only)]
Physical adsorption, chemisorption, adsorption isotherm

[Chapter 20 Chemical Kinetics (A, B, D Only)]
Reaction order, reaction rate equation (primary reaction, secondary reaction), Arrhenius equation

Before each lecture, prepare the relevant part with a textbook and review the previous lecture.

●Textbook

Atkins' Physical Chemistry(10th Revised edition), Oxford University Press.

●Additional Reading

Student Solutions Manual to Accompany Atkins' Physical Chemistry TENTH EDITION, Oxford University Press.

●Grade Assessment

Evaluate the degree of goal achievement through exercises and final exams.

●Notes

●Contacting Faculty

Heat Transfer and Diffusion (2.0credits) (熱移動と拡散)

Course Type	Basic Specialized Courses	
Class Format	Lecture	
Course Name	Department of Materials Science and Engineering	
Starts 1	2 Autumn Semester	
Elective/Compulsory	Compulsory	
Lecturer	"Takashi ITOH" Associate Professor	Seiichi DEGUCHI Lecturer

●Course Purpose

•Course Purpose

In the theory of transport phenomena, the transports of momentum, heat and mass are described with analogous basic formulae. In the various materials production and manufacturing processes, on the other hand, the transport of heat and mass play important roles frequently. In this lecture, students are expected to learn about the basic theories of heat transfer and materials diffusion.

Students are expected to obtain the following abilities concerning transport phenomena
(1) To understand the fundamental aspects of diffusion phenomena
(2) To understand the fundamental aspects of heat-transfer phenomena
(3) To understand the fundamental aspects of transport phenomena on the basis of energy

●Prerequisite Subjects

Dynamics 1,2 Mathematics 1,2 with Exercises Chemistry 1,2

●Course Topics

1. Fundamentals of diffusion phenomena, Fick's laws and mass flux
2. Physical aspects of diffusion and the mechanisms of diffusion
3. Diffusion equations under typical boundary conditions
4. Fluid flow and mass transfer
5. Fundamentals of heat transport phenomena (Fourier's law and heat flux)
6. Heat conduction equations under typical boundary conditions
7. Flow and conductive & convective heat transfer, and, radiative heat transfer
8. Combustion calculations
9. Thermal energy conversions (heat pumps)

Out-hours learning:
To prepare for the next class and understand the meaning of technical terms.

●Textbook

Appropriate handouts or specific citations will be given in the class.

●Additional Reading

R. B. Bird, W. E. Stewart, E. N. Lightfoot : Tranport Phenomena 2nd. ed., John Wiley & Sons.
D. R. Poirier & G. H. Geiger : Transport Phenomena in MaterialsProcessing, TMS

●Grade Assessment

A pass is accepted if diffusion phenomena and heat transfer phenomena of substance can be interpreted in principle, transfer phenomena including diffusion and heat transfer in general can be understood from the viewpoint of energy, and mass balance equation and heat balance equation can be derived.
If you can handle more difficult questions, it will be reflected in your grades accordingly.
Short tests and reports: 0 to approx.20%
Final examination: approx. 80% to 100%
Total points of 60% is required at the least.

●Notes

No course requirements

●Contacting Faculty

Contact phone number and email address
Assoc. Prof. T. Itoh
phone: 6064
e-mail: itoh.takashi(at)material.nagoya-u.ac.jp
Assoc. Prof. S. Deguchi
phone: 3383
e-mail: deguchi.seiichi(at)material.nagoya-u.ac.jp
** Please replace (at) with @.

Phase Equilibria (2.0credits) (相平衡論)

Course Type	Basic Specialized Courses
Class Format	Lecture
Course Name	Department of Materials Science and Engineering
Starts 1	2 Autumn Semester
Elective/Compulsory	Compulsory
Lecturer	Toru UJIHARA Professor

●Course Purpose

You study thermodynamics of solution, phase rule and phase diagram based on phase equilibrium based on the knowledge of chemical equilibrium and free energy. You can evaluate and describe phase diagrams by using the knowledge of chemical thermodynamics.

●Prerequisite Subjects

●Course Topics

The lecture (reports) includes the following topics:1. Outline of phase diagram2. phase equilibrium3. chemical potential and free energy4. binary phase diagram 5. isomorphous phase diagram6. Eutectic phase diagram7. Peridectic phase diagram8. Free energy and binary phase diagram9. Ternary phase diagram

●Textbook

Zairyoukei no jyoutaizu nyuumon (ASAKURA SHOTEN)

●Additional Reading

kinnzokubuturigaku goukinjyoutaizu tokuhon

●Grade Assessment

Your final grade will be calculated according to the term-end exam. To pass, students must earn at least 60 points out of 100.

●Notes

●Contacting Faculty

E-mail

Fluid Flow with Exercises (2.0credits) (流動及び演習)

Course Type	Basic Specialized Courses
Class Format	Lecture and Exercise
Course Name	Department of Materials Science and Engineering
Starts 1	2 Autumn Semester
Elective/Compulsory	Compulsory
Lecturer	Akira ITO Professor

●Course Purpose

The rheology, the basic equations for flow, and the laminar and turbulent flows in pipe are lectured. Based on these, the principles of measurement of velocity and flow rate, the design of fluid transportation and pipe line are followed. The exercises enhance the comprehensive understanding and make the ability of application of knowledge to the various problems. At the end of the course, participants are expected to master the basis of rheology, which leads to Multiphase Flow given in the spring semester for third graders.

●Prerequisite Subjects

Chemical Processes Engineering

●Course Topics

1. Rheology, 2. Basic equations for flow, 3. Laminar and turbulent flows in pipe, 4. Measurement of velocity and flow rate, 5. Pipeline design

The exercise will be held at every lecture, so please review it.

●Textbook

The Society of Chemical Engineers. Japan, Higher Education Committee, Hajimeteno Kagaku Kogaku - Purosesu kara Manabu Kiso (Maruzen) 2007

●Additional Reading

Kagaku Kogaku Benran 6th Ed. (Maruzen)

●Grade Assessment

For each of rheology, basic equations of flow, in-pipe laminar flow, and turbulent flow, the weights of evaluation for each goal are equivalent. It will be reflected in the grade in accordance to the difficulty of the problems. Evaluation is made by mid-term exam (30%), final exam (30%), exercise (30%), and learning attitude (10%), and pass 60 points or more out of 100 points.

●Notes

No registration requirements required.

●Contacting Faculty

Accepted at anytime

Experiments 1 (2.0credits) (学生実験1)

Course Type	Basic Specialized Courses		
Class Format	Experiment		
Course Name	Department of Materials Science and Engineering		
Starts 1	3 Spring Semester		
Elective/Compulsory	Compulsory		
Lecturer	Associated Faculty	Associated Faculty	Associated Faculty

●Course Purpose

The purpose of this program is to divide into small groups to practice basic items in material engineering, deepen the understanding of basic knowledge on material engineering, and cultivate applied skills to make use of it in the field.The goal is to be able to do the following by learning this subject.1. Learn the safety management, measurement principles, principles of various devices, and usage methods related to experiments.2. Learn how to analyze the experimental data.3. Learn how to write a report.

●Prerequisite Subjects

●Course Topics

●Textbook

●Additional Reading

●Grade Assessment

●Notes

●Contacting Faculty

Materials Quantum Chemistry (2.0credits) (マテリアル量子化学)

Course Type	Specialized Courses
Class Format	Lecture
Course Name	Department of Materials Science and Engineering
Starts 1	3 Spring Semester
Elective/Compulsory	Compulsory
Lecturer	Noritaka Usami Professor Yuhki TSUKADA Associate Professor

●Course Purpose

The aim of this course is to help students acquire an understanding of electronic theories for atoms and molecules and nature of chemical bondings.

The goals of this course are to
(1) be able to understand and explain the physical meaning of eigen value and eigen function in Schrodinger equation,
(2) be able to understand and explain the solution of Schrodinger equation for hydrogen atom,
(3) be able to understand and explain how to solve Schrodinger equation for a multi-electron atom,
(4) be able to understand and explain the relationship between electronic state and chemical bonding of molecules based on the molecular orbital method.

●Prerequisite Subjects

Quantum mechanics
Solid state physics

●Course Topics

Schrodinger equation
Electronic state of hydrogen atom
Electronic state of multi-electron atom
Molecular orbital method
Electronic state of molecule

●Textbook

●Additional Reading

●Grade Assessment

Reports: 20%
Term-end examination: 80%

●Notes

No registration requirements are imposed.
[Implementation policy of classes related to dealing with new coronavirus infections] Refer to NUCT.

●Contacting Faculty

Chemical Reaction Engineering (2.0credits) (反応工学)

Course Type	Specialized Courses
Class Format	Lecture
Course Name	Department of Materials Science and Engineering
Starts 1	3 Spring Semester
Elective/Compulsory	Compulsory
Lecturer	Seiichi TAKAMI Professor

●Course Purpose

Reaction engineering is the fundamental knowledge to understand chemical reaction processes, to design better chemical process, and to realize industrial scale production of various materials. This lecture treats the basic of reaction engineering including reaction kinetics, heterogeneous reaction, and mass transfer. Practices will be done during lecture.

Upon successfully completion of this course, students should become able to the following things.

1. Based on the understanding of kinetic theory of gases, students should be able to predict reaction rate constant at different temperatures.
2. Based on the understanding of rate kinetics, students should be able to evaluate the change in the concentration of reactants and products with reaction time.
3. Students should be able to determine reaction order and reaction rate constants based on experimental results.
4. Based on the understanding of heterogeneous reaction, students should be able to estimate the reaction rate of reactions with mass-transfer rate-determine step.

●Prerequisite Subjects

Physical Chemistry 3, Mathematics I, Mathematics II

●Course Topics

1. Review on reaction kinetics
Factors that affect the reaction rate will be studied based on kinetic theory of gases. Rate of heterogeneous reaction will be also reviewed about the adsorbed gases on solid surfaces.

2. Evaluation of the concentration of reactants and products
Evaluation method will be studded about the concentration of reactants and products based on reaction order and reaction rate constants.

3.Heterogeneous reaction with mass transfer
The idea of rate-determine step will be studied. The method to evaluate the rate of the reaction process with mass-transfer will also be studied.

A quiz will be placed at the end of the class. The contents of the class should be reviewed until next class.

●Textbook

Materials are supplied in the class.

●Additional Reading

Will be introduced in the class.

●Grade Assessment

Grade assessment will be performed based on the evaluation including midterm exam, final exam, and quizzes about kinetic theory of gases, reaction kinetics, and heterogeneous reaction. Student will earn a credit if they understand and treat principle knowledges and grade will be determined by the degree of understanding.

●Notes

No requirements for taking this course.

[Plan of classes in response to Coronavirus Disease 2019]
Changes in the plan of classes are shown in the NUCT page of this course.

●Contacting Faculty

Questions are accepted during lectures. Questions are also accepted by e-mail after lectures.

E-mail : takami.seiichi@material.nagoya-u.ac.jp

Exercises on Physical Chemistry (1.0credits) (物理化学演習)

Course Type	Specialized Courses		
Class Format	Exercise		
Course Name	Department of Materials Science and Engineering		
Starts 1	3 Spring Semester		
Elective/Compulsory	Compulsory		
Lecturer	Tetsuya Yamamoto Associate Professor	Hiroaki MATSUMIYA Associate Professor	Junko HIEDA Associate Professor

●Course Purpose

Outline: Complement the lecture contents and deepen understanding through exercises on physical chemistry.
Achievement: Understand the theoretical treatment of various issues such as chemical equilibrium, phase equilibrium, chemical reaction rate, intermolecular interaction, surface chemistry, and colloid chemistry, and develop fundamental skills to develop creativity and comprehensive power in material engineering.

●Prerequisite Subjects

Fundamentals of Chemistry II, Physical Chemistry 1-3

●Course Topics

1. Exercise on calculation of gas properties
2. Exercise for calculating thermodynamic quantities
3. Exercise of phase equilibrium calculation
4. Exercise of chemical equilibrium
5. Exercise for calculating chemical reaction rate
6. Exercise for calculating molecular interactions
7. Exercises on interface and colloid chemistry

●Textbook

Atkins' Physical Chemistry(10th Revised edition), Oxford University Press.

●Additional Reading

Student Solutions Manual to Accompany Atkins' Physical Chemistry TENTH EDITION, Oxford University Press.
For other books, refer to the syllabus for each background subject.

●Grade Assessment

Submit all reports to pass.

●Notes

No registration requirements are required.

Exercises are conducted in remote (on-demand) classes using NUCT.

Possible to exchange opinions between students regarding the exercises using the NUCT function "Message".

●Contacting Faculty

By e-mail
Tetsuya YAMAMOTO: yamamoto.tetsuya@material.nagoya-u.ac.jp
Hiroaki MATSUMIYA: matsumiya.hiroaki@material.nagoya-u.ac.jp
Junko HIEDA: hieda.junko@material.nagoya-u.ac.jp

Metallography (2.0credits) (材料組織学)

Course Type	Specialized Courses
Class Format	Lecture
Course Name	Department of Materials Science and Engineering
Starts 1	3 Spring Semester
Elective/Compulsory	Compulsory Elective
Lecturer	Toshiyuki KOYAMA Professor

●Course Purpose

Properties of materials depend strongly on their internal microstructures. The aim of this course is to understand the principles governing the phase transformations and microstructure changes. The main subjects of this course are phase diagrams and phase transformations based on the thermodynamics. The goals of this course are to know the microstructure components such as crystal structure, phases, defects, grain structures, domain structures, etc., to understand the phase equilibria based on the Gibbs energy of materials, and to understand the microstructure changes based on the diffusion controlled phase transformations and diffusion-less structural phase transitions.

●Prerequisite Subjects

Crystal PhysicsPhase Equilibria

●Course Topics

The contents of this course are as follows. 1. Introduction(Landscape of this course and the materials design engineering), 2. Crystal structure and X-ray diffraction, 3. Defects in crystalline materials, 4. Phases: solid solution, ordered phase, intermetallic compound and amorphous, 5. Phase diagram and Gibbs energy (I), 6. Phase diagram and Gibbs energy (II), 7. Nucleation and growth, 8. Diffusion in solids (I), 9. Diffusion in solids (II), 10. Diffusion controlled phase transformations (I), 11. Diffusion controlled phase transformations (II), 12. Diffusionless phase transformations (I), 13. Diffusionless phase transformations (II), 14. Recovery and recrystallization, 15. CALPHAD method and phase-field method, Students should check the above items based on the textbook or documents on NUCT by the next lecture.

●Textbook

T.Abe: Computational materials design - Computational thermodynamics -, Uchoda Roukakuho Publishing Co. Ltd., (2019), T.Koyama: Computational materials design - Computational phase transformations -, Uchoda Roukakuho Publishing Co. Ltd., (2019).

●Additional Reading

E. Matsubara et al., Metallograpy, Asakura Publishing Co. Ltd., (2011), M. Kato: Introduction to dislocation theory, Shokabo Co. Ltd., (1999).

●Grade Assessment

Your overall grade in the class will be decided based on the following:Class attendance and attitude in class: 10%, Short reports: 10%, Term-end examination: 80% As for the each of phase stability and phase transformations, pass the examination if the basic problem can be dealt with correctly, and if it can handle the more advanced problem, reflect it in the grade accordingly.

●Notes

There is no requirements to take this course.Implementation policy with respect to Corona virus infection: Please refer to the NUCT for the details of this course.

●Contacting Faculty

Recess after a lecture, or office hours (contact by e-mail).

Materials Plasticity (2.0credits) (材料塑性学)

Course Type	Specialized Courses
Class Format	Lecture
Course Name	Department of Materials Science and Engineering
Starts 1	3 Spring Semester
Elective/Compulsory	Compulsory Elective
Lecturer	Nobuki YUKAWA Associate Professor

●Course Purpose

In this class, students will learn the theory of plastic deformation and the basics of metal forming that utilizes plastic deformation to understand the importance of manufacturing.
Exercises will be done at the end of each lecture.

●Prerequisite Subjects

Mathematics, Mechanics of material, Strength of material

●Course Topics

1. Technology features of metal forming
2. Material science of plastic deformation
3. Dynamics and analysis method of metal forming
   Yield criteria
   Constitutive equation
   Slab method
   Upper bound method
   Finite element method
4. Various metal forming method
   Rolling
   Extrusion/Drawing
   Shearing
   Forging
   Sheet metal forming
5. Other issues
   Machining
   Tribology
   Measurement

●Textbook

●Additional Reading

Manuscripts will be distributed via NUCT

●Grade Assessment

80% by final exam, 20% by reports and homeworks
Total record more than or equal to C grade is qualified

●Notes

●Contacting Faculty

Face-to-face discussions after class or exchanging e-mails through web.
Contact address: yukawa@nagoya-u.jp(N. Yukawa)

Materials Process Engineering (2.0credits) (素材プロセス工学)

Course Type	Specialized Courses
Class Format	Lecture
Course Name	Department of Materials Science and Engineering
Starts 1	3 Spring Semester
Elective/Compulsory	Compulsory Elective
Lecturer	Ryouichi ICHINO Professor

●Course Purpose

In this lecture, students will learn the outline of the smelting process from ore to the production of metal as a raw material, and basic matters related to typical physicochemical and reaction process engineering phenomena in this series of processes.

aim
Basic explanation of iron-making and steel-making processes
Basic explanation of non-ferrous refining process
Chemical reactions in high temperature processes can be explained by equilibrium and kinetics
Chemical reaction of electrolytic process can be explained by equilibrium and kinetics

●Prerequisite Subjects

Fundamentals of Chemistry I-II, Physical Chemistry 13, Phase Equilibria, Chemical Reaction, Electrochemistry.

●Course Topics

1. Outline of Steel manufacturing process
Basis of iron making process and reactions in blast furnace, and outline of steelmaking process and reactions in converter and electric furnace
2. Outline of Non-ferrous smelting
Basics of dry non-ferrous refining, wet non-ferrous smelting and molten salt electrolysis, and each typical smelting process.

Homework is assigned after each class, so submit it as a small report next time.

●Textbook

Printed paper required for lecture items will be distributed.

●Additional Reading

Physical Chemistry of Metals, JIM, Maruzen
Ferrous Process Metallurgy, JIM, Maruzen
Extractive Metallurgy, JIM, Maruzen
Kinzoku-Binran, JIM, Maruzen

●Grade Assessment

Written examination.
Record more than or equal "C" rank is qualified.
The criteria for acceptance are as follows; A correct understanding of basic concepts and knowledge about the metal smelting process

●Notes

●Contacting Faculty

Face-to-face discussions after class or exchanging e-mail.
Prof. R. Ichino: ichino.ryoichi@material.nagoya-u.ac.jp

Electrochemistry (2.0credits) (電気化学)

Course Type	Specialized Courses	
Class Format	Lecture	
Course Name	Department of Materials Science and Engineering	
Starts 1	3 Spring Semester	
Elective/Compulsory	Compulsory Elective	
Lecturer	Yasutoshi IRIYAMA Professor	MunekazuMOTOYAMA Lecturer

●Course Purpose

"Electrochemistry" is a study on electron transfer of mataterials, and its application fields are expanding to batteries, surface treatments, sensors, electrolysis and so on. The purpose of this lecture is to acquire basic knowledge to understand the principles and laws of electrochemistry in equilibrium and kinetic theory, and to cultivate application skills applicable to the latest devices.By learning this lecture, students will be able to:1. Understand thermodynamics, especially chemical potential and electrochemical potential, and to derive chemical equilibrium and Nernst equation and solve fundamental problems related thereto.2. Understand Pourbaix Diagram and consider basic guidelines for corrosion and corrosion prevention.3. Understand Butler-Volmer equation and solve basic problems related to it.

●Prerequisite Subjects

●Course Topics

●Textbook

●Additional Reading

●Grade Assessment

●Notes

There are no course requirements.[Policy for the response to COVID-19]Refer to the NUCT of this course.

●Contacting Faculty

Multiphase Flow (2.0credits) (混相流動)

Course Type	Specialized Courses	
Class Format	Lecture	
Course Name	Department of Materials Science and Engineering	
Starts 1	3 Spring Semester	
Elective/Compulsory	Compulsory Elective	
Lecturer	Koyo NORINAGA Professor	Akira ITO Professor

●Course Purpose

The aim of the lecture is to deepen knowledge of the behaviors of particles, gas bubbles and liquid droplets in a fluid, and to learn the multiphase flow on the basis of knowledge of these behaviors. Moreover, students who take the lecture can acquire ability to apply the knowledge to solve problems of engineering topics. At the end of the course, participants are expected to master the basis of multipahse flow, which leads to System Control given in the fall semester for third graders.

●Prerequisite Subjects

Fluid Flow with Exercises

●Course Topics

1. Motion of particles, bubbles and droplets, 2. Flow of fluids through granular beds, 3. Multiphase flow, 4. Fluid flows in equipment

The exercise will be held at the end of lecture, so please review it.

●Textbook

Original text will be distributed

●Additional Reading

Kagaku Kogaku Benran, Maruzen

●Grade Assessment

For understanding the behavior of particles, bubbles, droplets, multiphase flow, the weights of evaluation for each goal are equivalent. It will be reflected in the grade in accordance to the difficulty of the problems. Evaluation is made by mid-term exam (30%), final exam (30%), exercise (30%), and learning attitude (10%), and pass 60 points or more out of 100 points.

●Notes

No registration requirements required.

●Contacting Faculty

Accepted at any time.

Separation Systems (2.0credits) (分離システム)

Course Type	Specialized Courses
Class Format	Lecture
Course Name	Department of Materials Science and Engineering
Starts 1	3 Spring Semester
Elective/Compulsory	Compulsory Elective
Lecturer	Yasuhito MUKAI Associate Professor

●Course Purpose
The mechanical separation engineering, including sedimentation, flocculation, filtration, membrane separation, centrifugation, crystallization, dust collection, is lectured to make the ability to apply this knowledge.

●Prerequisite Subjects
Fluid Flow with Exercises, Multiphase Flow

●Course Topics
1. Basis of mechanical separation engineering
2. Sedimentation
3. Flocculation
4. Filtration
5. Membrane separation
6. Centrifugation
7. Crystallization
8. Dust collection
9. Other mechanical separation systems

●Textbook
Bunri Prosesu Kogaku no Kiso, Asakura Shoten

●Additional Reading
Kagaku Kogaku Benran, Maruzen
Roka Kogaku Handobukku, Maruzen

●Grade Assessment
Examination and Reports

●Notes
No registration requirements required.

If you have questions in a remote lecture, use the function "Message" of NUCT.

●Contacting Faculty
Questions will be accepted in a lecture room after each lecture.

If you have questions in a remote lecture, use the function "Message" of NUCT.

Powder Technology (2.0credits) (粒子・粉体工学)

Course Type	Specialized Courses	
Class Format	Lecture	
Course Name	Department of Materials Science and Engineering	
Starts 1	3 Spring Semester	
Elective/Compulsory	Compulsory Elective	
Lecturer	Hideki KITA Professor	Tetsuya Yamamoto Associate Professor

●Course Purpose

Particles and powders refer to solid substances ranging from nanometers to tens of microns, and are widely used as raw materials for pharmaceuticals, foods, ceramics, catalysts, cosmetics, etc. It has the negative side of bringing the above risks.
Particle / powder engineering is not only a foundation for producing high-performance materials as a basis for the manufacturing industry, but is also a discipline that is environmentally friendly and operates powder particles safely.
By learning this lecture, the goal for students is to be able to:
1. Understand the chemical synthesis method of the particle powder as well as the physical method involving pulverization, and apply to specific problems.
2. Understand the mechanism by which the particle powder is dispersed and aggregated in the liquid phase, and can be applied to specific problems.
3. Understand how to quantify features such as the shape and size of particle powder based on statistics and apply it to specific problems.
4. Understand mechanical properties and calculation methods including friction of powder and apply to specific problems.

●Prerequisite Subjects

Surface-interface chemistry,Statistics,Fracture mechanics

●Course Topics

1.How to understand Particle and Powder Technology
2.Fracture mechanics of particles
3.Synthesis and production of powder
4.Measurement of powder size distributions,
5.Powder packing structure,
6,Behaviors of particles in fluids,Interactions of particles(focused on DLVO theory)
7.Powder mechanics(Mohr's circle,internal friction)
8.Fluid dynamics in powder bed
Read the relevant textbook before each class. After the lecture, solve the textbook examples and chapter end problems by yourself. In addition, students will be required to submit a report assignment several times, so solve it and submit it.

●Textbook

Nyumon RyusiFuntai kougakukaitei dai 2han(Nikkan kougyou sinbunsya)

●Additional Reading

Nothing special. Distribute materials if necessary.

●Grade Assessment

The degree of achievement for the achievement target is evaluated by reports and written tests.
“Pass” is given to the student who is able to correctly understand the basic issues with respect to the items shown in the class contents,For the student who is able to understand more difficult questions, reflect them on the grade according to the level and results of the questions.

●Notes

No registration requirements are required.

●Contacting Faculty

Lecturers will respond during breaks and office hours after lectures.
ex. 3096, kita.hideki@material.nagoya-u.ac.jp
Assoc. Prof.Yamamoto
ex. 3378, yamamoto.tetsuya@material.nagoya-u.ac.jp

Introduction to Advanced Materials Engineering 2 (1.0credits) (先端マテリアル工学概論2)

Course Type	Specialized Courses		
Class Format	Lecture		
Course Name	Department of Materials Science and Engineering		
Starts 1	3 Spring Semester		
Elective/Compulsory	Elective		
Lecturer	Associated Faculty	Associated Faculty	Associated Faculty

●Course Purpose

Students learn about the recent practical applications of materials science and engineering through the lectures by several experts working in various companies or research institutes. Through the course, students will gain practical and broad insight in the research and development of materials in the real world.

●Prerequisite Subjects

Each subject studied in Department of Materials Science and Engineering

●Course Topics

Advanced technologies of materials science and engineering and their recent applications in the following fields:

1. Metals/ceramics industries
2. Semiconductor industries
3. Automobile industries
4. Chemical industries

etc.

●Textbook

Textbooks are not specified, but documents will be distributed as needed.

●Additional Reading

We will introduce as needed.

●Grade Assessment

Reports and quizes are evaluated for the grade judgement. To pass, students must earn at least 60 points out of 100. It is required to explain the advanced technologies of materials science and engineering and their recent applications in metals/ceramics industries, semiconductor industries, automobile industries, chemical industries, and so on.

●Notes

There is no requirement to take this course.
This course will be conducted remotely.
The NUCT function "Message" should be used to ask questions.
The NUCT function "Message" should be used to exchange opinions among students regarding this course.

●Contacting Faculty

As mentioned above, questions about this course are accepted using the NUCT function "Message".
Representative instructor of this course: Toshio Ogawa

Advanced Processes Engineering 2 (2.0credits) (先端プロセス工学2)

Course Type	Specialized Courses		
Class Format	Lecture		
Course Name	Department of Materials Science and Engineering		
Starts 1	3 Spring Semester		
Elective/Compulsory	Elective		
Lecturer	Syunta HARADA Associate Professor	Nagahiro Saito Professor	Motonobu GOTO Professor

●Course Purpose

The purpose of this lecture is to deepen the understanding of the following three processes that are important in the material process.[1] Crystal growth process (Harada)[2] Plasma process (Saito)[3] Supercritical process (Goto)[1] Crystal growth process: Semiconductor thin film / bulk crystal growth process that supports electronics[2] Plasma process: Thin film formation / surface treatment / material synthesis process using plasma[3] Supercritical process: Fundamentals and applications of technology using supercritical fluids that exceed the critical temperature and critical pressure

●Prerequisite Subjects

●Course Topics

●Textbook

●Additional Reading

●Grade Assessment

●Notes

●Contacting Faculty

Exercises on Solid State Physics (1.0credits) (固体物理演習)

Course Type	Specialized Courses		
Class Format	Exercise		
Course Name	Department of Materials Science and Engineering		
Starts 1	3 Autumn Semester		
Elective/Compulsory	Compulsory		
Lecturer	MihoTAGAWA Associate Professor	Takahiro ITOH Associate Professor	Yuhki TSUKADA Associate Professor
	Takahisa YAMAMOTO Professor		

●Course Purpose

This course enhances students' skill in solving problems related to solid state physics.

By the end of the course, students should be able to solve problems related to crystal physics, quantum mechanics, solid state physics and quantum chemistry.

●Prerequisite Subjects

Crystal physics
Quantum mechanics
Solid state physics
Quantum chemistry

●Course Topics

1. Exercise in crystal physics
2. Exercise in quantum mechanics
3. Exercise in solid state physics
4. Exercise in quantum chemistry

●Textbook

●Additional Reading

●Grade Assessment

Exercises: 100%

●Notes

●Contacting Faculty

Experiments 2 (2.0credits) (学生実験2)

Course Type	Specialized Courses		
Class Format	Experiment		
Course Name	Department of Materials Science and Engineering		
Starts 1	3 Autumn Semester		
Elective/Compulsory	Compulsory		
Lecturer	Associated Faculty	Associated Faculty	Associated Faculty

●Course Purpose

This class aims for deepening your understandings of structures, functions, and properties of various materials and basic theories associated with their processing through basic and advanced experiments in different fields of materials engineering. You will do experiments with different purposes in this class. These experiments give you opportunities to learn important experimental methods for conducting a research in material science. Also, you will examine and analyze your own experimental results. Eventually, you will have acquired specialized knowledge and applied skills in material engineering.

●Prerequisite Subjects

●Course Topics

●Textbook

●Additional Reading

●Grade Assessment

●Notes

●Contacting Faculty

Physical Chemistry 4 (2.0credits) (物理化学4)

Course Type	Specialized Courses	
Class Format	Lecture	
Course Name	Department of Materials Science and Engineering	
Starts 1	3 Autumn Semester	
Elective/Compulsory	Compulsory	
Lecturer	MunekazuMOTOYAMA Lecturer	Wataru NORIMATSU Associate Professor

●Course Purpose

This course mainly deals with statistical thermodynamics that bridges the microscopic properties of matters and their bulk properties. As a preliminary step, students learn the basics and techniques on the rotational and vibrational spectra. Using statistical thermodynamics, students acquire knowledge to calculate thermodynamic quantities, chemical equilibrium constants, and the transition state theory of reaction dynamics from molecular information obtained by spectroscopic techniques.

●Prerequisite Subjects

Physical Chemistry I, Physical Chemistry II, Physical Chemistry III

●Course Topics

1. Rotational and vibration spectra (Chapter 12) ・Molecular rotation ・Vibrational spectroscopy of diatomic molecules2. Statistical thermodynamics (Chapter 15) ・Boltzmann distribution ・Molecular distribution function ・Molecular energy ・Canonical ensemble ・Internal energy and entropy ・Derivation of thermodynamic functions3. Chemical reaction dynamics (Chapter 21) ・Transition state theory ・Kinetics of molecular collisions

●Textbook

P. Atkins and J. de Paula, Atkins' Physical Chemistry 10th Edition, Oxford University Press

●Additional Reading

Will be designated during class as necessary.

●Grade Assessment

Report: 30%, Examination: 70%F: 0-59, C: 60-69, B: 70-79, A: 80-89, S: 90-100

●Notes

There are no course requirements.[Policy for the response to COVID-19]Refer to the NUCT of this course.

●Contacting Faculty

Respond orally or by e-mail (designate during class) after class.

Computational Materials Engineering (2.0credits) (理論計算材料学)

Course Type	Specialized Courses
Class Format	Lecture
Course Name	Department of Materials Science and Engineering
Starts 1	3 Autumn Semester
Elective/Compulsory	Compulsory Elective
Lecturer	Hajime KIMIZUKA Professor

●Course Purpose

In the field of materials science and engineering, recent advances in computers and application software have led to the development of a field called "computational materials science", which seeks to discover new phenomena and properties by modeling and simulation without relying only on conventional experimental methods. At present, the issues that are mainly dealt with in computational materials science are related to the structures and kinetics (and their interaction) of lattice defects such as dislocations and grain boundaries in materials, and the elementary processes such as diffusion, transformation, and precipitation in the formation of microstructures. In this field, various numerical methods at various scales have been proposed and a lot of studies have been vigorously performed, which include electronic approaches such as density functional theory, atomistic approaches such as Monte Carlo and molecular dynamics methods, and meso-macroscale approaches such as discrete dislocation dynamics and continuum mechanics. In this course, an overview of the main numerical methods used in computational materials science, their theoretical background, and related case studies will be given to deepen the understanding of the concept of modeling and simulation in materials science. At the end of this course, students will be able to explain the basic concepts and theoretical background of modeling and simulation in materials science to others.

●Prerequisite Subjects

Strength of Materials, Metallography

●Course Topics

The schedule of this class is as follows: (1) Class orientation and introduction of computational materials engineering(2) Modeling and simulation in materials science(3) Fundamentals and solution of differential equations(4) Basics of statistical mechanics(5) Monte Carlo method (I): Introduction(6) Monte Carlo method (II): Various ensembles(7) Monte Carlo method (III): Case studies(8) Molecular dynamics method (I): Introduction and interactions(9) Molecular dynamics method (II): Equations of motion and ensembles(10) Molecular dynamics method (III): Case studies(11) Case examples in materials science (I): Lattice defects and materials mechanics(12) Case examples in materials science (II): Diffusion(13) Case examples in materials science (III): Transformation and precipitation(14) Simulation techniques at the meso-macro scale (I)(15) End-of-term examinationNote that the schedule is tentative and the plan will be changed according to the learning situation. Students will be asked to submit a short report by the next time, as each assignment will be given.

●Textbook

Textbooks are not used. Handouts will be provided as needed.

●Additional Reading

D. Raabe, Computational Materials Science (Wiley-VCH, 1998).E. Matsubara et al., Metallograpy, Asakura Publishing Co. Ltd., (2011).

●Grade Assessment

Your overall grade in the class will be decided based on the following:Class attendance and attitude in class: 12%Short reports: 40%End-of-term examination: 40%

●Notes

There is no requirement to take this course.[Implementation policy for classes related to COVID-19 infections]Detaied information on how to take this course is available at the NUCT site. Please visit the NUCT site before each lecture.[Additional application for course registration]If you cannot browse the NUCT site until the additional application for course registration is approved, please contact kimizuka.hajime[at]material.nagoya-u.ac.jp.

●Contacting Faculty

Recess after a lecture, or office hours (contact by e-mail).

Structural Materials Engineering with Exercises (2.0credits) (構造材料学及び演習)

Course Type	Specialized Courses		
Class Format	Lecture and Exercise		
Course Name	Department of Materials Science and Engineering		
Starts 1	3 Autumn Semester		
Elective/Compulsory	Compulsory Elective		
Lecturer	Makoto KOBASHI Professor	Naoki TAKATA Associate Professor	Nobuki YUKAWA Associate Professor

●Course Purpose

In this lecture, we will first introduce various types of structural materials such as steel, non-ferrous materials, ceramics, and resin (composite materials), and learn the test methods for measuring the properties required for structural materials and various mechanical properties. In addition, we will understand the material strength of structural materials practically through exercises.

●Prerequisite Subjects

Mechanics of Materials, Strength of materials, Plasticityof Material

●Course Topics

1. Guidance:
We will explain lecture outline, how to proceed, reference book, practice method in class, report submission, grade evaluation.
2Exercise 1 (Mechanics of Material)
3. Exercise 2 (Strength of Material)
4. Exercise 3 (Plasticity of Material)

●Textbook

Kougaku kiso Zairyo rikigaku (Kyoritsu shuppan), Masaichiro Seike

●Additional Reading

Materials science and engineering, W.D.Callister Jr., Wiley

●Grade Assessment

report 50%, examination 50%
Total record more than or equal to C grade is qualified

●Notes

●Contacting Faculty

Face-to-face discussions after class or exchanging e-mails through web.
Contact address:
kobashi.makoto[at]material.nagoya-u.ac.jp
takata.naoki[at]material.nagoya-u.ac.jp
yukawa[at]nagoya-u.jp

Physics of Materials Functions (2.0credits) (材料機能物性学)

Course Type	Specialized Courses	
Class Format	Lecture	
Course Name	Department of Materials Science and Engineering	
Starts 1	3 Autumn Semester	
Elective/Compulsory	Compulsory Elective	
Lecturer	Masaki MIZUGUCHI Professor	Toshio MIYAMACHI Associate Professor

●Course Purpose

Functional materials with various physical properties such as electrical conductivity, dielectric property, and magnetism are used in various fields such as catalysts, sensors, and energy conversion, and are important to support the foundation of the modern information society. The electrical, optical, and magnetic properties of functional materials can be understood based on microscopic properties such as the arrangement of atoms and molecules and the behavior of electrons, that is, quantum theory. For example, the most important characteristics of semiconductor materials in electronics that support modern society are roughly divided into two. One is that it is possible to control the electron conduction in the material, and the other is that it exhibits light absorption and light emission phenomena by converting light energy and electron energy. These are used in diodes, transistors, solar cells, light emitting diodes, and so on.

The aim of this lecture is to understand basic properties of dielectric materials, optical materials, thermoelectric materials, semiconductors and magnetic materials in conjunction with the sciences and technologies related to these functional materials.

In this lecture, the goal for the students is to obtain the following knowledge and skills.

1. Understand and explain the origins of light absorption and reflection in solids.
2. Understand and explain the origin of magnetic properties of solids.
3. Understand and explain band structure of semiconductor and doping.
4. Understand and explain the mechanism of p-n junction.
5. Understand and explain the operating principles of semiconductor devices such as solar cells and light-emitting diodes and so on.

●Prerequisite Subjects

Quantum Mechanics for Material Engineering, Electrodynamics, Solid State Physics for Material Engineering, Quantum Chemistry for Material Engineering, Physics of Crystals, Mathematics with Exercises

●Course Topics

Guidance
Guidance for taking this lecture is provided.

[Optical properties of solids]
Electromagnetic waves in vacuum
Electromagnetic waves in materials (electric polarization and complex permittivity)
Optical properties of dielectric (insulator)
Dielectric polarization and frequency response
Ferroelectric, pyroelectric, piezoelectric
Optical properties of conductors

[Solid magnetic properties]
Various magnetism
Magnetic moment

Physical quantities related to magnetism
Potential energy of magnetic moment
Paramagnetism of atoms and ions
Larmor diamagnetism/Pauli
paramagnetism/Ferromagnetism/Antiferromagnetism/Ferrimagnetism/Magnetic domain

[Optical and electrical properties of semiconductor]
Semiconductor basics
Energy level diagram of pn junction
Current-voltage characteristics of pn junction diode
Depletion layer capacitance
Method of manufacturing pn junction diode
Light absorption and emission in semiconductors
Defects and recombination in semiconductors
Operating principle of semiconductor devices such as solar cells, light emitting diodes and transistors

* Please read the textbook "Solid State Physics Learned from the Beginning" before lecture.
* Please read the handouts uploaded to NUCT in advance.

●Textbook
Elementary Solid State Physics (Kodansha) [in Japanese] Chapters 12, 13, 14

●Additional Reading
Introduction to Solid State Physics (WILEY, Charles Kittel)
Physics of Semiconductor devices (WILEY, Sze)

●Grade Assessment
Examination (100%)
Grades of C or higher are considered as a pass.

●Notes
No special registration conditions are imposed. In addition, it is desirable to access the Internet environment because there is a possibility of shifting to online lessons in the process of advancing the lecture.

●Contacting Faculty
Questions are accepted in the lecture.
They can also welcomed by e-mail.
mizuguchi.masaki@material.nagoya-u.ac.jp

Metallic materials (2.0credits) (金属材料学)

Course Type	Specialized Courses
Class Format	Lecture
Course Name	Department of Materials Science and Engineering
Starts 1	3 Autumn Semester
Elective/Compulsory	Compulsory Elective
Lecturer	Yoshitaka ADACHI Professor

●Course Purpose

In this course, the lecturer intends to introduce some critical issues on manufacturing processes, chemical compositions, their related phase diagram, microstructures and phisical properties of ferrous as well as non-ferrous materials in terms of phasical metallurgies related to thermodynamics, kinetics and dislocation theory. Based on above knowledge, the students will be guided to understand relation between microstructure and processing routes and also to get some insight on the structural applications of ferrous & nonferrous materials.

●Prerequisite Subjects

Phase transformation, structural material, fundamental metallurgy, material mechanics

●Course Topics

1. A role of material in society
2.Thermodynamics and phase diagram
3.Crystallography and dislocation
4.Transformation
5.Mechanical property
6.Steels

●Textbook

In this class, resume and its related materials will be given out for students.

●Additional Reading

[1] Microstracture control, Prof.Tadashi Maki (Uchida roukakuho)

●Grade Assessment

Students must get the total score as shown below based on each scores of Exercises (quiz) and a couple of examinations (will be carried out) in this course.

Students (2020~)
100959480797069656460 59 or below
Students(~2019)
1009089807970696059 or below

●Notes

●Contacting Faculty

e-mail adresss: adachi.yoshitaka[at]material.nagoya-u.ac.jp

Ceramic Materials (2.0credits) (セラミック材料学)

Course Type	Specialized Courses	
Class Format	Lecture	
Course Name	Department of Materials Science and Engineering	
Starts 1	3 Autumn Semester	
Elective/Compulsory	Compulsory Elective	
Lecturer	Takahisa YAMAMOTO Professor	Masakuni Ozawa Professor

●Course Purpose

Purpose: Ceramic material is extensively used in various fields, such as not only conventional pottery but a semiconductor, a car, information and telecommunications, an industrial machine, and medical field. Aim at present lecture is to learn about various ceramic materials and their physics and chemistry.
Attainment target: Sudents will learn the practical skills for designing ceramic material, and will be able to solve the problem concerning the nature and physics of ceramic materials for creating a new idea in materials science and engineering.

●Prerequisite Subjects

●Course Topics

This lecture will be given by Japanese

●Textbook

●Additional Reading

●Grade Assessment

●Notes

●Contacting Faculty

Electronic Device Engineering (2.0credits) (電子デバイス工学)

Course Type	Specialized Courses
Class Format	Lecture
Course Name	Department of Materials Science and Engineering
Starts 1	3 Autumn Semester
Elective/Compulsory	Compulsory Elective
Lecturer	Noritaka Usami Professor Yasuyoshi KUROKAWA Associate Professor

●Course Purpose

The most important material in electronics supporting modern society is semiconductor. Two main functions of semiconductor materials are (1) the control of electron conduction in materials and (2) the conversion between optical energy and electrical energy. These features are applied to diodes, transistors, solar cells, and light emission diodes. In this lecture, we study fundamentals of carrier transport, details of pn junction, and fundamentals of light absorption and light emission, and we understand the operating principles of semiconductor devices.Superconductivity is a phenomenon in which the electric resistance becomes zero at a certain temperature and was first discovered by Kamerlingh Onnes in 1911. Superconducting materials have been closely related to our lives in recent years, such as the linear central bullet train and nuclear magnetic resonance imaging (MRI). In this lecture, we aim to understand the phenomena exhibited by superconductors and to learn about the BCS theory which physically explained superconductivity for the first time.In this lecture, the goal is for the students to obtain the following knowledge and skills at the end of the lecture.1. Understand and explain basic properties of semiconductor materials.2. Explain the operating principles, technical issues, and trends of semiconductor devices.3. Understand and explain superconductivity.

●Prerequisite Subjects

Quantum Mechanics for Material Engineering, Electrodynamics, Solid State Physics for Material Engineering, Quantum Chemistry for Material Engineering, Physics of Crystals, Mathematics with Exercises

●Course Topics

GuidanceFundamentals of Carrier TransportBand structure of semiconductorsDensity of statesFermi-Dirac distribution functionIntrinsic carrier density and temperature dependenceImpurity dopingDoped semiconductorHall measurementEnergy band alignment of p-n junctionCurrent-Voltage characteristics of p-n diodesDiffusion capacitanceFabrication methods of p-n diodesLight absorption and ligh emission in semiconductorDefect in semiconductor and carrier recombinationOperating principle of solar cells and light emission diodesElementary properties of superconductorsApplications of superconductorsBose–Einstein condensate and BCS theorySummaryRead the textbook "Elementary Solid State Physics (Kodansha)[in Japanese]" before a lecture.

●Textbook

Elementary Solid State Physics (Kodansha)[in Japanese] Chapter 11 & 14 & 15

●Additional Reading

●Grade Assessment

Exercises (20%), Examination (80%)

●Notes

No registration requirements are imposed.[Implementation policy of classes related to dealing with new coronavirus infections] Refer to NUCT.

●Contacting Faculty

Chemical Energy Systems (2.0credits) (化学エネルギーシステム)

Course Type	Specialized Courses	
Class Format	Lecture	
Course Name	Department of Materials Science and Engineering	
Starts 1	3 Autumn Semester	
Elective/Compulsory	Compulsory Elective	
Lecturer	Noriyuki KOBAYASHI Associate Professor	Yoshihiro KOJIMA Associate Professor

●Course Purpose

The principle and basic theory on heat transfer with phase change such as boiling, condensation and evaporation, and heat exchange and combustion will be lectured. In addition, students will learn outlines of evaporator, dryer and heat exchanger which are designed based on the principle and basic theory. The fundamental knowledge on these subjects will be cultivated.

●Prerequisite Subjects

Physical Chemistry 1, Heat Transfer and Mass Transfer

●Course Topics

1.Heat transfer with phase change: boiling, condensation and evaporation
2. Heat and material balances in evaporator and dryer, and designs of evaporator and dryer
3.Thermal insulation(theory, optimum thickness of heat insulator and optimization of heat insulation)
4.Heat recovery, the theory of heat exchange and design of heat exchanger
5.Basic theory of combustion and combustion characteristics of gas-, liquid- and solid-fuels
6.Combustion calculations (theoretical amount of air, theoretical amount of combustion gas, excess air ratio, combustion temperature, etc)

●Textbook

N. Takenaka et al., Introduction to Heat Transfer(Corona Publishing Co.Ltd.)

●Additional Reading

Kagaku Kogaku Benran (Maruzen Co.Ltd.)
Heat Transfer (J. P. Holman; McGraw-Hill Inc.), etc.

●Grade Assessment

The evaluation of learning results will be carried out by an interim examination(35 scores), a term-end examination(35 scores) and exercises(30 scores).
A+: 100-95, A: 94-80B: 79-70, C: 69-65, -: 64-60, F: 59 scores or less.

●Notes

No registration requirements are required.

●Contacting Faculty

Allow time for questions in the class and the office.

Diffusion Systems (2.0credits) (拡散システム)

Course Type	Specialized Courses	
Class Format	Lecture	
Course Name	Department of Materials Science and Engineering	
Starts 1	3 Autumn Semester	
Elective/Compulsory	Compulsory Elective	
Lecturer	Motonobu GOTO Professor	Yoshiaki KAWAJIRI Professor

●Course Purpose

Principles and operations of diffusional separations are lectured. Focus is placed on characteristics of the operation and equipment design for differential and stage-wise operations. Gas absorption, distillation, extraction and adsorption are covered as typical operations. Exercises are also included to enhance practice of equipment design.

●Prerequisite Subjects

Physical chemistry 1, 2 Mixed-phase flow Mass transfer

●Course Topics

1. Principles of separation in partitioning between different phases, 2. Vapor liquid equilibrium, 3. Single stage distillation and flash evaporation, 4. Design of distillation column, 5. Extraction and adsorption, 6. Equipment for contact between different phases, 7. Equilibrium between gas and liquid, 8. Design of packed column, 9. Application of packed column

●Textbook

Bunri Process Kougaku no Kiso (Asakura Shoten)

●Additional Reading

Shintaikei Kagakukougaku Bunrikougaku (ohmsha)Kagaku Kougaku -Kaisetsu to Enshu - (Asakura Shoten)

●Grade Assessment

Examinations and Exercises

●Notes

●Contacting Faculty

Questions are better to be asked after the class.

Chemical Reaction Systems (2.0credits) (化学反応システム)

Course Type	Specialized Courses	
Class Format	Lecture	
Course Name	Department of Materials Science and Engineering	
Starts 1	3 Autumn Semester	
Elective/Compulsory	Compulsory Elective	
Lecturer	Seiichi TAKAMI Professor	Koyo NORINAGA Professor

●Course Purpose

In order to produce chemical products using chemical reaction at an industrial scale, chemical reactors should be suitably designed considering reaction kinetics, properties of product, and the production scale. This lecture treats the character of reactors including batch-type reactor and plug-flow reactor, their design rule, and the difference of various industrial reactor. Practices will be done during lecture.

Upon successfully completion of this course, students should become able to the following things.
1. Students will be able to predict the products from the continuous operation of various reactors.
2. Students will be able to design the optimum operation conditions from yield calculation of various reactors.
3. Students will be able to design the reactor at industrial scale based on experimental data.

●Prerequisite Subjects

Chemical Reaction Engineering, Physical Chemistry 3, Mathematics I, Mathematics II

●Course Topics

1. Continuous operation of CSTR
The products from CSTR reactors under steady-state and unsteady-state operations will be studied.

2. Continuous operation of PFR
The products from PFR reactors under isothermal and non-isothermal conditions will be studied.

3. Various types of chemical reaction system
The kinds of chemical reactors will be studied. The selection and optimization methods of the chemical reactor will be also studied.

4. Design of optimization of chemical reaction system
Design procedure of industrial reactor will be studied. The design based on the experimental data will be also studied.

The contents of the class should be reviewed until next class.

●Textbook

"Chemical Reaction Operation" ed. by Shigeo Goto, Asakura Publishing Co., Ltd. (in Japanese)

●Additional Reading

Will be introduced in the class.

●Grade Assessment

Grade assessment will be performed based on midterm exam, final exam, and quizzes about the kinds of reactors and the operation of reactors. Student will earn a credit if they understand and treat principle knowledges and grade will be determined by the degree of understanding.

●Notes

No requirements for taking this course.

[Plan of classes in response to Coronavirus Disease 2019]
Changes in the plan of classes are shown in the NUCT page of this course.

●Contacting Faculty

Questions are accepted during lectures. Questions are also accepted by e-mail after lectures.

E-mail addresses:
takami.seiichi@material.nagoya-u.ac.jp (Takami)
norinaga.koyo@material.nagoya-u.ac.jp (Norinaga)

System Control (2.0credits) (システム制御)

Course Type	Specialized Courses
Class Format	Lecture
Course Name	Department of Materials Science and Engineering
Starts 1	3 Autumn Semester
Elective/Compulsory	Compulsory Elective
Lecturer	FUJIWARA Koichi Associate Professor

●Course Purpose

To gain understanding on fundamentals of classical control theory for control system design of mechanical systems, electric circuit systems as well aschemical process systems.

The goals of this course are as follows:
1. To model control subjects
2. To solve linear differential equations by Laplace transform
3. To analyze properties of systems, such as stability, transient characteristics, and frequency responses
4. To understand feedback control systems and design PID parameters.
5. To design feedback control systems on MATLAB/Simulink.

●Prerequisite Subjects

Linear algebra 12, Calculus 12, Mathematics with Exercises 1

●Course Topics

1. Introduction (1 week)
2. Process modeling (1 week)
3. Laplace transform (1 week)
4. Transfer functions (2 weeks)
5. Analysis of transient responses (2 weeks)
6. Design and analysis of feedback control systems (2 weeks)
7. Multi-input multi-output systems (1 week)
8. Model prediction control (1 week)
9. Feedback control system design on MATLAB/Simulink
10. Examination and evaluation (1 week)

After each of learning unit, a home-work may be assigned.

●Textbook

Hashimoto, Hasebe, Kano, "Process Seigyo Kogaku", Asakura Shoten (2002)

●Additional Reading

Y. Yamamoto, "From Vector Spaces to Function Spaces: Introduction to Functional Analysis with Applications," Society for Industrial and Applied Mathematics (2012)

●Grade Assessment

Evaluation by Homework 20%, Exams 80%. To obtain credit, students should solve problems that are system modeling and analysis and feedback control system design.

●Notes

Students are required to learn linear algebra and calculus before this lecture.

●Contacting Faculty

Students are encouraged to ask questions during lectures. The lecturer will respect and answer questions as much as possible unless that would delay lecture progress.

Environmental System Engineering (2.0credits) (環境システム工学)

Course Type	Specialized Courses	
Class Format	Lecture	
Course Name	Department of Materials Science and Engineering	
Starts 1	3 Autumn Semester	
Elective/Compulsory	Compulsory Elective	
Lecturer	Hideki KITA Professor	Seiichi DEGUCHI Lecturer

●Course Purpose

Through the historical background of resource / environmental issues, environmental technology, and recent topics, students will acquire the ability to consider resource / environment issues from a scientific and comprehensive perspective, and acquire expertise in environmental engineering and engineering ethics.Through this lecture, students understand the historical background of the environmental problems, the issues that humankind should address, and the role that humans involved in engineering should do especially in the future of science and technology. The goal is each student will be able to explain specifically,as his/her own opinioins.

●Prerequisite Subjects

Kagaku kougaku Chemical engineering)Butsuiri kagaku(Physical chemistry

●Course Topics

1. Introduction to energy resources2. Understanding environmental issues3. Air, water quality Contamination of soil and its prevention4). Actual situation of environmental resource issues in Japan and the world5. Environmental load assessment index (life cycle assessment)6). Environmental issues to consider in entropy7). Sustainable development8). Natural capital* Some changes are possible.Because it is necessary to deepen understanding widely, a report is imposed as appropriate for home study.

●Textbook

None. Distribute prints if necessary.

●Additional Reading

Kagaku kougaku binran dai 6 han (maruzen)Netsugaku gairon (Asakura syoten)

●Grade Assessment

The degree of achievement for the achievement target is evaluated by reports and written tests.“Pass” is given to the student who is able to correctly understand the basic issues with respect to the items shown in the class contents,For the student who is able to understand more difficult questions, reflect them on the grade according to the level and results of the questions.

●Notes

No registration requirements are required.[Implementation policy of classes related to dealing with new coronavirus infections] For the implementation method of this subject, refer to NUCT of this subject.

●Contacting Faculty

We accept office hours (Wednesday 13-17 pm) or e-mail.Professor Hideki Kita: Extension 3096 email: kita.hideki@material.nagoya-u.ac.jpSeiichi Deguchi Lecturer Extension 3383 e-mail: deguchi.seiichi@material.nagoya-u.ac.jp

Materials System Engineering (2.0credits) (材料システム工学)

Course Type	Specialized Courses	
Class Format	Lecture	
Course Name	Department of Materials Science and Engineering	
Starts 1	3 Autumn Semester	
Elective/Compulsory	Compulsory Elective	
Lecturer	Tetsuya Yamamoto Associate Professor	Hideki KITA Professor

●Course Purpose

Students need to learn basic physical properties of organic materials such as ceramics, metals, and polymers, understand the functions of various materials used in chemical equipment and plants, and learn how these physical properties are involved in equipment design. In addition, we will learn about the mechanism by which the generation of fine damage leads to the destruction of huge structures due to heat and stress received from the outside.

By learning this lecture, students will be able to:
1. Understand the crystal structure, microdefects and microstructure of ceramics and metals, and understand how they are related to macro phenomena such as deformation and fracture under external force. In addition, the acquired knowledge can be applied to specific problems.
2. Understand the properties of polymers and their evaluation methods, and apply them to specific problems.
3. Understand the forming process of polymer materials

●Prerequisite Subjects

Butsuri kagakuPhysical Chemstry) and 2
Solid mechanics

●Course Topics

1. Micro structure including defects and crystal structure of hard materials (inorganic materials, ceramics / glass, metal materials)
2. Relationship between deformation and fracture behavior and microstructure under external force
3. Chemical and mechanical properties, manufacturing methods, and design methods
4. Polymer materials (organic materials), structure and physical properties of polymers, characterization, molding of polymers
5. Manufacturing and evaluation methods and properties of composite materials

Read the relevant textbook before each class. After the lecture, solve the textbook examples and chapter end problems by yourself. In addition, students will be required to submit a report assignment several times, so solve it and submit it.

●Textbook

For textbooks on metals and inorganic materials, do not use textbooks, but distribute materials as appropriate.

Koubunsi wo manabou -Introduction to Polymer Material Science-: Kenji Yokota (Chemistry)

●Additional Reading

koroido kagaku-kiso to Ouyou-(Tokyo kagaku doujin)

●Grade Assessment

The degree of achievement for the achievement target is evaluated by reports and written tests.
“Pass” is given to the student who is able to correctly understand the basic issues with respect to the items shown in the class contents,For the student who is able to understand more difficult questions, reflect them on the grade according to the level and results of the questions.

●Notes

No registration requirements are required.

●Contacting Faculty

Lectures accept during breaks after class and office hours.
Hideki Kita
Extension 3096
email:kita.hideki@material.nagoya-u.ac.jp
Tetsuya Yamamoto
Extension 3378
email:yamamoto.tetsuya@material.nagoya-u.ac.jp

Materials Engineering Exercises (2.0credits) (マテリアル工学演習)

Course Type	Specialized Courses		
Class Format	Exercise		
Course Name	Department of Materials Science and Engineering		
Starts 1	4 Spring Semester		
Elective/Compulsory	Compulsory		
Lecturer	Associated Faculty	Associated Faculty	Associated Faculty

●Course Purpose

The aim of this course is to deepen the understanding of mechanics of materials, condensed matter physics, physical chemistry, transport phenomena, and chemical engineering. Through the exercises for these subjects, students will acquire the fundamental skills and practical knowledge of the theoretical treatment of various issues in materials science and engineering.

●Prerequisite Subjects

Crystal Physics, Physical Chemistry (1-3), Chemical Processes Engineering, Mechanics of Materials, Materials Quantum Engineering, Materials Solid State Physics (1-2), Strength and Fracture of Materials, Heat Transfer and Diffusion, Phase Equilibria, Fluid Flow, Materials Quantum Chemistry, Chemical Reaction Engineering

●Course Topics

1. Exercises for mechanics of materials
2. Exercises for condensed matter physics
3. Exercises for physical chemistry
4. Exercises for transport phenomena
5. Exercises for chemical engineering

●Textbook

Textbooks are not specified, but materials will be distributed as needed for the exercises.

●Additional Reading

Specified as needed during the class.

●Grade Assessment

Reports and quizes are evaluated for the grade judgement. To pass, students must earn at least 60 points out of 100. It is required to apply the knowledge of mechanics of materials, condensed matter physics, chemical thermodynamics, transport phenomena, and chemical engineering to the theoretical treatment of various issues in materials science and engineering.

●Notes

No requirements for taking this class.

●Contacting Faculty

During the class or at the office upon resevation.

Fundamentals of Chemical Engineering (2.0credits) (化学工学概論)

Course Type	Specialized Courses		
Class Format	Lecture		
Course Name	Department of Materials Science and Engineering		
Starts 1	4 Spring Semester		
Elective/Compulsory	Elective		
Lecturer	Associated Faculty	Associated Faculty	Associated Faculty

●Course Purpose

In this course, students are required to make literature survey on specific problems closely related to their graduation research themes in the chemical fields of materials engineering. Through the course, students are expected to learn how to use scientific journals and databases for literature survey, and are also expected to acquire the necessary skills to use scientific and engineering English.

●Prerequisite Subjects

Each subject studied in Department of Materials Science and Engineering

●Course Topics

Literature survey, presentation and discussion on specific problems closely related to the graduation research theme

1. Advanced process engineering
2. Chemical systems engineering

●Textbook

Specified as needed during the class.

●Additional Reading

Specified as needed during the class.

●Grade Assessment

Both of presentation and discussion are evaluated for the grade judgement. To pass, students must earn at least 60 points out of 100. It is required to understand an effective way of using scientific journals and databases for literature survey in English and to explain specific problems closely related to the graduation research theme.

●Notes

No requirements for taking this class.

●Contacting Faculty

During the class or at the office upon resevation.

Introduction to Materials Engineering (2.0credits) (材料工学概論)

Course Type	Specialized Courses		
Class Format	Lecture		
Course Name	Department of Materials Science and Engineering		
Starts 1	4 Spring Semester		
Elective/Compulsory	Elective		
Lecturer	Associated Faculty	Associated Faculty	Associated Faculty

●Course Purpose

In this course, students are required to make literature survey on specific problems closely related to their graduation research themes in the fields of materials engineering. Through the course, students are expected to learn how to use scientific journals and databases for literature survey, and are also expected to acquire the necessary skills to use scientific and engineering English.

●Prerequisite Subjects

Each subject studied in Department of Materials Science and Engineering

●Course Topics

Literature survey, presentation and discussion on specific problems closely related to the graduation research theme

1. Computational materials design
2. Advanced measurement and analysis
3. Nanostructure design
4. Advanced process engineering
5. Materials creation engineering
6. Materials chemistry

●Textbook

Specified as needed during the class.

●Additional Reading

Specified as needed during the class.

●Grade Assessment

Both of presentation and discussion are evaluated for the grade judgement. To pass, students must earn at least 60 points out of 100. It is required to understand an effective way of using scientific journals and databases for literature survey in English and to explain specific problems closely related to the graduation research theme.

●Notes

No requirements for taking this class.

●Contacting Faculty

During the class or at the office upon resevation.

Graduation Thesis A (5.0credits) (卒業研究A)

Course Type	Specialized Courses		
Class Format	Experiment and Exercise		
Course Name	Department of Materials Science and Engineering		
Starts 1	4 Spring Semester		
Elective/Compulsory	Compulsory		
Lecturer	Associated Faculty	Associated Faculty	Associated Faculty

●Course Purpose

By working on specific research questions, you will build the skills you have used to integrate the knowledge you have learned and solve problems. Under the guidance of faculty members, research themes are determined, research plans are drafted, data is collected, data is analyzed, and results are interpreted and considered. In the process, you will learn how to ask questions, give presentation techniques, and discuss. Specifically, research topics are set in consultation with the supervisor, and research goals are clarified through information gathering, including survey reading and reading of literature, and a method of experiment or analysis to achieve the purpose is devised. And execute it, and summarize and announce it in writing and verbally. 1) Understand the engineering and academic objectives of the research project2) Establish information or research methods to solve problems through spontaneous learning, collecting information including foreign languages3) Research objectives and results obtained Students will be able to summarize and present in written and oral forms and acquire the ability to answer questions accurately.

●Prerequisite Subjects

●Course Topics

●Textbook

●Additional Reading

●Grade Assessment

●Notes

●Contacting Faculty

Graduation Thesis B (5.0credits) (卒業研究Ｂ)

Course Type	Specialized Courses		
Class Format	Experiment and Exercise		
Course Name	Department of Materials Science and Engineering		
Starts 1	4 Autumn Semester		
Elective/Compulsory	Compulsory		
Lecturer	Associated Faculty	Associated Faculty	Associated Faculty

●Course Purpose

By working on specific research questions, you will build the skills you have used to integrate the knowledge you have learned and solve problems. Under the guidance of faculty members, research themes are determined, research plans are drafted, data is collected, data is analyzed, and results are interpreted and considered. In the process, you will learn how to ask questions, give presentation techniques, and discuss. Specifically, research topics are set in consultation with the supervisor, and research goals are clarified through information gathering, including survey reading and reading of literature, and a method of experiment or analysis to achieve the purpose is devised. And execute it, and summarize and announce it in writing and verbally. 1) Understand the engineering and academic objectives of the research project, 2) Establish information or research methods to solve problems through spontaneous learning, collecting information including foreign languages, 3) Research objectives and results obtained Students will be able to summarize and present in written and oral forms and acquire the ability to answer questions accurately.

●Prerequisite Subjects

●Course Topics

●Textbook

●Additional Reading

●Grade Assessment

●Notes

●Contacting Faculty

Engineering Ethics (2.0credits) (工学倫理)

Course Type	Related Specialized Courses		
Class Format	Lecture		
Course Name	Department of Chemistry and Biotechnology	Department of Materials Science and Engineering	Department of Physical Science and Engineering
	Department of Energy Science and Engineering	Department of Electrical Engineering, Electronics, and Information Engineering	Department of Mechanical and Aerospace Engineering
	Civil Engineering	Architecture	
Starts 1	1 Spring Semester	1 Spring Semester	1 Spring Semester
	1 Spring Semester	1 Spring Semester	1 Spring Semester
	1 Spring Semester	1 Spring Semester	
Elective/Compulsory	Elective	Elective	Elective
	Compulsory	Elective	Elective
	Elective	Elective	
Lecturer	Part-time Faculty		

●Course Purpose

All students will push forward the preparations to a member of society through a college life having high flexibility as well as the lecture of the university, but this is the conscious problem that it is independent and should work on. Therefore, about life, the responsibility of the necessary member of society (a person of occupation and researcher solving another person such as engineers and social problem situation), found ability, ethic, it is the purpose of the class that gets an image at the beginning of student life. I solved many problems until now, and the engineer developed the society, but had much failure, accidents and the ethical disgraceful affair. I understand basic power to act as a member of society, an engineer ethically while having the viewpoint to the future a little while referring to a lot of such failure examples. In addition, I acquire a custom to think on the spot, and to be settled necessary for an engineer, a member of society. (the lecturer is engaged in a study and the business of the engineer ethic in professional engineer (nation qualification) with the work experience.)

●Prerequisite Subjects

●Course Topics

●Textbook

●Additional Reading

●Grade Assessment

●Notes

There are no prerequisites.

●Contacting Faculty

E-mail:roofrate3-nug@yahoo.co.jp

Outline of Engineering 1 (1.0credits) (工学概論第１)

Course Type	Related Specialized Courses		
Class Format	Lecture		
Course Name	Department of Chemistry and Biotechnology	Department of Materials Science and Engineering	Department of Physical Science and Engineering
	Department of Energy Science and Engineering	Department of Electrical Engineering, Electronics, and Information Engineering	Department of Mechanical and Aerospace Engineering
	Civil Engineering	Architecture	
Starts 1	1 Spring Semester	1 Spring Semester	1 Spring Semester
	1 Spring Semester	1 Spring Semester	1 Spring Semester
	1 Spring Semester	1 Spring Semester	
Elective/Compulsory	Elective	Elective	Elective
	Elective	Elective	Elective
	Elective	Elective	
Lecturer	Part-time Faculty		

●Course Purpose

Based upon the wide and deep experiences, alumini and/or aluminae of Nagoya University, who work the hub of society,give future perspectives, foster internal and external active personality and propose guideline for their further study.

●Prerequisite Subjects

Because it is a common subject not to affect a specialized subject, I do not appoint the subject to become the background.

●Course Topics

Experience every time own as "do your best younger student" a senior playing an active part in the social center I perform a class on the basis of this. In all eight times of classes, I perform orientation and the lecture by seven outside lecturers. What I check about a lecturer and a title released before a class of every time beforehand. After a lecture, conduct an additional investigation depending on the need including contents and the phrase handled in a lecture. In addition, submit it as you impose the report problem about lecture contents every time.

●Textbook

I distribute a slide or the print which the person in charge of each time lecturer uses as a lecture document.

●Additional Reading

Instructions will be given as necessary in class

●Grade Assessment

I evaluate an acquirement degree for the accomplishment by a report. I keep lecture contents of every time under control, and it is said that I pass if I can collect own thought and lets results reflect it according to the depth of the contents which were able to learn it such as the grasp of lecture contents, a guideline for the future dream, study of oneself.

●Notes

●Contacting Faculty

I cope after a lecture every time. Or ask the staff of the educational affairs section.E-mail:t-nagasaki@energy.nagoya-u.ac.jp

Outline of Engineering 2 (1.0credits) (工学概論第２)

Course Type	Related Specialized Courses		
Class Format	Lecture		
Course Name	Department of Chemistry and Biotechnology	Department of Materials Science and Engineering	Department of Physical Science and Engineering
	Department of Energy Science and Engineering	Department of Electrical Engineering, Electronics, and Information Engineering	Department of Mechanical and Aerospace Engineering
	Civil Engineering	Architecture	
Starts 1	4 Spring Semester	4 Spring Semester	4 Spring Semester
	4 Spring Semester	4 Spring Semester	4 Spring Semester
	4 Spring Semester	4 Spring Semester	
Elective/Compulsory	Elective	Elective	Elective
	Elective	Elective	Elective
	Elective	Elective	
Lecturer	Part-time Faculty		

●Course Purpose

It is recognized as an urgent issue to create low-carbon society in order to mitigate global warming. The objective of this lecture is to understand the current situation of Japan in terms of energy supply and demand as well as technologies of energy conservation and renewable energy utilization. Energy policy of Japan such as Energy Basic Plan is also one of the topics.
It is expected that the lecture provides fundamental understanding of measures to deal with reducing primary energy consumption.

●Prerequisite Subjects

Fundamentals of Engineering

●Course Topics

1. Situation of Japan with respect to energy
2. Energy policy and Energy Basic Plan
3. Solar energy technologies
4. Energy conservation technologies with wasted heat recovory
5. Social systems for low-carbon society
6. Try "Test of Energy"

●Textbook

None.

●Additional Reading

To be distributed in the lecture.
"Test of Energy", http://www.ene-kentei.jp

●Grade Assessment

Reports are required to be submitted during the lecture. The subjects are presented in the lecture.

●Notes

There are no prerequisites.

●Contacting Faculty

All questions are encouraged to be presented during the lecture.

Outline of Engineering 3 (2.0credits) (工学概論第３)

Course Type	Related Specialized Courses		
Class Format	Lecture		
Course Name	Department of Chemistry and Biotechnology	Department of Materials Science and Engineering	Department of Physical Science and Engineering
	Department of Energy Science and Engineering	Department of Electrical Engineering, Electronics, and Information Engineering	Department of Mechanical and Aerospace Engineering
	Civil Engineering	Architecture	
Starts 1	4 Autumn Semester	4 Autumn Semester	4 Autumn Semester
	4 Autumn Semester	4 Autumn Semester	4 Autumn Semester
	4 Autumn Semester	4 Autumn Semester	
Elective/Compulsory	Elective	Elective	Elective
	Elective	Elective	Elective
	Elective	Elective	
Lecturer	Emanuel LELEITO Lecturer	GRIB Dina Lecturer	Gang ZENG Lecturer
	Kiyohisa NISHIYAMA Designated Lecturer		

●Course Purpose

This course will introduce the history, the current state and future prospects of R&D (research and development) in various sectors related to the field of engineering in Japan. The course will expose you to a wide range of issues being tackled by engineers in different fields, with the aim of motivating and preparing you to pursue your research interest. You will have an opportunity to explore basic concepts and real-world applications, and to do a mini research tasks leading to a final presentation.

Apart from the engineering field related knowledge, this lecture will also help you develop the following skills:
Cross-disciplinary communication skills
Communication across language barriers (English/Japanese)
Online search and research skills for information gathering
Presentation skills

●Prerequisite Subjects

You do not require any background knowledge to join this class. Each lecturer will provide the basic knowledge that might be needed to understand the lecture topics.

●Course Topics

This class consists of “omnibus-style” lectures on the following topics.

1. Science, Technology and Innovations in Embedded Computing Systems (Gang ZENG)
- This lecture gives an overview of the embedded computing systems related technologies in Japan. In particular, the latest innovations on the low-energy and automotive applications will be introduced.
- The students are asked to participate in group discussion to share their ideas and thoughts about energy conservation and future automobiles.

2. The innovative factors of technologies in Japan (Kiyohisa NISHIYAMA)
- This lecture provides the participants with the concept of 40 innovation principles. Some Japanese technologies are broken down into the combination of the principles as examples.
- The students each are asked to analyse a technology of interest found in Japan. The students will be able to grab the concepts of any technological innovations after completing this lecture.

3. Science, Technology and Innovation for Disaster Risk Reduction (Emanuel LELEITO)
- This lecture gives students an overview of the Scientific and Technology Innovations that have contributed to Japan's leading role in Disaster Risk Reduction (DRR).
- DRR related discussions and presentation in class will help students exercise their creative thinking and problem solving skills.

4. Societal, Cultural and Economic Contexts of Engineering Practice in Japan (Dina GRIB)
- The last part of this course introduces you to the Science, Technology and Society studies (STS) field and provides a brief overview of how Japanese cultural, economic, societal and political tradition affects technological innovation and scientific research as well as how STI in turn affect Japanese culture, society and politics.
- The participants will be invited to conduct a mini case study using online materials, share their findings in class and participate in group discussions.

●Textbook
Lecture materials will be distributed in class during each lecture.

●Additional Reading
References and materials for additional reading will be introduced in class during each lecture.

●Grade Assessment
Credits will be awarded to those students who score over 60 out of 100 based on the following evaluation criteria:

1) Reports (60%): Each lecturer will ask you to prepare and submit reports to valuate your understanding of the topics taught. The reports will be worth 60% of the total score.
2) Presentation (40%): You will be asked to do a final presentation based on one or a combination of the topics taught. The presentation will require that you to do independent online research to gather necessary information and present the topic in 3-5 minutes. Your understanding of the topic as well as the effectiveness of your presentation will be evaluated. The presentation is worth 40% of the total score.

●Notes
None

●Contacting Faculty
Questions are received during or after class time. Lecturers will provide contact information during class orientation.

Outline of Engineering 4 (3.0credits) (工学概論第４)

Course Type	Related Specialized Courses		
Class Format	Lecture		
Course Name	Department of Chemistry and Biotechnology	Department of Materials Science and Engineering	Department of Physical Science and Engineering
	Department of Energy Science and Engineering	Department of Electrical Engineering, Electronics, and Information Engineering	Department of Mechanical and Aerospace Engineering
	Civil Engineering	Architecture	
Starts 1	1 Spring Semester	1 Spring Semester	1 Spring Semester
	1 Spring Semester	1 Spring Semester	1 Spring Semester
	1 Spring Semester	1 Spring Semester	
Elective/Compulsory	Elective	Elective	Elective
	Elective	Elective	Elective
	Elective	Elective	
Lecturer	Part-time Faculty		

●Course Purpose

Elementary ClassThis course is intended to teach Japanese to students who have not learnt Japanese before or who have learned only a very little. Basic Japanese which is necessary for daily life in Japan will be taught.
The students study the fundamentals of grammar and basic conversational expressions. The students are requested to communicate in daily life using simple expressions.
Intermediate ClassThis course is intended to teach Japanese to students who already learned Japanese of Elementary level. The aims of this study are to obtain the ability necessary to explain their experiences concretely.
The students are requested to communicate in their study in Japanese. Depending on the students' Japanese ability, the advanced class will also be prepared.

●Prerequisite Subjects

Elementary ClassNone
Intermediate ClassElementary Japanese

●Course Topics

Elementary Class1.Pronunciation of Japanese 2.Structure of Japanese sentences 3.Fundamental vocabulary and expressions 4.Conversation practice 5.Listening practice, Students must read the part which they will study in the next lecture.
Intermediate Class1 Grammar, 2 Conversation, 3 Opinion delivery, 4 Reading comprehension, 5 Listening practice, The students must momorize the most important sentences which they will study in the next lecture.

●Textbook

Elementary ClassNIHONGO Breakthrough, From suruival to communication in Japanese, JAL Academy, ASK Publishing Co.Ltd.

Intermediate Classweekly J ： 6

●Additional Reading

I introduce it to progress appropriately

●Grade Assessment

Elementary ClassClass performance 20Assignments 20Interview test and examination30, Presentation 30
In each item, the ability of comversation is an important check point.
Intermediate ClassClass performance 20Assignments 10Interview test 20Written examination20, Presentation 30.

In each item, the ability of correct expressions is an important check point.
These scores are summed and evaluated. The students with the evaluation S, A, B, or C can pass this subject.

●Notes

This subject is open for NUSIP students.

●Contacting Faculty

Ext. 6797 ishida@nuem.nagoya-u.ac.jp

Technical Writing (2.0credits) (テクニカルライティング)

Course Type	Related Specialized Courses		
Class Format	Lecture		
Course Name	Department of Materials Science and Engineering	Department of Physical Science and Engineering	Department of Energy Science and Engineering
	Department of Electrical Engineering, Electronics, and Information Engineering	Department of Mechanical and Aerospace Engineering	Civil Engineering
	Architecture		
Starts 1	4 Spring Semester	4 Spring Semester	4 Spring Semester
	4 Spring Semester	4 Spring Semester	4 Spring Semester
	4 Spring Semester		
Elective/Compulsory	Elective	Elective	Elective
	Elective	Elective	Elective
	Elective		
Lecturer	Emanuel LELEITO Lecturer	Gang ZENG Lecturer	GRIB Dina Lecturer

●Course Purpose

This course is to learn the logical thinking and the method of expression for sending scientific and technical contents to others in English and learn how to apply these methods to technical writing and presentation in English.

What you will get in this course:
1. Understand logical thinking and structure issues.
2. Understand and write the document structure that leads to problem solving.
3. Write abstracts of scientific and technical papers in English.
4. Apply the above methods to presentations and debates in English.

●Prerequisite Subjects

This course will be taught from the basics, background subjects are not specified.

●Course Topics

1. Research skills
1.1 Academic literacy and critical reading
1.2 Logical thinking and structuring logic
1.3 Avoiding plagiarism
2. Writing skills
2.1 Understanding document structure
2.2 Organizing document structure
2.3 Writing abstracts in English
3. Presentation skills
3.1 Creating slides in English
3.2 Presentation and Q & A in English
3.3 Discussion in English

Students are required to read related contents of next lecture in advance. Reports will be assigned after each lecture, which should be completed independently by searching necessary information. Reports and final presentation will be used for evaluation.

●Textbook

No textbook is specified. Lecture materials will be distributed in each class.

●Additional Reading

A Manual for Writers of Research Papers, Theses, and Dissertations: Chicago Style for Students and Researchers (Chicago Guides to Writing, Editing, and Publishing) - Kate L. Turabian, Revised by Wayne C. Booth, Gregory G. Colomb, Joseph M. Williams, Joseph Bizup, William T. FitzGerald and the University of Chicago Press Editorial Staff.

●Grade Assessment

Evaluation will be conducted based on reports and final presentation. Credits will be awarded to those students who can write abstract and present idea using basic skills.

●Notes

●Contacting Faculty

Questions will be accepted during or after the lecture.

Introduction to Materials Engineering (1.0credits) (マテリアル工学概論)

Course Type	Related Specialized Courses		
Class Format	Lecture		
Course Name	Department of Materials Science and Engineering		
Starts 1	1 Spring Semester		
Elective/Compulsory	Elective		
Lecturer	Associated Faculty	Associated Faculty	Associated Faculty

●Course Purpose
The aim of this course is to understand the outline of the Department of Materials Science and Engineering througth the introductory talk on the current research topics.

●Prerequisite Subjects
Mathematics, physics, and chemistry at a high school level

●Course Topics
You learn the outline of current research topics in each department shown below.

1. Computational materials design
2. Advanced measurement and analysis
3. Nanostructure design
4. Advanced process engineering
5. Materials creation engineering
6. Chemical systems engineering
7. Materials chemistry

We will give you assignments as appropriate, you should submit by the deadline.

●Textbook
Textbooks are not specified, but documents will be distributed as needed.

●Additional Reading
We will introduce as needed.

●Grade Assessment
The submitted report is evaluated for the grade judgement. To pass, students must earn at least 60 points out of 100. It is required to explain the outline of the current research topics of the laboratories in the Department of Materials Science and Engineering.

●Notes
There is no requirement to take this course.
This course will be conducted remotely (on-demand type).
The NUCT function "Message" should be used to ask questions.
The NUCT function "Message" should be used to exchange opinions among students regarding this course.

●Contacting Faculty
As mentioned above, questions about this course are accepted using the NUCT function "Message".
Representative instructor of this course: Toshio Ogawa

Training in Industrial Plants (1.0credits) (工場実習)

Course Type	Related Specialized Courses		
Class Format	Practice		
Course Name	Department of Materials Science and Engineering		
Starts 1	3 Spring Semester		
Elective/Compulsory	Elective		
Lecturer	Associated Faculty	Associated Faculty	Associated Faculty

●Course Purpose

Students are required to have practical experience of working in an industrial factory of materials production. Through the practice, students are expected to raise up their potentialities as materials and chemical engineers and to have solid image of their own future life in the societies of scientific and industrial fields

●Prerequisite Subjects

Major Subjects for Materials Science and Engineering

●Course Topics

●Textbook

●Additional Reading

●Grade Assessment

Training in industrial plants more than 45 hours, written reports, and evaluation by the coordinators of the plants.

●Notes

●Contacting Faculty

Technical Visits in Industrial Plants (1.0credits) (工場見学)

Course Type	Related Specialized Courses		
Class Format	Practice		
Course Name	Department of Materials Science and Engineering		
Starts 1	3 Autumn Semester		
Elective/Compulsory	Elective		
Lecturer	Associated Faculty	Associated Faculty	Associated Faculty

●Course Purpose

Students are required to visit industrial factories and research institutes. Through the visit, students are expected to deepen their understandings of the relation between fundamental knowledge and practical applications, and are also expected to have knowledge of the recent progress in the technological aspects of materials production industries.

●Prerequisite Subjects

Major subjects for Materials Science and Engineering

●Course Topics

●Textbook

●Additional Reading

●Grade Assessment

●Notes

●Contacting Faculty