1. **Japanese 1, 2, 3, 4**
Assoc. Prof. Wataru NAKAMURA, Assoc. Prof. Kensaku SOEJIMA and staffs

**Japanese 1**

Japanese 1 (B110) is for beginners. Successful students of the course can expect to pass Level 4 of the Japanese Language Proficiency Test. The contents of the course are as follows:

1. Japanese alphabet (hiragana and katakana): Learn to read and write the basic Japanese syllabary.

2. Lessons 1 to 25 of “Minna no Nihongo I” published by 3A Network Corporation, Tokyo: Learn and practice useful sentence patterns in such conversational situations as self-introduction, shopping, talking about daily life, taking a train, asking friends to go somewhere, birthday greetings, visiting a friend’s office, explaining condition of one’s illness, asking for directions, sending a package at the post office.

The class meets four times (in two days) a week. The course grade is based on attendance, performance and test results.

**Japanese 2**

Japanese 2 (B210) is for those who have finished Japanese 1 or those who have equal proficiency. Successful students of the course can expect to pass Level 3 of the Japanese Language Proficiency Test. The contents of the course are as follows:

Course materials: Lessons 26 to 50 of “Minna no Nihongo II” published by 3A Network Corporation, Tokyo:

In class activities: Practices of useful sentence patterns in such conversational situations as inviting a friend to have lunch together, rejecting someone’s offer politely, talking about one’s family, ordering at a restaurant, asking for permission, visiting a Japanese family, talking over the telephone, asking someone for his/her opinion, presenting one’s opinion, explaining how to use a machine, making a farewell speech.

The class meets four times (in two days) a week. The course grade is based on attendance, performance and test results.
Japanese 3

Japanese 3 is for those who have taken Japanese 2 in the preceding semester or for those who have equal proficiency. You must take all the four classes of Japanese 3 (G3, S3, R3, and P3) to receive the credit for the course. The contents of Japanese 3 are as follows:

1. G310 (Grammar):
Learn and practice post-beginning level grammatical patterns. The course materials are provided by the instructor.
2. S310 (Speaking):
Learn how to convey one’s ideas and opinions orally in Japanese by having discussions and presentations on familiar and current topics in class.
3. R310 (Reading):
Practice reading easy but authentic reading materials to be familiarized with literary Japanese and acquire reading comprehension skills. The textbook is "Daigaku/Daigakuin Ryuuugakusei no Nihongo 1" published by ALC.
4. P310 (Practice in Japanese):
Practice the use of Japanese language in general in order for you to learn how to write a resume/handout, prepare for an oral presentation, and engage in discussion in Japanese.

Japanese 4

Japanese 4 is for those who have completed Japanese 3 in the preceding semester or those who have equal proficiency (i.e., Level IV according to the placement test for JAPANESE LANGUAGE PROGRAM AT KAWAUCHI). When you successfully complete this course, your proficiency will be between Level 1 and Level 2 of the Japanese Language Proficiency Test (http://www.jees.or.jp/jlpt/en/). Japanese 4 consists of the following six classes, and you must take FOUR of them to receive the grade for the course:

1. G410 (Grammar):
2. S410 (Speaking):
Learn how to convey one’s ideas and opinions orally in Japanese by having discussions and presentations on familiar and current topics in class. You are required to write a resume and short reports. The course materials are provided by the instructor.
3. R410 (Reading):
Practice reading easy but authentic reading materials to familiarize yourself with literary Japanese and boost up your reading comprehension ability. The textbook is "Daigaku/Daigakuin Ryuuugakusei no Nihongo 3: Ronbun Dokkai hen" published by ALC.

4. P410 (Practice in Japanese):
Practice the use of Japanese language in general in order for you to learn how to write a resume/handout, prepare for an oral presentation, and engage in discussion in Japanese.

5. SP400 (Short Program Planning):
In collaboration with Japanese students, we will be planning an educational tour for foreign students visiting Sendai during their short-term program (approximately two weeks). In the tour, foreign students will experience Sendai, the Tohoku region, and Japanese culture. We will research examples of short-term programs in various countries, and acquire a multicultural perspective that will allow both Japanese students and foreign students to assess the program from both the viewpoint of visitors and hosts.

6. CP400 (Collaborative Project)
In this class, students will work with Japanese students on visits to the Miyagi Museum of Art in the fall term and the Sendai City Museum in the spring term. They will exchange opinions, and help each other on a project. They will work together on a single presentation, while sharing their values and ideas.

Each class has its own class and exam schedule and grading policy, which are to be announced on the first day of the class. Japanese 3/4 grade will be based on the average score of the four classes you take.
2. **Japanese Culture A and B**  
Part-time Lecturer Koji SHIDARA

Japanese Culture A and B are exploratory courses designed to help the students in the Junior Year Program in English to learn about and share insights into various aspects of the living culture of Japan. Nearly the same contents are covered in the two classes, which are offered in different semesters, class A in the fall semester and class B in the spring semester. The courses comprise three basic approaches—lectures on certain cultural aspects of the country, reading and discussion of literature, and field trips to places of cultural significance. Lectures, reading and field trips are designed to complement one another.

The lecture subjects include, to name a few, the sustaining of traditional cultural activities, the significance of the 17th century diplomatic mission from Sendai to the Vatican, or the cultural implications behind the reconstruction effort following the 2011 earthquake and tsunami disaster. Reading selections will include literature which arose from the 2011 earthquake and tsunami experience as well as a few stories featuring the 17th century diplomatic mission, both of which will prepare the class for field trips to destinations including Ishinomaki, a municipality that was seriously affected by the 2011 tsunami.

The two courses also serve as gateways to opportunities for volunteer activities for those students who are interested. Some of the people we meet as part of the class are actively involved in the reconstruction effort following the 2011 earthquake and tsunami event. By volunteering to help out in these actions, students can actually take part in the building of new culture for this nation.

Textbooks:

References:
3. **Japanese Culture C and D**  
Part-time Lecturer Koji SHIDARA

Japanese Culture C and D are exploratory courses designed to help the students in the Junior Year Program in English to learn about and share insights into various aspects of the living culture of Japan. Nearly the same contents are covered in the two classes, which are offered in different semesters, class C in the fall semester and class D in the spring semester. The courses comprise three basic approaches—lectures on certain cultural aspects of the country, reading and discussion of literature, and field trips to places of cultural significance. Lectures, reading and field trips are designed to complement one another.

The lecture subjects include, to name a few, the story of a samurai witnessing Japan's transition from the feudal age to the modern age, sustaining of one of the oldest sake breweries in the nation, or the cultural implications behind the reconstruction effort following the 2011 earthquake and tsunami disaster. Reading and discussion will focus on short stories written by such modern authors as Enchi Fumiko, Higuchi Ichiyo, and Miyazawa Kenji. As for field trips, the Shiroishi Castle, a sake brewery, and Buddhist temples make up part of the destinations.

The two courses also serve as gateways to opportunities for volunteer activities for those students who are interested. Some of the people we meet as part of the class are actively involved in the reconstruction effort following the 2011 earthquake and tsunami event. By volunteering to help out in these actions, students can actually take part in the building of new culture for this nation.

**Textbooks:**

**References:**
4. **Science, Technology and Industry of Japan**  
   *(Contemporary Engineering Industry in Japan)*  
   Emeritus Prof. Yoshihito SHIGENO

This course aims at providing knowledge on the distinctive features of traditional and contemporary Japanese industries.

1. Guidance
2. Electric vehicle I
3. Electric vehicle II
4. Electric vehicle III
5. Electric vehicle IV
6. Super steel I
7. Super steel II
8. Katana (Japanese Sword) I
9. Super conductivity-magnet levitation train I
10. Super conductivity-magnet levitation train II
11. Robot (humanoid) I
12. Robot (humanoid) II
13. Robot (humanoid) III
14. Semiconductor I
15. Semiconductor II

Some lecture materials are to be provided in advance of the class. VTR will be often used for better understanding of the lectures. Grading is evaluated based on the presentation and class attendance.

Reference book:
- *Introduction to Solid State Physics* by C. Kittel, John Wiley & Sons, 2005
5. Mathematics A and B
Assoc. Prof. Takuya YAMAUCHI, Assoc. Prof. Shouhei HONDA,
Assoc. Prof. Tsukasa IWABUCHI

Mathematics A
1. Introduction to elementary number theory I
   * Review in number theory
   * Diophantine equation, infinite descent, and Fermat's last theorem
   * Prime number theorem
   * A proof of Prime number theorem
   * Open problems
2. Introduction to spherical geometry
   * Euclidean geometry
   * Cosine formula
   * Positive curvature
   * Gauss-Bonnet formula on sphere
3. Fourier series and its application
   * Fourier coefficients and series
   * Point-wise convergence of Fourier series
   * Application to partial differential equations

Mathematics B
1. Introduction to elementary number theory II
   * Review on groups, rings, and fields
   * Congruence and quadratic reciprocity law
   * Congruence number problem and elliptic curves I
   * Congruence number problem and elliptic curves II
   * Open problems
2. Introduction to hyperbolic geometry
   * Euclidean geometry
   * Cosine formula
   * Negative curvature
   * Gauss-Bonnet formula on hyperbolic space
3. Fourier transform and its application
   * Fourier transform
   * Point-wise convergence of Fourier transform
   * Application to partial differential equations
6. **Introductory Courses of Experimental Research in Physics III**

Prof. Masayuki YOSHIZAWA

Course Objectives and Outline
Experiments are very important for development of new physics. Based on basic knowledge of physics, students experience introductory experiments of leading researches.

Learning Goal
The goal of this program is to let students experience basic research of experimental physics.

Course Content
Students are required to perform two subjects from (a) through (o) listed as below. (Subjects opened for JYPE course depend on year.)

1. Experimental Nuclear and Particle Physics
   (a) Experimental Particle Physics (Research Center for Neutrino Science)
   (b) Experimental Nuclear Physics
   (c) Intermediate Energy Nuclear Physics

2. Condensed Matter Experiment
   (d) Photoemission Solid-State Physics
   (e) Solid State Physics on Nano-Network Solids
   (f) Low Temperature Quantum Physics
   (g) Macroscopic Quantum Phenomena
   (h) Microscopic Research on Magnetism
   (i) Low-Dimensional Quantum Physics
   (j) Surface Physics
   (k) Soft Matter Biophysics
   (l) Solid State Photophysics
   (m) Solid-State Quantum Transport
   (n) Ultrafast Spectroscopy

Course Schedule
1. Entry and assignment of subjects
   Students are requested to contact Prof. M. YOSHIZAWA by Email (m-yoshizawa@m.tohoku.ac.jp) for entry to the course.
   Assignment of subjects is done by office considering request and capacity.
2. November – December
The first subject.

3. December – January
The second subject.

Assessment Criteria
Students will be evaluated based on: class attendance, presentations, and reports.
Course Description
The purpose of the class is to understand a concept of atomic orbitals, chemical bonds, constitution of atom, quantum mechanics, periodicity of elements, molecular orbital and chemical bond. We also learn briefly about crystal field theory, ligand field theory and resultant coordination compounds.

Outline
- Self introduction and guidance of this class.
- Learn concept of quantum mechanics and Shrōdinger equation, and understand quantum numbers and atomic orbitals.
- Learn periodicity of elements and their properties (ionization energy, electron affinity, electron negativity, etc).
- Examination
- Learn molecular orbital and chemical bonds.
- Learn the concept of crystal field theory, ligand field theory and coordination compounds.
- Learn spectrochemical series, spin state, d-d transition
- Learn symmetry of the coordination molecules.

Text books, Shriver & Atkins’ Inorganic Chemistry. 5th edition, Oxford University Press.

Grading, Students will be evaluated based on: class attendance, presentations, in-class participation, homework assignments, reports and the final exam.
8. **Physical Chemistry**  
Assoc. Prof. Hideaki TAKAHASHI, Assoc. Prof. Asuka FUJII,  
Assoc. Prof. Yukiyoshi OHTSUKI, Assoc. Prof. Yutaka SHIBATA

Course Description  
Modern physical chemistry is the basis of applied science and engineering. Reaction kinetics is useful in a variety of chemical reactions occurring in our environment. Spectroscopy is an essential tool in life science and material science. In order to understand chemical reaction and spectroscopy, one has to learn the fundamentals of quantum chemistry and statistical thermodynamics. In this course, these two essential subjects will be given by four different lectures who are experts of modern physical chemistry.

Outline  
- Reaction kinetics and dynamics  
  - Kinetic Theory of Gases, The Rates of Chemical Reactions, Theories of Chemical Reactions  
- Quantum chemistry  
  - Quantum theory, Atomic orbitals, Many electron atoms, Molecular orbitals  
- Spectroscopy and molecular structures  
  - Rotational, vibrational and electronic spectroscopy, Application of spectroscopy  
- Current trends in physical chemistry  
  - Basic concepts of computational chemistry, electronic structure, molecular simulation

Text books, Any textbook with the title including “physical chemistry” will be fine. Each of the lecturers may have one’s favorite textbooks and study-aid books. These will be announced at the beginning of each topic.

Grading, Students will be evaluated by each lecturer with attendance, short tests, or reports depending on the lecturer, which will be explained during the lectures.
This course aims at learning the outlines of geophysics. The following items, which are actively investigated at the Department of Geophysics, are especially focused on:

(1) Solid earth physics
Selected topics from the classical and the latest researches on seismology, paleo-seismology and seismic hazard assessment, together with probabilistic approach of long-term earthquake forecasting to mitigate damage, several basic earthquake statistics, and physics of stress transfer to understand the time dependency of seismic hazard.

(2) Fluid earth (atmosphere and ocean) physics
Selected topics from meteorology, global warming, and physical climatology for the purpose of obtaining a basic knowledge about climate change and related global environment problems.

(3) Solar-terrestrial and planetary physics
Selected topics from geomagnetism, upper atmosphere physics, and planetary science for the purpose of obtaining a basic knowledge about the electromagnetic environment of the earth and planets.

The evaluation will be mainly based on a record of attendance, and contribution to discussions.
10. Dynamics of the Earth
Prof. Motohiko MURAKAMI, Associate Prof. Takahiro KURIBAYASHI
Assist.Prof. Tatsuya SAKAMAKI, Assist.Prof. Yoshihiro Furukawa,
Assist.Prof. Akio GOTO

This is the introductory geology program to understand the Earth dynamics. The constituents of the Earth (rocks and minerals) and their beauty will be taught; museum tour is planned. The structure of the Earth and driving force for the Earth dynamics (volcanic activities, earthquake, hot spring activities and so on) will be discussed; a short field excursion around Sendai is planned. Life is also very important constituents of the Earth, and it will be discussed how life was flourished in the early Earth and how they coevolved with the Earth. Geological aspects of current environmental problems (global warming, etc.) and their possible solution will be discussed.
11. Ecology and evolution
Prof. Jotaro URABE, Prof. Kouki HIKOSAKA, Assoc. Prof. Shuichi SHIKANO,
Assistant Prof. Wataru MAKINO, Assistant Prof. Masahiro AIBA,
Assoc. Prof. Satoki SAKAI, Prof. Masakado KAWATA, Prof. Masayuki MAKI,
Assoc. Prof. Takashi MAKINO, Prof. Satoshi CHIBA, Assistant Prof. Koji YONEKURA,
Assistant Prof. Riichi OGUCHI, Assistant Prof. Motonari OHYAMA,
Assistant Prof. Shinichiro MARUYAMA

This course aims to give students some basic concepts on vegetation, ecology and evolution
using materials lecturers have been studying. Students are required to attend the class and
to submit an essay dealing with a topic covered in one of the lectures. Do not skip class
without notifying the lecturer by e-mail in advance.

Global change and plants (K. Hikosaka)
Atmospheric CO₂ concentration is expected to increase in future. Plants are an important
component of ecosystem as they absorb CO₂ by photosynthesis. So far a number of
experiments have been conducted to elucidate plant responses to elevated CO₂. In this
course, I introduce general knowledge and our recent findings on plant responses to
elevated CO₂.

Floral ecology of plants (S. Sakai)
Animal pollinated plants attract pollinators by presenting visual flowers and rewarding
nectar and pollen, and the strategy of attracting pollinators has been widely diversified. I
lecture the adaptive significances of flowers: on the function of floral organs and how
flowers attract pollinators.

An introduction of Ecological Stoichiometry (J. Urabe)
This lecture introduces you a unified basic theory on balance of chemical elements in
individual performance and biological interactions, which is useful to understand how
individual fitness is related with ecosystem processes.

Evolution (M. Kawata)
The evolution is a change over time in the proportions of individual organisms differing
genetically in one or more traits. Evolution is the most important factor creating biological
diversity. The purpose of this lecture is to explain basic mechanisms for evolution within
populations and evolution of creating species.
Reproductive isolation of plant species (M. Maki)
Reproductive isolation is a mechanism interfering gene flow between different species, and maintaining unity of species. Many kinds of reproductive isolations are known in wild plant species. In this talk, I will introduce some of them by showing examples and discuss plant speciation, the process by which different species arise, from the view of development of reproductive isolations.

Gene and genome duplication (T. Makino)
I give a lecture focusing on animal evolution driven by gene and genome duplication. Gene duplication frequently occurs in eukaryotic genomes and plays a major role in evolution. Whole genome duplication has made a significant contribution to vertebrate evolution.

Heterospecific mating interactions (W. Makino)
Heterospecific mating interactions are important for the ecology and evolution of co-occurring species. Genetic introgression between species could occur when the level of heterotrophic mating interactions is high. Even when no hybrid offspring are produced between species, heterospecific mating interactions can still be important because conspecific may suffer from fertilization limitation through the reproductive interference by heterospecific, which in turn negatively affect the population dynamics of conspecific. Theoretical studies show that the reproductive interference may work in nature as an efficient mechanism to cause habitat partitioning in either time or space between species (sexual competition).

Island biology (S. Chiba)
Fauna and flora of oceanic islands and ancient lakes have provided excellent model systems for ecology, evolution, and conservation biology. I introduce examples of studies on island ecosystems that have contributed to our understanding of how biological diversity was created and how it can be maintained.

Microorganisms and environments (S. Shikano)
Nucleic acid-based methods for examining microorganisms in the environments will be lectured with comparison to classical methods that use the microscopic and culture techniques. In addition, we will talk about the microorganisms in the environments which play important roles in the element cycles.

Functional ecology in plant response to environmental change (R. Oguchi)
Plants experience various environments in their life in time and space. Ecological and physiological viewpoint of plant response to the environmental change, especially about the
mechanisms and restriction of adaptation and acclimation to the change in light environment will be lectured.

**Biodiversity and ecosystem services (M. Aiba)**
Ecosystem services are variable benefits of ecosystems to human well-being. Recent studies on relationships between biodiversity and ecosystem functions/services have demonstrated essential roles of biodiversity for provisioning of ecosystem functions/services, the stability and the multidimensionality. I explain the mechanism for the positive relationship between biodiversity and ecosystem functions/services from a perspective of plant community ecology.

**Regional floras and herbaria: source of information of ecological studies (K. Yonekura)**
Currently biodiversity studies on land plants have been carried out throughout the World, and numerous samples (herbarium specimens, living plants and DNA samples, images, etc.) have been accumulated in research centers on each work. Based on these studies numerous floristic works have been published as a results of surveys in many levels of coverage area (nature reserve, township, region, island/s, nation, continent …), and voucher specimens of these studies are eventually kept into regional herbaria for future reference. In this lecture I introduce usefulness and how to use regional floras and herbaria as the source of information of further ecological studies. Inside tales on my compilation of regional floras (well or ill-studied area) and on my management of herbarium of Tohoku University are also included.

**Dendrochronology (M. Ohyama)**
Dendrochronology is the science of dating tree rings. It provides the most reliable dating with the highest accuracy of any of other paleorecords, and includes investigations of the information content in the structure of dated rings and applications to environmental and historical questions. I explain its principles, methods, and applications for archaeology, ecology and paleoclimatology.

**Endosymbiosis and the origin of plants (S. Maruyama)**
Endosymbiosis has been a driving force of the evolution and diversification of ecosystems. In this lecture we overview the following topics and recent progress in our understanding of how photosynthetic life forms have originated and evolved.
1. Endosymbiotic models for the evolution of the eukaryotic cells
2. Primary and secondary endosymbioses giving rise to photosynthetic organelles
3. ‘Solar-powered’ animals harboring endosymbiotic algae
12. Molecular and Cellular Biology
Assoc.Prof. Kazumasa OHASHI, Prof. Gaku KUMANO, 
Assistant Prof. Ryusuke YOKOYAMA, Prof. Koji TAMURA, Prof. Asako SUGIMOTO, 
Assoc. Prof. Kenichiro TSUTSUI, Assoc. Prof. Masayuki KOGANEZAWA, 
Prof. Junko KYOZUKA, Prof. Mitsunori FUKUDA, Prof. Erina KURANAGA, 
Prof. Taku TANIMOTO

This course offers an introduction to biochemistry, genetics, cell biology, early development, 
and neurobiology; emphasis on the cell as the basic unit of life: its composition, functions, 
replication, and differentiation. For evaluation, students are required to attend the class, 
and must submit an essay dealing with a topic covered in one of the lectures.

01. Cell motility and cytoskeleton (K. OHASHI) 
02. Germline cell development in animal embryos (G. KUMANO) 
03. Molecular biology of plant (R. YOKOYAMA) 
04. Pattern formation in vertebrates (K. TAMURA) 
05. Dynamic cellular behaviors in embryogenesis (A. SUGIMOTO) 
06. Investigation of the brain function by neurophysiological methods (K. TSUTSUI) 
07. Neural mechanisms of courtship behavior (M. KOGANEZAWA) 
08. Pattern Formation in Plants (J. KYOZUKA) 
09. Membrane dynamics in cells (M. FUKUDA) 
10. Collective cell movement in epithelial morphogenesis (E. KURANAGA) 
11. Reward, punishment, and neural circuits (T. TANIMOTO)
13. **Nuclear Physics**  
Prof. Satoshi NAKAMURA

The goal of modern nuclear physics is to understand quantum many-body system interacting by the strong interaction. Based on a picture which treats a nucleus as multi-quark system or hadronic system, basic introduction to the modern nuclear physics will be given. Introducing recent experimental techniques and results, it will be discussed how we understand behavior of materials under extreme conditions like early universe or deep inside of neutron stars. The goal of this lecture is to learn basic concept of modern nuclear physics and recent research techniques. Evaluation will be based on class participation, quiz during each lecture and the final exam or essay.

**Course Outline**

01. What is nuclear physics? Definition of nuclear physics in this course and basic terminologies necessary for nuclear physics study will be explained.
02. Mass of nucleus and binding energy of nucleon will be discussed.
03. Lifetime of radio isotopes, radiation and radiation effects to health will be explained.  
   Course participants will discuss about the Fukushima accidents.
04. Iso-spin and charge symmetry of nuclear force will be discussed.
05. Electron scattering experiments and exotic atoms will be discussed.
06. Rosenbluth formula and experiments to measure form factors will be discussed.
   Relation between the results of those experiment and charge distribution of nucleus will be discussed.
07. Quasi-elastic scattering and nuclear resonances will be discussed.
08. Deep inelastic scattering and structure function will be discussed.
09. Quark model and Baryons will be explained.
10. Baryon magnetic moment and color in QCD will be explained.
11. Nuclear force, Fermi gas model and neutron stars will be discussed.
12. Shell model and hypernuclei will be discussed.
13. Final Examination

**Textbook**

No textbook will be used. Resumes with necessary information will be given in the course. If you want to study modern nuclear physics more, following reference books are recommended.

*Bogdan Povh et al., "Particle and Nuclei", Springer.*
*C.A.Bertulani, "Nuclear Physics in a Nutshell", Princeton U. Press*
*W.R.Leo, "Techniques for Nuclear and Particle Physics Experiments", Springer*
14. **Solid State Physics and Statistical Physics**
Prof. Riichiro SAITO

Subjects: In the lecture, we overview the basic solid state physics. The subjects of the lecture are as follows. The lecture will be given in the ppt file.

1. Crystal structure of solid
2. Electronic structure of solid
3. Phonon structure of solid
4. Free electron model for physical properties
5. Magnetism
6. Optical properties of solid
7. Electron-electron interaction
8. Electron-phonon interaction
9. Transport properties

Goal of this class:
1. The basic concepts of solid can be explained by equations and values.
2. The students can plot the properties in a graph.
3. The students can make a powerpoint presentation file for home works.
4. The students can answer the questions by LaTeX.

Textbook:
Any solid state physics textbook should be read.
We do not specify the textbook. But in the lecture, some textbook is recommended.
There is a Japanese textbook based on this course written by R. Saito.

Examination:
The mid-term and final examinations and solving the questions are points that the students can obtain.
15. **Material Science**  
Assoc. Prof. Takafumi SATO

**Description**  
Fundamental concepts of solid state physics, such as phonon, band dispersion, Fermi surface, and superconductivity

**Details and Schedule**  
This class is open only to foreign students from abroad, therefore expected to be a mini-class.

**Readings**  
Textbooks of solid state physics (*e.g.*, “Solid-State Physics, An Introduction to Principles of Materials Science”, Harald Ibach, Hans Lüth)
16. **Evolution of the Western Pacific Island Arcs and their Environments**
Assoc. Prof. Jun Muto, Prof. Yasufumi IRYU, Prof. Kunio KAIHO,
Prof. Hiroyuki NAGAHAMA, Prof. Hiroshi NISHI, Assoc. Prof. Shinichi HIRANO, Assoc.
Prof. Toru NAKAMORI, Assoc. Prof. Osamu SASAKI,
Assoc. Prof. Reishi TAKASHIMA, Assoc. Prof. Yuzuru ISODA,
Lecturer Soichi OSOZAWA

This course aims at presenting some basic concepts and information of geological,
geographical and environmental science and the plate tectonic history of the world
including Japan Islands, active faults and earthquakes, ocean environments and their
history. Also, this class deals with the effect of the Western Pacific island arcs and Japan
sea to the coral reefs and Asian monsoon circulation. The lectures include the problems how
natural hazard and earth’s environmental changes affect the living world. The students can
understand multidisciplinary aspects of the Western Pacific/Northeast Asian regions
through the case studies referred frequently in these lectures.
Recent advance in bioscience and biotechnology have opened new frontiers in the fundamental understanding of life in the practical fields of bio-industries, agriculture and environment. This course will give each student recent progress in the research-field of molecular biology, cell biology, physiology, and ecology in plants, animals, and microbes. Students are expected to join discussion in each lecture. Course evaluation will be based on the attendance to the lectures including active participation, contribution to discussion, and reports.

1. Plant biotechnology for the development of plants with novel characteristics (K. Toriyama)
2. Marine ecosystems and land ecosystems (W. Sato-Okoshi)
3. Insect taxonomy (Y. Konno)
4. Forage production and grazing systems in Japan (S. Ogura)
5. Plant breeding in Japan (T. Nishio)
6. Carbon and nitrogen assimilation in rice (M. Miyao)
7. Photosynthetic Oxygen Evolution (A. Makino)
8. Plant immune system against virus infection (H. Takahashi)
9. Late effects on central nervous system and reproductive organ induced by early exposure of environmental chemicals (K. Tanemura)
10. Recent progress in the mucosal vaccine development (T. Nochi)
11. Mitochondria-driven energy metabolism in birds (M. Toyomizu)
12. Cells and DNA (M. Harata)
13. Structures and functions of enzymes (T. Uchida)
18. Introduction to Fisheries Science
Prof. Makoto OSADA, Prof. Satoshi KATAYAMA, Prof. Yoshihiro OCHIAI,
Prof. Yukio AGATSUMA, Prof. Toru SUZUKI, Prof. Akihiro KIJIMA,
Assoc. Prof. Keisuke TAKAHASHI, Assoc. Prof. Toshiyasu YAMAGUCHI,
Assoc. Prof. Waka SATO-OKOSHI, Assoc. Prof. Masamichi NAKAJIMA,
Assoc. Prof. Minoru IKEDA, Assoc. Prof. Masakazu AOKI

This course provides an overview of the fishery science. Students will learn the fishery science on the basis of marine biology in a broad sense from molecules to ecosystem. The goal is to understand the fishery science basically from ecology, physiology, genetics, molecular biology and evolution, and to appreciate the fishery science as the applied marine biology. Course evaluation will be based on attendance and report. The report should be directly submitted to the instructor of each lecture by the next lecture.

Topics on marine ecology and oceanography
- “How to know the fish age” (S. KATAYAMA)
- “How to know the fish migration” (S. KATAYAMA)
- “The ecology of floating seaweeds” (M. AOKI)
- “Introduction to rocky subtidal communities” (Y. AGATSUMA)
- “Physical and chemical environment of marine organisms” (W. SATO-OKOSHI)
- “Plankton and benthos in the ocean” (W. SATO-OKOSHI)

Topics on biology and biochemistry of aquatic organisms
- “Manipulation of reproduction in bivalve mollusks” (M. OSADA)
- “Immunity in marine invertebrates” (K. TAKAHASHI)
- “Food chemistry of fish and shellfish” (Y. OCHIAI)
- “Function of marine lipids” (T. YAMAGUCHI)

Topics on fish genetics and biotechnology
- “Fish development and biotechnology” (T. SUZUKI)
- “Genetic conservation and sustainable use of resources in aquatic organisms” (M. NAKAJIMA)
- “Conservation genetics for fishery resources -1” (M. IKEDA)
- “Conservation genetics for fishery resources -2” (A. KIJIMA)
This course provides reproduction, grazing activity, population dynamics of herbivores associated with marine forest. Students will learn marine forestation, and management and enhancement means of sea urchin and abalone associated with their ecological characteristics.

The goal is to understand how sea urchin and abalone maintain their population associated with seaweeds beds and how enhancement means of seaweed, sea urchin and abalone were developed on the basis of biological and ecological knowledge.

Contents and progress schedule of class
1. Structure and function of marine forest
2. Reproduction of herbivore
3. Growth and gonad production of herbivore
4. Grazing activity
5. Chemical defense of seaweeds
6. Mechanisms of population maintenance and fluctuation
7. Effects of sea urchin grazing on rocky subtidal communities
8. Restoration of “barren”
9. Effect of ocean warming and acidification on rocky subtidal communities
10. Development of enhancement means of sea urchin and abalone

20. **Food and Chemistry**
Assoc. Prof. Tsuyoshi TSUDUKI, Prof. Michio KOMAI,
Assoc. Prof. Hitoshi SHIRAKAWA, Prof. Kiyotaka NAKAGAWA,
Prof. Mari YAMASHITA, Assoc. Prof. Keiichi KONOKI, Prof. Tomoyuki FUJII,
Assoc. Prof. Masae TAKAHASHI, Assoc. Prof. Tomohisa OGAWA,
Prof. Shinjiro YAMAGUCHI, Prof. Hirokazu ARIMOTO, Prof. Makoto SASAKI,
Assoc. Prof. Haruhiko FUWA

The object of this class is to study the basic concepts of biochemistry and chemistry of food and related bioactive natural products. More than ten Professors and Associate Professors will give the lectures weekly to introduce their specific research fields.

1. Bioactive food components
2. Novel functions of dietary vitamins and minerals and their contribution to our health
3. Food and bioactive natural products for human health
4. Chemistry and biochemistry of marine toxins
5. Application of high pressure to food processing and terahertz spectroscopy in biological systems
6. Protein chemistry
7. Chemistry and biology of plant hormones
8. Medicinal chemistry of antibacterial and antiviral agents
9. Synthetic and medicinal chemistry of marine natural products
21. Introduction to Applied Animal and Dairy Science
Prof. Kentaro TANEMURA, Prof. Masaaki TOYOMIZU, Prof. Masahiro SATOH, 
Prof. Fuminori TERADA, Assoc. Prof. Tomonori NOCHI, 
Assoc. Prof. Hiroshi YONEYAMA, Assoc. Prof. Haruki KITAZAWA, 
Prof. Yutaka NAKAI, Prof. Shin-ichiro OGURA

This class object is to study the basic concepts of applied animal and dairy science. More than ten Professors and Associate Professors will give the lectures weekly to introduce their specific research fields.

1) Overview of Animal Reproduction
2) Overview of Animal Nutrition
3) Overview of Animal Breeding and Genetics
4) Overview of Animal Physiology
5) Overview of Animal Immunology
6) Overview of Animal Microbiology
7) Overview of Animal Food Science
8) Overview of Grazing Management
9) Overview of Animal Health and Management
22. **Mechanics of Materials**  
Prof. Hideo MIURA, Assoc. Prof. Kazuhisa SATO, Assoc. Prof. Go YAMAMOTO

Mechanics of materials is a branch of applied mechanics that deals with the basic behavior of solid bodies subjected to various types of loading. The knowledge of the stress and strain set up within the bodies and resulting deflection is a prerequisite for the structural design of industrial products and infrastructures such as buildings, roads, and bridges.

This course is intended as an introductory course in the mechanics of solids offered to engineering students. It concentrates on developing analysis techniques from principle for a range of practical problems that include simple structures, pressure vessels, beams and shafts. This course is one semester course. The topics covered in this course are listed in the syllabus as is shown below.

After the presentation of the underlying theory for each topic, the students will be provided with problems for homework to aid the understanding of the principles. It is assumed that the students have some experience in elementary statics (mechanics of rigid bodies) and mathematics (such as differentiation and integration). The student's performance will be evaluated by considering the results of homework and examinations.

1. Introduction (1): Modeling of engineering systems and concepts of stress and strain  
2. Introduction (2): Hooke's law, and stress-strain diagram, strength and stiffness  
3. Tension, compression and shear (1): Pin-jointed structures and statically indeterminate problems  
4. Tension, compression and shear (2): Thermal stress and residual stresses, thin rings, and stress concentration  
5. Mid-term examination (1)  
6. Combined stresses (1): Biaxial tension, normal stress and shear stress, plane stress  
7. Combined stress (2): Stress-strain relations  
8. Torsion (1): Torsion of circular shafts, and closecoiled helical spring  
9. Torsion (2): Shaft of rectangular or profile section and thin-walled tube of arbitrary cross section  
10. Mid-term examination (2)  
11. Shearing force and bending moment in a beam: Type of supports for beams and reactions, type of loads on a beam  
12. Stress in a beam  
13. Deflection in a beam  
14. Statically indeterminate beam  
15. Final examination
23. Materials Science and Engineering A & B

Materials Science and Engineering A
Prof. Yutaka WATANABE

This course will provide concise introduction to the microstructures and processing of materials and how these are related to the properties of engineering materials. In this course, although we mostly deal with metals, properties of other engineering materials will also be discussed. The goal of this course is understanding basic properties of materials, of how properties are related to microstructures, of how microstructures are controlled by processing, and of how materials are formed and joined. Evaluation will be based on “class participation and homework assignment (30%)” and “final exam (70%).”

1. Orientation

2. Properties and Structures of Metals
   • Generic metals and alloys
   • Design data

3. Properties and Structures of Metals
   • Range of metal structures that can be altered to get different properties

4. Equilibrium Constitution and Phase Diagrams
   • Mixing elements to make an alloy can change their structure

5. Case Studies in Phase Diagrams
   • Phase diagrams

6. Case Studies in Phase Diagrams
   • Examples: choosing soft solders, pure silicon for microchips, making bubble-free ice

7. Driving Force for Structural Change
   • Solidification, solid-state phase changes, precipitate coarsening, grain growth, recrystallization
8. Kinetics of Structural Change
   • Diffusive transformations

9. Kinetics of Structural Change
   • Nucleation
   • Displacive transformations

10. Case Studies in Phase Transformation
    • Artificial rain-making
    • Fine-grained castings

11. Case Studies in Phase Transformation
    • Single crystals for semiconductors
    • Amorphous metals

12. Carbon Steels
    • Structures produced by diffusive changes
    • Structures produced by displacive changes (martensite)
    • TTT diagram

13. Alloy Steels
    • Solution strengthening
    • Precipitation strengthening
    • Corrosion resistance

14. Production, Forming, and Joining
    • Casting
    • Plastic working
    • Joining
    • Surface engineering

15. Final exam

Textbook
M. F. Ashby and D. R. H. Jones, Engineering Materials 2, ELSEVIER.
“Materials Science and Engineering B” is a half-year class to learn the fundamentals of the “Materials Processing” based on the high temperature physical chemistry and process engineering. This class basically consists of three parts as thermodynamics for materials processing, ferrous and process metallurgy (iron- and steel-making), nonferrous metallurgy (pyro- and hydro-metallurgy), and electro-metallurgy in active metal processing. Students can study fundamentals and latest topics in the area of materials processing and engineering. The grade of students will be evaluated with the score of home works, class participation, exercises during the class and the final examination.

1. Guidance
2. Introduction to chemical thermodynamics for materials processing
3. Introduction to chemical thermodynamics for materials processing
4. Reduction/Oxidation equilibrium for materials.
5. Stability diagrams and phase diagrams of materials.
6. Basic principle of iron and steel making.
7. Fundamentals of pyrometallurgy
8. Fundamentals of pyrometallurgy
9. Application of pyrometallurgy (Copper making)
10. Application of pyrometallurgy (Zinc, Lead production)
11. Fundamental electrochemistry in metallurgy
12. Application of hydrometallurgy
13. Aluminum and active metal production
14. Aluminum and active metal production
15. Final examination
24. Mechanical Vibrations I 
Assoc. Prof. Hisashi NAKAMURA

With the increase of velocity and the decrease of weight in modern machines, the analysis of vibration problems is becoming more and more important in engineering design. Therefore, in this course, the focus will be on the acquisition of fundamental knowledge regarding dynamic problems which may arise in machinery. To develop their understanding, students will be asked to solve examples during the lectures and as mini tests. I will also ask some students to show us their solutions during the following lectures. The evaluation will be based on mini test and a final examination.

Course Outlines
1. Introduction
2. Free vibrations of systems with one degree of freedom (I)
   The simplest possible vibratory system consists of a mass element connected by a spring. It is called a system with one degree of freedom since one coordinate is sufficient to specify the position of the mass. There is no external force applied to the mass. Hence, the motion resulting from an initial disturbance is a free vibration. We will firstly focus on such systems, which are fundamental to the understanding of more advanced topics concerning vibrations.
3. Free vibrations of systems with one degree of freedom (II)
4. Free vibrations of systems with one degree of freedom (III)
5. Forced vibrations of systems with one degree of freedom
   If a system is subjected to an external force, the resulting vibration is known as forced vibration. We shall consider the dynamic responses of systems with one degree of freedom under harmonic force.
6. Free and forced vibrations of systems with one degree of freedom with viscous damping(I)
   In actual practice, the amplitude of free vibration diminishes gradually over time due to the resistance offered by the surrounding medium (such as air). Such vibrations are said to be damped. We shall consider damped vibrations in the absence of forces and the vibrations under harmonic forces.
7. Free and forced vibrations of systems with one degree of freedom with viscous damping(II)
8. Free and forced vibrations of systems with one degree of freedom with viscous damping(III)
9. Free and forced vibrations of systems with one degree of freedom with viscous damping(IV)
10. Free and forced vibrations of systems with two degrees of freedom (I)
   We sometimes encounter systems which consist of several masses connected by several
   springs. In this case, multiple independent coordinates are required to describe the
   motion of the masses. Such systems are said to have multiple degrees of freedom. We
   will learn about systems with two degrees of freedom so as to provide a simple
   introduction to the behavior of systems with multiple degrees of freedom in the
   absence of external forces. The dynamic responses of systems with two degrees of
   freedom under harmonic forces will also be introduced.

11. Free and forced vibrations of systems with two degrees of freedom (II)

12. Free and forced vibrations of systems with two degrees of freedom (III)

13. Vibrations of systems with multiple degrees of freedom (I)
   All the concepts introduced in the preceding lectures can be directly extended to the
   case of systems with multiple degrees of freedom. The general analysis of such systems
   can be handled conveniently in matrix form. We shall therefore consider how to
   analyze such complex systems using matrix form. It is often convenient to analyze
   such systems by using Lagrange's equations. We will therefore also learn how to
   analyze such systems using Lagrange's equations.

14. Vibrations of systems with multiple degrees of freedom (II)

15. Final examination

Textbook
   The course will be organized without a specific textbook.

Reference books
   M. Katatoka and T. Ioi, Fundamentals of Mechanical Vibration「振動工学の基礎」, Corona
   K. Aso, J.Tani, S. Chonan and K. Hayashi, Kikai Rikigaku「機械力学」, Asakura
25. **Computer Software Engineering**

Assoc. Prof. Hideaki GOTO

AIMS & GOALS

1. Aims
   Students will acquire the basic knowledge about algorithms and data structures.

2. Descriptions
   Evaluation methods and programming techniques for making good programs are discussed.

3. Goals
   Students will have the ability of designing and making good programs. (Programming in a particular language is not included.)

NOTES

Prerequisites for regular course students are “The Basics of Information Sciences” and “Programming Seminar.” Taking “Fundamentals of Computer Engineering” is strongly recommended.

Prerequisites for JYPE/DEEP/IMAC-U students are the similar courses as mentioned above. Students should have some knowledge about a programming language, preferably C or Java.

CLASS SCHEDULE

1. Introduction of this course, Computation, Algorithms
2. Evaluation of computational complexity
3. Data structures, Abstract Data Types (ADTs)
4. Basic data structures: array, list
5. Basic data structures: stack, queue
6. Basic data structures: graph, tree
7. Basic data structures: set, table (dictionary), hashing
8. Priority queue, heap
9. Binary search tree and Balanced search tree
10. Sorting: bubble sort, shell sort, bucket sort, radix sort, insertion sort
11. Sorting: heap sort, quick sort, merge sort
12. Graph searching: breadth-first search, depth-first search
13. Graph algorithms: minimum spanning tree, shortest path problem
14. Optimization problems
15. Basic design of algorithms
26. **Fundamentals of Computer Engineering**
Prof. Hiroaki KOBAYASHI

**GOALS**
On completing this course, a student should be able to:
1. Know the concept of today's computers based on the history of computers,
2. Understand the concrete structure and functionality of computers in terms of hardware and software, and
3. Further understand their performance related firstly to hardware and software.

**STUDY-AID BOOK**

**GRADING**
Grades will come from the in-class final exam (80%) and other in-class tests (20%).

**CLASS SCHEDULE**
1. History of Computers
2. Basic Structure of Computer
3. Data Representation: Binary number
5. Combinational Logic Circuits: Basics
6. Combinational Logic Circuits: Design Procedure and Example
7. Sequential Logic Circuits: Basics
8. Sequential Logic Circuits: Design Procedure and Examples
9. Memory Systems
10. Computer Organization: Control Unit
11. Computer Organization: Machine Instructions
12. Language, Compiler and Operating System
13. Techniques for High-Performance Computing
14. Supercomputer Systems
15. Computer Network Systems
27. **Electricity and Magnetism A and B**

This is a year-long course for the foundation of the theory of electricity and magnetism. This course is divided into two semester courses, “Electricity and Magnetism A (E&M A)” and “Electricity and Magnetism B (E&M B)”. E&M A begins from the vector analysis. Then, the basic concepts of electric and magnetic fields in vacuum will be lectured. In E&M B, the electric and magnetic fields in matters are first lectured. The electromagnetic induction will be also lectured and the Maxwell’s equations are derived to introduce the goal of this lecture, i.e., the electromagnetic wave, of which existence Maxwell predicted from the equations.

The students will learn how mathematical tools will help them understand a variety of electromagnetic phenomena, which are useful both in science and technology. The students are assumed to have had introductory college-level physics and calculus including simple vector analysis. E&M A or an equivalent is a prerequisite to take E&M B. Problems for exercise will normally be assigned at the end of each class and solved during the next class. Homework exercise will be due the following week before the class. The course grades are basically determined by class participation, homework and the midterm and final examinations.

**Electricity and Magnetism A**
Prof. Taichi OTSUJI, Prof. Takumi FUJIWARA

1. Lecture plan, course contents, homework and grading policy. What is electricity and magnetism?
2. Vector analysis
3. Electric and magnetic fields (Coulomb’s law)
4. Electrostatics (Gauss’s law and electrostatic potential)
5. Currents and magnetic fields (Biot-Savart law, Ampere’s law and vector potential)
6. Maxwell’s equations in vacuum
7. Summary

**Electricity and Magnetism B**
Assoc. Prof. Toshihiko HIROOKA

*Detailed contents are subject to change depending on the progress in course A
1. Review of Electricity and Magnetism A
2. Dielectric materials and polarization
3. Magnetic dipole and magnetization current
4. Magnetic materials
5. Electromagnetic induction (Faraday's law)
6. Maxwell's equations and electromagnetic wave in matters (propagation and reflection)
7. Summary

Reference Books
E. M. Purcell, Electricity and Magnetism, Berkeley, Volume 2.
D. J. Griffiths, Introduction to Electrodynamics, 3rd ed.
J. D. Jackson, Classical Electrodynamics, 2nd ed.
J. A. Edminister, Electromagnetics, 2nd ed.
(Textbook will be announced later, if necessary.)
28. **Introductory Quantum Mechanics**
Assoc. Prof. Simon J. GREAVES

Beginning with a review of some early 20th century experiments, this course aims to develop an understanding of the basic concepts of quantum mechanics and how they differ from classical mechanics. The Schrödinger equation will be used to solve one-dimensional problems and show that quantum mechanics can be used to predict the existence of physical phenomena such as quantum mechanical tunneling, discrete energy levels and energy band-gaps in solids. Students are assumed to have introductory college-level physics, calculus, and linear algebra.

Course grades are based on homework, mid-term and final examinations.

**Course Outline**
1. Introduction. What is quantum mechanics? Double slit experiments
2. Blackbody radiation, photoelectric effect
3. Compton scattering, Franck and Hertz experiment
4. Bohr's model of the hydrogen atom, de Broglie theory
5. Schrödinger equation, wavefunctions
6. Operators, eigenvalue equations, expectation values
7. The infinite potential well
8. Pauli exclusion principle, particle in a box, Heisenberg uncertainty principle
9. Delta-function potential, scattering and tunneling
10. One dimensional barrier problems
11. Solids, band gaps, angular momentum
12. The harmonic oscillator
13. Free particles and wave packets

**Textbook**
There is no set text. Many textbooks cover the topics discussed in the course, e.g.
This course provides a quick overview of four research fields of computer science to bridge fundamental theories of computer science with the cutting-edge research in our department. The course consists of four parts (given by four instructors): communication network, algorithm theory, bioinformatics, and natural language processing.

Course Plan
1. Course Orientation
   - Basic Technologies for Communication Networks
2. Next Generation Networks 1
3. Next Generation Networks 2
4. Algorithm Theory 1
   - What is algorithm? · Power of “efficient” algorithms
5. Algorithm Theory 2
   - How to evaluate algorithms
6. Algorithm Theory 3
   - Basic techniques for algorithms
7. Computational Biology 1
   - Encode and decode biosystems
8. Computational Biology 2
   - Genetic history of human
9. Computational Biology 3
   - Genetic diversity and adaptive evolution
10. Introduction to Natural Language Processing
11. Statistical approach
12. Machine-learning approach

Textbook
There is no textbook for this lecture series, but some references will be given by each instructor.

Evaluation
Attendance and writing assignments. Details will be announced by each instructor.
30. Chemical and Biomolecular Engineering I & II

Chemical and Biomolecular Engineering I
Prof. Yuji MATSUMOTO, Prof. Nobuhiko IKI, Prof. Daisuke NAGAO, Assoc. Prof. Masaki KUBO, Assoc. Prof. Yoshiyuki SATO, Assoc. Prof. Yoshinao NAKAGAWA, Assoc. Prof. Fabio PICHIERRI

Abstract and objective
We are surrounded by a large number of chemical products manufactured with various types of materials including organic, inorganic and their composite materials. Even in our body, biological materials are constantly being produced using a variety of chemical and biochemical reactions. The present course focuses on chemistry-oriented topics in developing functional materials in various areas. Students will learn some basic aspects of chemical production, with special emphasis on how environment-friendly synthetic methodologies of materials have been developed for new advanced products.

Course Plan
1. Chemistry of materials processing in vacuum by Prof. Yuji MATSUMOTO
   1-1. Basic vacuum technology for materials processing
   1-2. Vacuum deposition techniques of inorganic and organic thin film materials

2. Chemical functions of coordination compounds by Prof. Nobuhiko IKI
   2-1. Basic concepts of coordination chemistry
   2-2. Applications to functional materials and biomedicine

3. Chemistry of composite materials in wet processing by Prof. Daisuke NAGAO
   3-1. Wet chemical processing for composite particles and thin films
   3-2. Controls over sizes and morphologies of composite particles

4. Particle dynamics in nanofluids by Assoc. Prof. Masaki KUBO
   4-1. Aggregation / dispersion of particles
   4-2. Aggregation kinetics and colloidal dynamics

5. Thermophysical Properties of Polymers and Polymer Solutions by Assoc. Prof. Yoshiyuki SATO
   5-1. Volumetric Properties of Polymers
   5-2. Phase Equilibria of Polymer Solutions
6. Catalytic production of chemicals from biomass by Assoc. Prof. Yoshinao NAKAGAWA
   6-1. Production of pure platform chemicals from biomass
   6-2. Conversions of biomass-derived platform chemicals
7. Chemistry of Carbon Nanomaterials by Assoc. Prof. Fabio PICHIERRI
   7-1. Structure and bonding in organic molecules
   7-2. Fullerenes, carbon nanotubes and graphene

Requirements
Knowledge on fundamental chemistry is required.

Evaluation
Examinations and/or reports, depending on topics. No make-up exam.

**Chemical and Biomolecular Engineering II**
Prof. Hitoshi SHIKU, Prof. Tomokazu MATSUE, Assoc. Prof. Seiji TAKAHASHI,
Assoc. Prof. Masato NOGUCHI, Assoc. Prof. Masaru WATANABE,
Assoc. Prof. Yasuhiro FUKUSHIMA, Assoc. Prof. Naoya MOROHASHI

Bimolecular engineering refers to any technological applications of chemical and biological systems, such as biomolecules and environmental materials to make or modify products or green processes for specific purposes. This class focuses on biomaterials, biomedical engineering, metabolic engineering, glycochemistry, environmentally benign materials and reactions, green process and life cycle assessment. Students will learn some basic aspects of engineering for biotechnology, biological and environmental materials.

Course Outline
1. Biomaterials and cell culture (by Prof. Hitoshi Shiku)
   1-1. Cell culture and embryology
   1-2. Tissue engineering and biomaterials
2. Biomedical engineering and Biosensors (by Prof. Tomokazu MATSUE)
   2-1. Basics of bioelectrochemistry
   2-2. Biosensor technology
3. Plant specialized metabolites (by Associate Prof. Seiji TAKAHASHI)
   3-1. Basic sciences and histories of use
   3-2. Metabolic engineering for production of valuable metabolites
4. Carbohydrate chemistry (by Associate Prof. Masato NOGUCHI)
   4-1. Principles of carbohydrate chemistry
   4-2. Chemical glycosylation reaction
5. Transformation of biomass molecules in green solvents (Associate Prof. Masaru WATANABE)
   5-1. Hydrothermal water process
   5-2. Ionic liquid-based green solvents
6. Chemical Systems Engineering (by Prof. Yasuhiro FUKUSHIMA)
   6-1. Basics in evaluating sustainability aspects of process technologies
   6-2. A case study on integrated biological, agricultural and chemical process systems design
7. Development of environmentally benign materials and reactions (by Associate Prof. Naoya MOROHASHI)
   7-1. Host–guest chemistry and separation materials using host molecules
   7-2. Development of carboxylation reactions with carbon dioxide

Requirements
Knowledge of organic chemistry and biochemistry will be required.

Evaluation
Examinations and/or reports, depending on topics.
No make-up exam.
It is clear through past disastrous earthquakes that the earthquake damage is quite different depending on the geological conditions. The earthquake observation during the 2011 Tohoku earthquake explains this truth. Therefore, it is important to take into account the difference of ground motion due to soil conditions in a seismic design of urban structures and in urban disaster prevention planning. This course comprises the lectures, students' presentations and discussions on engineering topics for earthquake disaster prevention considering geological environment. In each lecture, the relevant material will be handed out. In this course, two reports are requested and students make presentations and discussions based on the reports during classes. The evaluation will be based on the reports and presentations for the requested subjects.