<1> Linear Algebra A

Class Schedule: Monday, 1st. (2 credits) Category: Basics of Discipline-Basics of Mathematics

Course Code: CB11225 Instructors: Rintaro OHNO

1. Class Subject

Basics of linear algebra

2. Object and Summary of Class

Linear algebra is an essential tool to handle multi-component quantities and it helps studies not only in mathematics but also natural and social sciences. This class aims to provide basic notions and understanding of linear algebra such as vectors and matrices.

3. Goal of Study

Fundamental understanding of methods dealing with vectors, matrices and determinants as well as the purpose for future studies.

4. Contents and Progress Schedule

Class 1: Introduction and notations
Class 2: Vector space
Class 3: Linear independence and basis
Class 4: Matrices and their rank
Class 5: Gaussian elimination
Class 6: Addition, scalar and matrix multiplications
Class 7: Regular matrices
Class 8: Inverse of a matrix
Class 9: Determinants and their properties
Class 10: Calculation of determinants
Class 11: Cofactor expansion
Class 12: Systems of linear equations
Class 13: Cramer's Rule
Class 14: Linear mappings
Class 15: Summary and final exam

Depending on the understanding of attending students, the schedule and content of the lecture mentioned above may be modified.

5. Evaluation Method

Evaluation will be based on the results of tests and the final exam

6. Textbook and References

Linear Algebra 3rd ed. Serge Lang Springer 1987 Reference

7. URL

8. Preparation and Review

Students are required to review the content of the lectures, prepare questions if necessary and show the level of their understanding during class.

9. Practical business

10. Students must bring their own computers to class

A PC or tablet will be useful, but not required.

11. Lecture slides are allowed during tests and the exam.

12. In Addition

The first class wil be held face-to-face.
Details of lectures will be discussed during the first class.

<2> Physics A (for AMC, IMAC-U)

Class Schedule: Monday, 2nd. (2 credits) Category: Basics of Discipline-Basics of Physics

Course Code: CB12221 Instructors: Takeshi KOIKE

1. Class Subject

Classical Mechanics

2. Object and Summary of Class

This is an introductory course to Newtonian mechanics, but also serves as an introduction to the way we try to understand various natural phenomena encountered in Physics B (oscillations and waves, fluid dynamics) and Physics C (electromagnetism). Mechanics deals with motion of a physical body as well as response to forces applied to the body. The mechanics we study in this course is applicable to an object or system of particles that is slow moving in comparison to the speed of light (non relativistic) and large enough in physical scale as to be unaffected by quantum fluctuations, hence the name“classical".

3. Goal of Study

By the end of the course, you are expected to gain familiarity with and obtain basic understandings of Newton's laws, work and energy, conservation of energy, linear momentum, and angular momentum, systems of particles, rotations, and Newton's law of gravitation with Kepler's law of planetary motions.

4. Contents and Progress Schedule

Schedule of the course:

0. Orientation to WileyPlus + historical perspective of Newtonian mechanics
1. Ch3: Vectors (General introduction to physics, scalar vs vector, addition, dot and cross product, unit vector, and vector and calculus)
2. Ch4: Motion in Two and Three Dimensions (Projectile motion under uniform gravity, uniform circular motion, and relative motion)
3. Ch5: Force and Motion I(Newton's law of motion, its applicability, Galilean relativity, inertial frame, force and rate of change of linear momentum, and conservation of momentum)
4. Ch6: Force and Motion II (free body diagram, frictional force, drag force (viscous and inertial), and centripetal force)
5. Ch7: Kinetic Energy (transformation and transfer of energy, work, work done by gravity, work done by spring, and power)
6. Ch8: Potential Energy (isolated system, conservation of energy, conservative force and potential energy)
7. Ch9: Center of Mass (a system of particles, center of mass, conservation of total momentum of a system, and reduced mass of two body system)

Midterm (Lecture 2-6)

8. Ch9: Collision (impulse, elastic and inelastic collision, and rocket equation)
9. Ch10: Rotation (coresspondence between linear and angular motion, moment of inertia, parallel and orthogonal axis theorem, center of mass and gravity)
10. Ch11: Rolling, Torque, and Angular Momentum (rigid body, torque as a rate of change of angular momentum, torque in the center of mass frame, rolling on an inclined plane)]
11. Ch11 (rolling on a flat surface, physics of tops, precession, and gyroscopic effect)
12. Ch13: Gravitation (central force, effective potential, constant of motion, Kepler's law of planetary motion)
13. Ch13: Gravitation (gravity near the earth surface, gravitational potential) and Course survey

Final examination (Lecture 7-13)

5. Evaluation Method

Evaluation will be based on a midterm exam (30%), final exam (30%), homework assignments (20%), pre-lecture assignment(20%).

6. Textbook and References

Fundamentals of Physics Extended, 11th Edition David Halliday, Robert Resnick, Jearl Walker Wiley 2018 textbook

The Feynman Lectures on Physics, Volume I Feynman • Leighton • Sands Feynman • Leighton • Sands

7. URL

https://www.wileyplus.com/

8. Preparation and Review

A pre-lecture reading of the textbook followed by short adaptive quizzes will be assigned for each lecture. In addition, after each lecture, a set of selected problems from WileyPlus will be assigned.

9. Students must bring their own computers to class

Yes.

Various demonstration/simulation with MATLAB will be performed.

10. In Addition

This course requires purchase of the WileyPlus system which costs $45 USD. The system includes an electronic version of the required textbook with many integrated features to facilitate understanding of the subjects and problem solving skills in physics. The system also comes with self-diagnostic adaptive quizzes, with which one will practice problem solving based on his/her own proficiency in each chapter that will be covered in the course. Access to the internet is necessary outside of the class. Registration to the WileyPlus and payment method will be announced in the orientation during the first lecture.

<3> Life and Nature

Class Schedule: Tuesday, 2nd. (2 credits) Category: Foundations-Life

Course Code: CB22239 Instructors: Satoshi KATAYAMA

1. Class Subject

Life and Nature: Biology of plant, animal, marine organism, microorganism, and their future researches

2. Object and Summary of Class

The aims of this class are to develop an understanding of biological facts and principles, to enhance an interest in and develop an appreciation of the nature and diversity of organisms, to create an awareness of the application of biological knowledge to modern society in personal, social, economic, environmental, industrial, agricultural, medical, waste management and other technological contexts, and to develop in students an ability to make informed evaluations about contemporary issues concerning life and nature.

3. Goal of Study

In this course, the student will have basic knowledge about plant science, animal science, marine biology, micro-organism science, and will gain a broad perspective about natural and living systems, their basic constituents and properties. These knowledge will be very useful when considering agricultural, scientific and engineering measures for global environmental problems and food problems..

4. Contents and Progress Schedule

Classes are conducted onsite and/or online.

1. Life and nature of plant 1 (Plants and climate) Prof. K. Homma
2. Life and nature of plant 2 (Functional properties of plants) Assoc. Prof. K. Kato
3. Life and nature of plant 3 (Plants and pathogens) Assist. Prof. D. A. Abebe
4. Life and nature of animal 1 (Evolution and phylogeny of animal) Prof. K. Sato
5. Life and nature of animal 2 (Reproduction and generation of animal) Prof. K. Sato
6. Life and nature of animal 3 (Ecology and physiology of animal) Prof. K. Sato
7. Life and nature of ocean 1 (Evolution and phylogeny of marine organisms) Prof. S. Katayama
8. Life and nature of ocean 2 (Marine ecology) Prof. S. Katayama
9. Life and nature of ocean 3 (Marine ecosystem) Prof. S. Katayama
10. Life and nature of microorganism 1 (Metabolism and Energy Generation Systems in Microbes) Prof. Y. Tanaka
11. Life and nature of microorganism 2 (Structure analysis of bacterial toxins) Prof. Y. Tanaka
12. Life and nature of microorganism 3(Structural analysis of antibiotics on their bacterial targets) Assist. Prof. T. Yokoyama
13. Future researches of life and nature 1 (Food and agricultural immunology) Prof. M. Toda
14. Future researches of life and nature 2 (Future agricultural production and food industry) Prof. S. Ogura
15. Future researches of life and nature 3 (Life sciences using synchrotron light) Prof. M. Harata

Textbook and references will be notified at the class.

5. Evaluation Method

Evaluation will be based on weekly attendance (50%) and homework assignments & reports (50%)

6. Textbook and References

7. URL

8. Preparation and Review

Review related topics

9. Practical business

10. Students must bring their own computers to class No

11. In Addition

<4> Physics A (for AMB)

Class Schedule: Tuesday, 3rd. (2 credits) Category: Basics of Discipline-Basics of Physics

Course Code: CB23238 Instructors: Takeshi KOIKE

1. Class Subject

Introductory Physics

2. Object and Summary of Class

This course is intended for students without any or little background in physics and calculus. Through Newtonian mechanics, important concepts in physics such as force, momentum, energy, angular momentum, and laws of conservation will be introduced. In addition, how these concepts are described in the language of mathematical equations, in particular, using calculus will be explored.

3. Goal of Study

By the end of the course, you are expected to gain familiarity with Newton's laws of motion, momentum, and energy, and angular momentum as well as their conservation properties. In addition, you are expected to be able to draw a free-body diagram, derive an equation of motion, and solve it using simple vector algebra and calculus.

4. Contents and Progress Schedule

Schedule of the course:

0. Orientation to WileyPlus and a historical perspective of Newtonian mechanics
1. Ch1: Measurement (unit)
2. Ch2. Motion Along a straight line (acceleration and free fall)
3. Ch3. Vectors
4. Ch4: Motion in Two and Three Dimensions (Projectile motion under uniform gravity)
5. Ch4. Motion in Two and Three Dimensions (Uniform circular motion, and relative motion)
6. Ch5: Force and Motion I(Newton's law of motion)
7. Ch5 and Ch6: Force and Motion I & II (free body diagram, frictional force, and centripetal force)

Midterm examination (Ch1-Ch6)

8. Ch7: Kinetic Energy (transformation and transfer of energy, work, work done by gravity, work done by spring, and power)
9. Ch7: Kinetic Energy (transformation and transfer of energy, work, work done by gravity, work done by spring, and power)
10. Ch8: Potential Energy (isolated system, conservation of energy, conservative force and potential energy)
11. Ch9: Center of Mass (a system of particles, center of mass, conservation of total momentum of a system)
12. Ch10: Rotation (coresspondence between linear and angular motion, moment of inertia, angular momentum)
13. Review and course survey

Final examination (Lecture 7-10)

5. Evaluation Method

Evaluation will be based on a midterm exam (25%), final exam (25%), homework assignments (20%), attendance (10 %), pre-lecture assignment (20%).

6. Textbook and References

Fundamentals of Physics Extended, 11th Edition David Halliday, Robert Resnick, Jearl Walker Wiley 2018 textbook

7. URL

https://www.wileyplus.com/

8. Preparation and Review

A pre-lecture reading of the textbook followed by short adaptive quizzes will be assigned for each lecture. In addition, after each lecture, a set of selected problems from WileyPlus will be assigned.

9. Practical business

10. Students must bring their own computers to class Yes.

Various demonstration/simulation with MATLAB will be performed.

11. In Addition

If you are planning to take Physics B or/and C, you must register for another Physics A, which is targeted for chemistry and engineering majors with highschool-level physics and calculus background.This course requires purchase of the WileyPlus system which costs $45 USD. The system includes an electronic version of the required textbook with many integrated features to facilitate understanding of the subjects and problem solving skills in physics. The system also comes with self-diagnostic adaptive quizzes, with which one will practice problem solving based on his/her own proficiency in each chapter that will be covered in the course. Access to internet is necessary outside of the class. Registration to the WileyPlus and payment method will be announced in the orientation during the first lecture.

<5> Economy and Society

Class Schedule: Wednesday, 1st. (2 credits) Category: Foundations-Social Sciences

Course Code: CB31227 Instructors: Jeremy Ryan September

1. **Class Subject** Social Entrepreneurship: An Introduction
2. **Object and Summary of Class**

In this course students will receive a comprehensive overview of the field of social entrepreneurship. The course will combine theoretical knowledge and practical examples of social entrepreneurship. Students with a more practical interest will be encouraged to develop their own ideas and plans regarding potential social entrepreneurship projects. Thus, this course is designed for students who want to explore social enterprise start-ups, as well as those students who are just curious about the field and want to learn more about entrepreneurship.

This course also explores the role of Social Entrepreneurship as a lever for economic, social and sustainable development. The subject of Social Entrepreneurship overlaps with a number of fields including the nonprofit sphere, development projects, SMEs, community initiatives and others. This multiplicity will be reflected in the course contents.

3. **Goal of Study** The study goals for this course are as follws:

1)For students to acquire foundational knowledge of social entrepreneurship theory.

2)For students to acquire a broad understanding of the operation of a social enterprise

3)For students to deepen their understanding by exploring their particular interests within this field through class discussion and assignments.

4. **Contents and Progress Schedule**

"**Lesson 1**:Background, Characteristics and Context of Social Entrepreneurship

Focus: Introduction to the course.

The evolution and historical background of social entrepreneurship.

Lesson 2: Social Entrepreneurship Defined

Focus:Define the central elements of social innovation.

Identify the different types of social innovation.

Lesson 3: Value Creation in social ventures

Focus:Define what the creation of value is.

Analyze the value proposition by social innovation

Lesson 4: Social Entrepreneurs and their Personality

Focus:Understand the role of personality in entrepreneurship studies.

Describe the current knowledge on the personality in social entrepreneurs.

Lesson 5: Human Resource Management and Volunteer Motivation

Focus:Understand the special characteristics of volunteers.

Illustrate the theoretical elements in a practical context.

Lesson 6: Collaborations and Partnerships

Focus: Explain the reasoning behind social venture partnerships

Discuss the collaborative value chain integration and specific types of collaboration.

Lesson 7: Business Models in Social Entrepreneurship

Focus:Explain what a business model is.

Explain the differences between business models of commercial enterprises and business models of social enterprises.

Lesson 8: Marketing a Social Enterprise

Focus:Generate an awareness of the characteristics of marketing in social enterprises. Understand a systematic approach to marketing in terms of a concerted marketing conception.

Lesson 9: Financing of Social Entrepreneurship

Focus:Describe the characteristics of the financing structure of social enterprises.Explain the financing instruments available for social enterprises.Explain the trade-off between social and financial return.

Lesson 1o: Performance Measurement and Social Entrepreneurship

Focus:Understand the origins of the current momentum in measuring social impact. Critically evaluate efforts to measure social impact

Lesson 11: Student Presentations: The first round of students' group presentations

Lesson 12: Student presentations: The second round of students' group presentations

Lesson 13: New Technologies and perspectives

Focus: An explanation of the most disruptive technologies being developed and their potential influence on social entrepreneurship

Lesson 14: Innovative Case Study

Focus:A description of a The Grassroots Economics Foundation in Kenya and their innovative work.

Lesson 15: Course Reflection - Students also have group discussions regarding their reflections of the course.

5. **Evaluation Method**

Minute Papers: 40%, Group Presentations 30%, Final Essay 30% "

6. **Textbook and References**

Social Entrepreneurship and Social Business Christine K. VolkmannKim Oliver TokarskiKati Ernst SpringerLink 2012 e-book

"Social Innovation and Social Entrepreneurship" Luis Portales Palgrave Macmillan 2019

7. **Preparation and Review**

The students will be provided with material and readings for each lecture. They will be expected to read in advance so as to contribute towards class discussion.

8. **Students must bring their own computers to class** As this course will be an online course, students will need access to a computer

<6> Chemistry A

Class Schedule: Wednesday, 2nd. (2 credits) Category: Basics of Discipline-Basics of Chemistry

Course Code: CB32227 Instructors: Mott Derrick

1. Class Subject

Introduction to Chemistry, Atoms and Molecules

2. Object and Summary of Class

Chemistry includes the fundamental analysis of atoms and molecules, which make up the world around us. By understanding the basics of atomic structure, reactivity and the formation of molecules, it is possible to create new substances with uses in advanced applications including medicine, energy, materials, environmental quality and others. The goal of this class will be to become familiar with the basics of chemistry, understand what atoms are composed of and their structure, learn about compounds, how to study these materials, and how they may be used to improve quality of human life.

3. Goal of Study

Gain an understanding of fundamental chemistry, what are atoms, understand their composition and structure.
Learn about electronic structure of atoms, how it influences chemical reactions and material formation.
Become familiar with different types of chemical bonds (ionic bonds, covalent bonds, coordination bonds, and metallic bonds).

4. Contents and Progress Schedule

1st: Introduction to chemistry, atomic and electronic structure of simple atoms, fundamental characteristics of atoms
2nd: Atomic and electronic structure of higher atomic number elements
3rd: Periodic properties of elements: Spin quantum number, Pauli exclusion principle
4th: Periodic properties of elements: Effective nuclear charge, electron orbital arrangement
5th: Periodic properties of elements: Ionization energy and electron affinity, electronegativity
6th: Quiz 1, Ionic and metallic bonds
7th: Covalent bonding (1): Octet rule
8th: Covalent bonding (2): Molecular orbital theory (σ bond, π bond, etc.)
9th: Covalent bonding (3): Bonding nature of molecular orbitals and bond order
10th: Covalent bonding (4): Molecular shape, hybrid orbitals and conjugate systems
11th: Quiz 2, Intermolecular force, hydrogen bonds
12th: Analyzing materials: Spectroscopy techniques
13th: Crystalline solids, amorphous materials, metallic glasses
14th: Technological advancement and chemistry: Applications of chemistry in daily life
15th: Introduction to chemistry disciplines
16th: Review, final examination

5. Evaluation Method

Evaluation is based on quizzes (25%), group work (25%), homework assignments (25%) and final examination (25%).

6. Textbook and References

Fundamentals of Physics Halliday & Resnick Wiley Online System

7. URL

8. Preparation and Review

Read the designated textbook sections and complete homework assignments to prepare for each class.

9. Practical business

10. Students must bring their own computers to class Yes

11. In Addition

Office hours for the course will be determined based on student availability.

<7> Information and Data Literacy

Class Schedule: Thursday, 1st. (2 credits) Category: Advanced Subjects-Information Science and Technology Education
Course Code: CB41216 Instructors: Xavier DAHAN

1. Class Subject

Basics of information and data science

2. Object and Summary of Class

Provide some survival and essential knowledge in the modern digital age: systems, network, cybersecurity, programming, manipulating data, doing some basic data analysis.

3. Goal of Study

1) Raise awareness about the modern issues of science and technology (systems, networks, cybersecurity).
2) Learn basic notions of programming common in most procedural programming languages.
3) Develop computational thinking: convert a problem into a solution implementable in computer.
4) Learn basic programming in the language Python
5) Represent data, manipulate data with Pandas' module
6) Perform very basic data analysis with Scikit-learn module

4. Contents and Progress Schedule

1. Orientation. Introduction to computer system tools.
2. Introduction to programming in Python I: variable and assignment. Some DataType.
3. Python II: list and dictionaries.
4. Python III: Boolean tests and if-then-else.
5. Python IV: Iterations. For, while loop.
6. Review
7. Python V: Functions and recursions.
8. Problem solving.
9. Introduction to networks.
10. Introduction to cybersecurity
11. Data Science I: Principles. Introduction to modules NumPy, Matplotlib.pyplot.
12. Review of basic probability notions.
13. DataFrames in Pandas.
14. Linear Regression with Scikit-learn module.
15. Classification: logistic regression, decision tree,clustering. Practice with real data.

5. Evaluation Method

Attendance and participation in class (20%)
Assignments and Quizzes (80%)

6. Textbook and References

7. URL

8. Preparation and Review

Review materials taught in class, in particular programming exercises given through GoogleColaboratory.
Develop autonomy in programming in Python.

9. Practical business

10. Students must bring their own computers to class No

11. In Addition

<8> Introduction of Academic Learning

Class Schedule: Friday, 4th. (2 credits) Category: Foundations-Navigating Academia

Course Code: CB54208 Instructors: Takeshi KOIKE, etc.

1. Class Subject

学問論 Introduction to Academic Learning

2. Object and Summary of Class

This course aims to smooth the transition of studying from overseas high schools to Tohoku University.

The course is designed to assist students in learning about Tohoku University and its contributions to society, about the responsibility of students as members of the academic community of Tohoku University, and to foster their motivation for education and research at Tohoku University.

Through a variety of teaching methods and activities such as lectures, field trips, discussions, writing, & presentations, the course also aims to help students recognize important differences in education between high school and university, including basic attitudes toward education and research in the university.

3. Goal of Study

The learning goals for students taking this course are to

(1) Learn about the roles of the university and their contributions to society,

(2) Learn about the education, research, and facilities at Tohoku University,

(3) Learn about the responsibility of students as members of the academic community of Tohoku University,

(4) Foster the motivation for education and research at Tohoku University,

(5) Improve communication skills through more effective delivery and gain deeper understanding of ideas through class discussions and presentations.

4. Contents and Progress Schedule

1. October 4, Orientation, D. Mott
2. October 11, History of Tohoku University-1, M. Nakagawa
3. October 18, History of Tohoku University-2, M. Nakagawa

4 & 5. October 25, Viewing of 3.11 documentary followed by trip to Arahama elementary school, D. Mott, X. Dahan, and T. Koike

6. November 8, Nuclear power plant Accident in Fukushima, T. Koike

7 & 8. November 9, Field Trip to Hamadori, Fukushima, T. Koike

9. November 22, Internationalization at Tohoku University, Y. Shimmi
10. November 22, Academic Integrity, T. Koike
11. November 29, Collaboration with industry and government at Nano TESRASU , J. Yoshida
12. December 6, Education and Society, M. Kojima
13. December 8, Entrepreneurship and opportunities at Tohoku University, Y. S. Matsushita

December 13, Spare

14. December 20, Review Quiz, X. Dahan
15. December 26, Final Presentation (Class time extended), D. Mott

5. Evaluation Method

Attendance and active participation including submission of reflection (50%)

Review Quiz (25%)

Final Presentation (10 minutes) (25%)

6. Textbook and References

7. URL

8. Preparation and Review

Reading assigned reference materials and studying a specific topic before a class.

For each lecture, take notes and write down takeaways. These notes can be used for the final quiz.

A review quiz consists of 50 questions, 5 question each from each lecture/field trip.

9. Practical business

10. Students must bring their own computers to class 必要

11. In Addition

<9> Chemistry B

Class Schedule: Monday, 3rd. (2 credits) Category: Basics of Discipline-Basics of Chemistry
Course Code: CB13216 Instructors: Mott Derrick

1. Class Subject

Introduction to Physical Chemistry

2. Object and Summary of Class

Physical chemistry covers the topics of thermodynamics, which governs the flow of energy in a system. The relationship between heat, work, temperature and energy dictate chemical equilibrium and the behavior of atoms and molecules. This course will introduce the fundamentals of physical chemistry covering the topics of entropy, enthalpy and free energy, and will also introduce the technological areas where physical chemistry is used.

3. Goal of Study

Become familiar with the basics of physical chemistry.
Learn about the laws of thermodynamics and how they are used.
Learn about the interplay between preservation of energy, state of system, temperature and other topics.

4. Contents and Progress Schedule

1st: Introduction to chemical thermodynamics
2nd: Kinetic theory of gases
3rd: Kinetic theory of gases and gas equation of state
4th: The first law of thermodynamics: Introduction of gas volume change, work energy and enthalpy
5th: The first law of thermodynamics: Gas heat capacity, gas isothermal change and adiabatic change
6th: Quiz 1, The second law of thermodynamics: Introduction of Carnot cycle and entropy
7th: The second law of thermodynamics: Entropy and its microscopic meaning
8th: The second law of thermodynamics: Free energy and chemical potential
9th: Thermochemistry: Reaction heat, heat of formation, Hess's law, bond energy
10th: Phase equilibrium: Water phase diagram, single component phase equilibrium
11th: Quiz 2, Phase equilibrium: Liquid and solid vapor pressure, solution vapor pressure depression
12th: Phase equilibrium: Boiling point elevation, freezing point depression, osmotic pressure
13th: Chemical equilibrium: Equilibrium constant, standard free energy of formation
14th: Modern challenges: Conservation of energy in a thermodynamic chemical system
15th: Physical chemistry used in advanced technological applications
16th: Summary and final examination

5. Evaluation Method

Evaluation is based on quizzes (25%), group work (25%), homework assignments (25%) and final examination (25%).

6. Textbook and References

Fundamentals of Physics Halliday & Resnick Wiley Online System

7. URL

8. Preparation and Review

Read the designated textbook sections and complete the homework to prepare for each class.

9. Practical business

10. Students must bring their own computers to class Yes

11. In Addition

Office hours for the course will be determined based on student availability.

<10> Earth Material Science

Class Schedule: Thursday, 3rd. (2 credits) Category: Basics of Discipline-Basics of Earth and Space Science
Course Code: CB43230 Instructors: Breedlove Brian Keith

1. Class Subject

Earth material science

2. Object and Summary of Class

Often we think of rocks as just being rocks without understanding how they formed, their composition or purpose. This goes for the variety of materials that make up the world on which we reside. In this course, we examine how different minerals form and how to identify them and examine the applications of some of the naturally occurring materials.

3. Goal of Study

Goals of this courses include understanding how minerals form and how they are characterized. In addition, students will learn some uses of natural earth materials.

4. Contents and Progress Schedule

Below is a tentative schedule for the semester. It may be subject to change due to time constraints.
Week:
1. Introduction: This lecture will involve chapters 1 and 2 of the textbook. There will be a brief description of how the elements form, followed by the formation of minerals. In addition, a brief introduction to materials will be provided.
2. Identification of minerals: The characteristics used to identify rocks and minerals and modern techniques will be presented (chapter 3).
3-6 Introduction to crystallography and symmetry: The basics of crystallography will be presented and space group symmetry will be discussed. Students should be able to identify basic symmetry elements (chapters 4 and 5).
7 Polarizing microscopy (chapter 6)
8-13 Igneous, sedimentary and metamorphic rocks: The petrology and examples of the different types of rocks will be discussed (chapters 7-15 and videos).
14-15 Applications of minerals: a few biological and scientific uses of minerals will be presented. Students should understand minerals play a part in everyday life.

5. Evaluation Method

Students will be evaluated by their efforts on two short reports, two exams and their level of class participation.

6. Textbook and References

Earth Materials: Introduction to Mineralogy and Petrology 2ed. Klein C. and Philpots A. Cambridge University Press 2017 textbook

7. URL

8. Preparation and Review

Read the chapters in the textbook that were covered in class.
Review the lecture slides given before each class period

9. Practical business

10. Students must bring their own computers to class Yes

11. In Addition

Google classroom will be used to distribute lecture slides and report information.

<11> Biology A

Class Schedule: Thursday, 4th. (2 credits) Category: Basics of Discipline-Basics of Biology
Course Code: CB44205 Instructors: Toshiharu ICHINOSE, etc.

1. Class Subject

Biology A - Essential Cell Biology

2. Object and Summary of Class

Cells are the structural and functional units of living organisms. Understanding basics of cell biology is essential for studying all areas of life sciences and any related branches of natural sciences. The main objective of this course is to learn the essential principles of cell biology by learning how the living cells are made and operating from a molecular perspective: especially, how DNA, RNA and proteins cooperatively work inside the cells to allow the maintenance, replication and responses to stimuli. Together with Biology B, which will be held in the next spring, the textbook "Essential Cell Biology" will be covered.

3. Goal of Study

Upon finishing this course, students will have a solid grasp of structure of cells and how they replicate themselves, exert cellular functions and communicate with each other. More concretely, intracellular structure and molecular dynamics inside cells, mechanisms of DNA replication, repair and recombination, gene expression and its regulation, and cellular signaling will be introduced. In addition, research topics of the instructors, all of whom are young biologists/biochemists in FRIS, will be introduced so that students will have a glimpse of cutting-edge sciences.
To achieve this, students will need to read one or a half of a chapter of the textbook every week. Mini-quiz will be assigned in each class. Active participation, such as asking questions and discussion in the class, is strongly encouraged.

4. Contents and Progress Schedule

1) General introduction
2) Cells as the fundamental units of life and cell communities (Chap. 1)
3) Chemical components of cells (Chap. 2)
4) Chemical reactions of cells 1 (Catalysis) (Chap. 3)
5) Chemical reactions in cells 2 (Biosynthesis) (Chap. 3)
6) DNA and chromosomes (structure & function) (Chap. 5)
7) DNA replication, repair, & recombination (Chap. 6)
8) From DNA to RNA (transcription & RNA processing) (Chap.7)
9) From RNA to proteins (translation & protein synthesis) (Chap. 7)
10) Control of gene expression 1 (transcriptional controls) (Chap.8)
11) Control of gene expression 2 (post-transcriptional controls) (Chap. 8)
12) Gene and genome evolution (Chap. 9)
13) Cell signaling 1 (principles and concepts) (Chap. 16)
14) Cell signaling 2 (receptors & cell-cell communication) (Chap. 16)
15) Final exam

5. Evaluation Method

Attendance, active participation and weekly mini-quiz (50%) and final exam (50%).

6. Textbook and References

Essential Cell Biology Alberts B, Hopkin K, Johnson A, Morgan D, Raff M, Roberts K, Walter P: WW Norton & Co Garland Science 2018 Textbook

7. URL

https://wwnorton.com/books/9781324033356

8. Preparation and Review

Students are expected to spend 2-3 hours per week, reading relevant textbook material, and completing online assignments.

9. Practical business

10. Students must bring their own computers to class No.

However, the final exam will be done with the computer.

11. In Addition

1) This is a general, entry-level biology course, open to all students and compulsory for first-year FGL students in the AMB program. High school-level familiarity with basic organic chemistry and biology is expected, but not necessarily.
2) Japanese students and exchange students from any field of study are encouraged to enroll, knowing that this is an introductory course held in English.
3) Instructors are available for questions and consultation upon appointment.

<12> Calculus A

Class Schedule: Friday, 2nd. (2 credits) Category: Basics of Discipline-Basics of Mathematics

Course Code: CB52221 Instructors: Xavier DAHAN

1. Class Subject

Calculus of functions of the real variable

2. Object and Summary of Class

This is a classical first course of calculus for engineering students. It takes root in Calculus learnt in high-school and brings it to a more advanced/college level. The core of the course is differential and integral calculus.

3. Goal of Study

Learn fundamental techniques of calculus of functions of the real variable, especially differentiation and integration.
Learn basic and fundamental applications.
Raise calculation skills. Become confident in conducting substantial calculations as met in Physics, Chemistry, Probability and Statistics, Engineering.

4. Contents and Progress Schedule

1.Introduction. Review of elementary functions.
2. Inverse functions (including some inverse trigonometric functions).
3. Limit of a sequence of numbers, definition and properties of real numbers.
4. Limit of a function and continuity. Intermediate value theorem.
5. Definition of the derivative of a function, differentiability.
6. Calculations of derivatives. Mean value theorem and applications to extrema problems
7. De L'Hospital's rule and practical evaluation of limits.
8. Midterm examination
9. Taylor's expansions, practical calculation.
10. Taylor-Lagrange remainder, application to estimation of the error.
Definition of the Riemann integral and the fundamental theorem of calculus.
11. Antiderivatives of elemententary functions.
Technique of integration I: substitution
12. Technique of integration II: integration by parts.
13. Technique of integration III: integration of partial rational functions.
14. Area, volume, length.
15. Improper integrals
16. Final examination

5. Evaluation Method

A mix of the final and midterm exams, and reports.

6. Textbook and References

Shaum's outline. Calculus (sixth edition) Frank ayres. Elliott Mendelson McGraw Hill

7. URL

8. Preparation and Review

Each new topic leanrt is accompanied by "practice sheets" that illustrate and deepen each newly introduced material. A selection of these problems will be solved in class. Two to three reports will be assigned and serve to prepare the midterm and final exams.

9. Practical business

10. Students must bring their own computers to class No

11. In Addition

<13> History

Class Schedule: Friday, 1st. (2 credits) Category: Foundations-Humanities
Course Code: CB51204 Instructors: Clinton Godart

1. Class Subject

Modern Wars and Military History

2. Object and Summary of Class

As we can see from recent events in Ukraine and the Middle East, to understand our modern world, we should study war and conflict. War "remains the most expensive, complex, physically, emotionally and morally demanding enterprise that humans collectively undertake." In this course we will explore major dimension of modern war and military history, such as causes of war, strategy, adaptation, militarism, war and culture, the home front, war and memory. We will take up important themes through the experience of modern Japan, but also through other periods and conflicts. Students will undertake a group research project and present in class.

3. Goal of Study

Learn about several main themes of military history. Learn about the modern world through conflict.

4. Contents and Progress Schedule

1) Orientation
2) Introduction: conflicts in the world today/ what is military history?
3) The Imperial Japanese Army and Navy
4) The Manchurian Intervention of 1931
5) The Japan-China War, 1937-1941
6) The Asia-Pacific War
7) Cold War conflicts
8) "Small wars" and the return of interstate conflicts
9) Student project work
10) Student project work
11) Student project work
12) Student project presentations
13) Student project presentations
14) Student project presentations
15) Summary and Overview

5. Evaluation Method

Participation in discussion: 20%
Presentation: 30%
Group work: 50%

6. Textbook and References

7. URL

Google Classroom

8. Preparation and Review

Prepare readings beforehand
Work in group research projects

9. Practical business

10. Students must bring their own computers to class Yes

11. In Addition

Group-work intensive class, limited to 25 students
ディスカッション、アクティブ・ラーニング、プロジェクト型授業。25人に限定する。

<14> Basic Japanese I

Class Schedule: Monday, 4th / Tuesday, 5th / Thursday, 2nd / Friday, 3rd. (4 credits) Category: Languages-Japanese

Course Code: CB14208 Instructors: Yukiko SHUKURI, Wataru NAKAMURA, Yuna MIKODA

1. Class Subject

Japanese for beginners

2. Object and Summary of Class

This class will use Google Classroom.
Intended for students who will study Japanese for the first time. This class aims to help students acquire basic knowledge of Japanese language and enhance the four basic skills.

3. Goal of Study

Students will
- master elementary Japanese grammar, vocabulary, kana (hiragana, katakana) and approximately 150 basic kanji
- acquire minimum skills in speaking, listening, reading and writing for essential everyday situations
- achieve a proficiency level equivalent to JLPT N5.

4. Contents and Progress Schedule

1. Course orientation
2-5. Lesson 1 New Friends
6-9. Lesson 2 Shopping
10-13. Lesson 3 Making a Date
14-18. Lesson 4 The First Date
19-23. Lesson 5 A Trip to Okinawa
24-28. Lesson 6 A Day in Robert's Life
29. Midterm exam (Kanji, Grammar, Listening)
30. Midterm exam (Speaking)
31-34. Lesson 7 Family Picture
35-39. Lesson 8 Barbecue
40-44. Lesson 9 Kabuki
45-49. Lesson 10 Winter Vacation Plans
50-54. Lesson 11 After the Vacation
55-58. Lesson 12 Feeling Ill
59-60 Summary

*The above schedule is subject to change.

5. Evaluation Method

Homework assignments and class participation 60%
Midterm and final exams 40%

6. Textbook and References

Genki 1, 3rd edition Banno et al. The Japan Times 2020 Textbook

7. URL

8. Preparation and Review

(1)Those who have no knowledge of the Japanese characters (hiragana, katakana) should learn them as a prerequisite to joining the program.
(2) During the course we expect you to:
1. Submit all homework assignments by due dates. Late work will be marked lower.
2. Prepare for the lessons: Listen audio materials and learn vocabulary in advance. Read the grammar explanations in advance.

9. Practical business

10. Students must bring their own computers to class

初回授業時に連絡する。

11. Students are informed of how to contact the instructor in the first class.

12. In Addition

Students MUST purchase the THIRD edition of GENKI 1.

<15> Foundations of Calculus

Class Schedule: Tuesday, 4th. (2 credits) Category: Foundations-Natural Sciences

Course Code: CB24225 Instructors: Ying CHEN

1. Class Subject

Foundations of Calculus

2. Object and Summary of Class

Built upon Calculus learnt in high-school, this course prepares to more advanced/academic techniques of essential Calculus. Differential and Integral Calculus are the core of this course.

3. Goal of Study

Learn more advanced techniques of differentiation and integration.
Learn applications of differential and integral calculus.
Be confident to use differential and integral calculus in other courses like Physics and Chemistry, Probability and Statistics.

4. Contents and Progress Schedule

1. Review of essential mathematics notions.
2. Review of functions. Trigonometric functions, inverse trigonometric function.
3. Limits. Continuity.
4. Derivative of a function. Differentiation.
5. Derivatives of usual functions. Product, quotient and chain's rules.
6. Mean value theorem. 1st and 2nd derivative tests.
7. Concrete min/max problems.
8. Mid-term examination.
9. De L'Hospital's rule. Computations of limits.
10. Integration. Definition and Fundamental Theorem of Calculus.
11. Technique of Integration I: substitution
12. Technique of integration II: integration by parts.
13. Length, area, volume, average.
14. Improper integrals.
15. Review.
16. Final examination.

5. Evaluation Method

Mix of scores obtained at the midterm, final and reports.

6. Textbook and References

Thomas' Calculus M.-D. Weir. J. Hass Pearson

7. URL

8. Preparation and Review

Each new topic leanrt is accompanied by "practice sheets" that illustrate and deepen each newly introduced material. A selection of these problems will be solved in class. Two reports will be assigned and will serve to prepare to the midterm and final exams.

9. Practical business

10. Students must bring their own computers to class No

11. In Addition