

Code	Subject	Day/Period	Categories	Credit(s)	Object	Instructor (Position)	Semester	Language Used in Course E:English J:Japanese	Class Subject	Object and Summary of Class	Goal of Study	Contents and Progress Schedule of the Class	Evaluation Method
CB11204	An Introduction to Information Science B	Fall, Mon./1st	Common Subjects--Information Sciences	2	FGL	Takeshi TOKUYAMA, Matias Korman (Graduate School of Information Sciences)	2	E	Information Fundamentals B	Understanding basic literacy and knowledge of information science and society.	Obtain basic knowledge of computer science and technology, and also obtain basic skill and ethics to live in information society	1. Overview and guidance 2. Learn the use of computer system of university 3. History of computer and computer science 4. Documentation and presentation 5. Discussion on information ethics 6. Computer Architecture and Network 7-9. EXCEL and Database 10-12. Programming skill 13-15. Computer Science Fundamentals	Report (3 times) 60% Presentation and Q&A 10% Attendance 30%
CB12273	Mineralogy, Petrology & Geochemistry	Fall, Mon./2nd	Expansion Subjects-Natural Sciences/ Earth and Space Science	2	FGL	ZHANPEISOV, Nurbosyn (Institute for Excellence in Higher Education)	2	E	Fundamentals of crystal structures of solids	The chemical crystallography applied to different kinds of solid structures is an important fundamental concept in many fields of chemistry and physics. One will learn the diversity of oxide, salt, metallic as well as organic solids, the nature and types of ordered structures composed of identical repeating units of a group or large atoms, molecules, ions as well as basic principles of defining crystal structures by physical and theoretical methods.	One must understand different types of solids with crystalline and/or amorphous structures, a number of possible chemical bonding (driving force) in solids as well as fundamental energy units to characterize crystalline association. Also one must understand the structure-property relationship to describe tiny chemical and physical properties of any solid.	1. Introduction to the chemistry and physics of solids, mineralogy 2. Amorphous solid, glass and polymer (biopolymer) 3. Chemical bonding in solids, coordination number 4. Cohesive energies in solids, formation energy of a unit 5. Interatomic distances in crystal structures 6. Basic structure motifs of crystalline solids 7. Anisotropy and the Avogadro constant 8. Mid-term test 9. Magnesium oxide, low coordination ions 10. Silica and zeolites 11. Titanium dioxides (rutile, anatase, brookite) 12. Covalent crystals of carbon 13. Metals 14. Metal-organic frameworks 15. Term-end test	Evaluation will be based on class attendance, reports and on the results of term-end test.
CB13258	Foundations of Calculus	Fall, Mon./3rd	Expansion Subjects-Mathematics	2	AMB	HANSEN, Frank (Institute for Excellence in Higher Education)	2	E	Foundations of Linear Algebra	1. Academic aims: An elementary introduction to linear algebra. 2. Keywords: Vectors, matrices, systems of linear equations, determinants, eigenvalues, diagonalization, quadratic forms.	The student will learn fundamental notions of elementary linear algebra, master the sweeping-out (echelon) method to solve systems of linear equations, invert matrices, calculate determinants and eigenspaces, and determine the definiteness of quadratic forms.	第1回 Vectors in the two-dimensional plane, vector calculus, the dot-product, Cauchy-Schwartz inequality, orthogonal vectors, the angle between two vectors. 第2回 Vectors in the n-dimensional space, vector calculus, the dot-product, Cauchy-Schwartz inequality, orthogonal vectors, the angle between two vectors, lines and hyper planes. 第3回 Matrix addition and scalar multiplication, matrix multiplication, regular matrix, transposed matrix. 第4回 Systems of linear equations, linear equations on matrix form, row operations, echelon form of linear equations. 第5回 Operation matrices, inversion of matrices. 第6回 Exercises on the blackboard. 第7回 Determinants. 第8回 Calculating determinants. 第9回 Eigenvalue and eigenvector. Calculating eigenspaces. 第10回 One hour mid-term test, exercises. 第11回 Diagonalisation of symmetric matrices. 第12回 Quadratic forms. 第13回 Applications in calculus. Interpolation and convex functions of two variables. 第14回 Summary of the course and exercises. 第15回 Examination	Evaluation: By class participation and by the result of the examination.
CB14274	Life and Nature	Fall, Mon./4th	Core Subjects-Science Studies	2	FGL	ROBERT, Martin (Institute for Excellence in Higher Education)	2	E	Big History: The organization and evolution of the universe (from the Big Bang to now, in one semester)	This course aims to provide an overview of the natural processes that occurred over a 13.7 billion years and led to the world that surrounds us. One ambition is to help students in various fields appreciate the fundamental importance and interdependence of physical, chemical, biological, and social sciences. The course will provide a broad perspective about this fantastic growth in organization and complexity in the universe throughout its 13.7 billion year history. It will also provide a general foundation for more advanced studies and help students appreciate the deep connections that exist between otherwise seemingly disparate scientific disciplines. Students will explore the origin of our universe and our world, the intricate connectivity in nature, life and human development. This will motivate them to think about the larger issues and challenges in science and technology. The course will also highlight our current knowledge based on scientific evidence, investigations, the evolution of scientific ideas, and some of the remaining big and unsolved questions. We will also explore how specific events lead to the appearance of humans and the enormous impact of social and technological developments for our species and its consequences for our planet. - Big History tells the story of the Universe from the Big Bang to the present, a time span of 13.8 billion years. Big History asks big questions. Among these are: How was the Universe created? Why does it work the way it does? What is life? Why are stars so big? Why are you and I so small?	After this course, the student will have general perspective on natural and living systems, their basic constituents and properties. The student will also better understand how natural and living systems consist of complex networks of elements whose intricate and dynamical balance is critical for our planet and all its inhabitants, as the ultimate global ecosystem. Some of the specific learning objectives include: - Explain how thresholds of increasing complexity, differing scales of time and space, claim testing, and collective learning help us understand current and future events as part of a larger narrative. - Use multiple scientific perspectives to understand the history and evolution of the Universe and Universal change. - Deepen an understanding of key scientific concepts and facts, and the use of these in constructing explanations. - Critically evaluate, analyze, and synthesize primary and secondary scientific, and technical texts to form well-crafted and carefully supported written and oral arguments. - Analyze various scientific topics using valid reasoning and relevant and sufficient evidence through individual or shared writing, speaking, and other formats. - Locate and understand how our own place, our community's place, and humanity as a whole both fit into and impact the Big History narrative, using the concept of "thresholds" to frame the past, present, and future. - Engage in scientific analysis using the theories and practices from multiple disciplines, toward an integrated, interdisciplinary understanding of the history of the Universe To achieve this, the course will include lectures, interactive video presentations, as well as group activities and discussions on selected topics about the origin of matter and structure and the elements in the universe, our solar system, the origin of life, ecology, biodiversity, and evolution and human development driven by collective learning. Much of the teaching material is derived from the Big History Project, adapted for first year undergraduate curriculum and the limitations of a single semester course.	1)Introduction: What is Big History? 2)Getting started: The Big Bang 3)Stars light up. New chemical elements 4)Our solar system and earth 5)Life: What is Life? 6)Origin of life 7)Mid-term examination. Biogeochemical cycles 8)The Biosphere, biodiversity and ecosystems 9)Evolution and natural selection 10)Early humans and collective learning 11)Agriculture and civilization 12)Expansion and interconnection 13)The Anthropocene: technologies and economies 14)Acceleration and the Future 15)Final examination	Evaluation will be based on weekly attendance and active participation (10%), completion of in-class activities, exercises and assignments (30%), a team project (20%) as well as a mid-term and final examination (40%).
CB15202	Basic Japanese 1	Fall, Mon./5th Tue./5th Thu./5th Fri./5th	Common Subjects-Subjects for International Students	4	FGL	Natue SUGAYA, Kei YOSHIMOTO 菅谷 奈津恵, 吉本 啓 Institute for Excellence in Higher Education Atsuko UCHIYAMA 内山 敦子	2	E	Japanese for beginners	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 skills of speaking, listening, reading, and writing.	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.	1. Course orientation, Kana quiz 2-5. Lesson 1 X wa Y desu construction, Question sentences 6-9. Lesson 2 Demonstrative (ko/so/a) 10-13. Lesson 3 Verb types and the present tense 14-18. Lesson 4 Describing where things are, Past tense of verbs 19-23. Lesson 5 Adjectives, Counting 24-28. Lesson 6 Te-form, Describing two activities 29. Midterm exam (Katakana, Kanji, Grammar, Listening) 30-34. Lesson 7 Various meanings of te iru form 35-39. Lesson 8 Short forms (plain forms) 40-44. Lesson 9 Past tense short forms 45-49. Lesson 10 Comparison between two items 50-54. Lesson 11 Describing hope or aspiration (-tai) 55-58. Lesson 12 Explaining things (-n desu) 59-60 Summary	1. Exams(Midterm exam: Katakana, Kanji, Grammar, Listening, Speaking; Final exam (Katakana, Kanji, Grammar, Listening, Writing, Speaking) 60%, 2. Quizzes (Kana, Kanji, vocabulary, grammar) 20%, 3. Homework 10% 4. Class participation 10%

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An Introduction to Information Science B																		There should be homework on programming and documentation.	Lecture will be given in English, but with Japanese accent.
Mineralogy, Petrology & Geochemistry	Physical Chemistry	R.J. Silbey and R.A. Alerty		2000														We will have small quizzes, mid-term and term-end tests. A number of original journal papers will be also given at selected lecture classes.	The lecture attendance will be strictly controlled.
Foundations of Calculus	Introduction to Linear Algebra 2.ed.	Serge Lang	Springer Verlag	2008	0387962050												https://sites.google.com/site/frankhansentohoku2016	Homework: The students are required to solve excersises for each lecture.	The lecturer prepares presentation files for each lecture and post them on the homepage for the course.
Life and Nature	Big History Project web site			2017			Cosmic evolution	Eric J. Chaisson		2013							https://school.bighistoryproject.com/bhplive	Students will be expected to spend 1-2 hours per week, on average, reviewing video and written documents and doing assignments.	1)This is a general, entry-level course that is open to all students, regardless of their study program and background. It is a required course for all first-year FGL program students. Japanese students and exchange students from any field of study are encouraged to enroll, knowing that this is an introductory course that is held completely in English. There will be many opportunities to listen, read, write and discuss in English in small groups. 2)Instructor available for questions and consultation during office hours, Thursday 10:00-12:00, and by e-mail (mrobert@m.tohoku.ac.jp).
Basic Japanese 1	Genki 1, second edition	Banno et al.	The Japan Times	2011	978-4-7890-1440-3	Textbook	Genki 1 Workbook, second edition	Banno et al.	The Japan Times	2011	978-4-7890-1441-0	Textbook					Genki-Online http://genki.japantimes.co.jp/index_en	(1)Those who have no knowledge of the Japanese characters (hiragana, katakana) should learn hiragana and katakana as a prerequisite to joining the program by using prescribed materials. (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 CD and learn vocabulary in advance. Read the grammar explanations in advance.	

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CB21241	Economics	Fall, Tue./1st	Expansion Subjects-Social Sciences	2	FGL	Dan QIN (Graduate School of Economics and Management)	2	E	Japanese Business and Economy A	This course studies the behavioral foundations of Japanese business and economics. The objective of this course is twofold. In the first place, students will learn basic microeconomic methods in modelling individual behavior. In the second place, we will introduce and discuss several examples of non-standard behavior that are common among Japanese people. We will then discuss the modelling of such types of behavior.	Upon the completion of this course, students will come to understand the difference between real life decision making (in the case of Japanese people) and the behavioral patterns assumed by classical economic theory. Students are also expected to be able to build simple models explaining nonstandard behavior.	We will first introduce the economic sense of "rationality" and then discuss several typical behavior deviating from this hypothesis. At the end of this class, students will give presentations about typical nonstandard behaviors in their own culture. 1) Orientation and introduction 2) Rational decision maker in the economic sense: Preference maximization hypothesis 3) Properties of preference and utility 4) Uncertainty and risk 5) Strategic behavior: Non-cooperative game 6) Giri: The Japanese social obligation 7) Honne to Tatemae: Private vs. public stance in Japan 8) Kenkyo: The Japanese virtue of modesty 9) Shundan Ishiki: Japanese group consciousness 10) Kirituteki (Following rules) 11) Modeling non-standard behavior 12) Modeling non-standard behavior 13) Student Presentation Week 13, 14, and 15 are reserved for student to make presentations about examples of nonstandard behavior in their own culture. 14) Student Presentation Week 13, 14, and 15 are reserved for student to make presentations about examples of nonstandard behavior in their own culture. 15) Student Presentation Week 13, 14, and 15 are reserved for student to make presentations about examples of nonstandard behavior in their own culture.	Students will be evaluated by class participation (40%) and presentation (60%).
CB22272	Biology A	Fall, Tue./2nd	Expansion Subjects-Biology	2	FGL	ROBERT, Martin (Institute for Excellence in Higher Education)	2	E	Essential Cell Biology	The cell is the fundamental unit of life. Its basic understanding is essential for any aspiring student or researcher in the natural sciences. The objective of this course is for students to learn the fundamental principles of cell biology by studying the cell structure, organization, and basic biochemical functions and how these relate to the cell's fundamental role in all living systems.	After this course the student will have a solid grasp of basic cellular functions including its components, DNA structure, replication and repair, gene expression, cellular communication and cell division. To do this, the main components, structures and information storage functional systems of the cell will be introduced and explored. In addition, the broader picture and the important connectivity among all cellular components and a view of the cell as a non-reducible system will be emphasized. Some of the specific learning objectives include: - Explain the fundamental differences between prokaryotic and eukaryotic cells from both a structural and evolutionary perspective - Understand the function of the main cellular components and how they are connected to the living process - Describe the basic component and functions of the DNA replication and repair machinery and its mechanism, gene expression (transcription and translation) and their regulation - Explain the basic mechanisms of gene and genome evolution - Understand principles of cellular signaling and information processing in cells - Describe the main phases of the cell cycle and regulation as well as the properties of cell communities - Realize the importance of studying the cell in order to understand living organisms, ecosystems, as well as health and disease. To achieve this, students will complete weekly reading and problem set assignments for the units listed below. Quizzes, in-class group activities and exercises, and an online forum will enhance interactions and student learning. In addition to those activities, a mid-term and final examination will be used to evaluate student learning and ability to recognize the components, structure and systems of the cell as well as the student ability to extend what they learned to novel contexts.	1)The fundamental unit of life (cell theory and the cell as a complex system) 2)Basic cell structure and architecture (prokaryotic and eukaryotic) 1 3)Basic cell structure and architecture (prokaryotic and eukaryotic) 2 4)DNA and chromosomes (structure and function) 5)DNA replication, repair, and recombination 6)From DNA to RNA (transcription, RNA processing, and degradation) 7)Mid-term examination From RNA to proteins (translation and protein synthesis, the genetic code, and protein degradation) 8)Gene and genomes (structure, function, and evolution) 9)Analyzing genes and genomes 10)Regulation of gene expression (transcriptional and post-transcriptional mechanisms) and epigenetics (non-genetic means of information storage and transmission) 11) Cell signaling and communication (principles, signals, and receptors) 1 12) Cell signaling and communication (principles, signals, and receptors) 2 13) The cell cycle and cell division (overview, phases, and regulation) 14) Cell communities (extracellular matrix, cells junctions, maintenance) 15) Final examination	Attendance and active participation (20%), weekly exercises and assignments (30%), examinations (50%).
CB23255	Sports A	Fall, Tue./3rd	Common Subjects-Health Sciences	1	AMB	Akira TAMAGAWA 玉川 明朗 (Graduate School of Medicine)	2	J	Badminton	In this class, students will learn the importance of physical activity and how to exercise appropriately through badminton, a recreational sport with which many students are already familiar. Also, by playing competitively they will experience the importance of expressing intent and relating to and communicating with others. This will foster their initiative and cooperativeness. The class will be conducted so that anyone can take it, regardless of their level of physical fitness or badminton ability. By hitting the shuttlecock back and forth with various partners, I hope that students will learn not only the technical abilities needed to enjoy rallying, but also social skills. The class aims to teach students to enjoy sports activities, and feel confident about engaging in sports in their everyday lives. Badminton uses a shuttlecock. The word "shuttle" means "to come and go." The player hits the shuttlecock, which their partner then returns, so the player then must hit it back to the partner again. This is essentially a form of communication. Both beginners and experts are welcome in this class.	Students will come to enjoy exercising through actively participating in physical activities. All students will learn to enjoy rallying and matches without fear of making mistakes. Students will acquire enough skill to participate in doubles matches. In this class, "learning to play" and "technique" do not refer only to skill at hitting the shuttlecock with the racket. They also include playing badminton under various conditions while observing others, in addition to the ability for self-observation. They will learn about "intangibles" that cannot be taught in classroom lectures with the objective of obtaining "awareness" of the present moment.	1st Class, guidance 2nd What kind of sport is badminton? 3rd Making contact between shuttlecock and racket 4th Misc. strokes pt. 1 5th Misc. strokes pt. 2 6th Misc. strokes pt. 3 7th Misc. strokes pt. 4 8th Misc. strokes pt. 5 9th Misc. strokes pt. 6 10th Basic skills for enjoying doubles games pt. 1 11th Basic skills for enjoying doubles games pt. 2 12th Basic skills for enjoying doubles games pt. 3 13th Basic skills for enjoying doubles games pt. 4 14th Basic skills for enjoying doubles games pt. 5 15th Concluding remarks From the 2nd class on, content will be arranged based on assessment of the students' skill level. Also, 1 v. 1 (singles) and 2 v. 2 (doubles) practice will be conducted while learning stroke skills. Content of instruction may be changed depending on student proficiency. The pace of the class may also change depending on the speed at which the students progress.	Needless to say, this class largely assumes participation as it is based on learning skills and practicing. On the 15th class there will be a lecture. A test may be given as well. Basically, the class will be graded as Pass - A (excellent) or Fail - D (poor).
CB23256	Sports A	Fall, Tue./3rd	Common Subjects-Health Sciences	1	AMB	Akira SATO 佐藤 明 (Graduate School of Medicine)	2	J	Kyudo (Japanese Archery – Rules of Shooting and Etiquette)	As many of the students will be studying Kyudo for the first time, they will learn the basics of handling the bow and arrows, and drawing and releasing the bow. Students will learn how the skills in Kyudo are based on a deep understanding of the mechanics of the human body and the characteristics of the equipment; in addition to learning how to hit a target, they will gain a rational and aesthetic understanding of the postures and movements.	Because Kyudo techniques and etiquette are very closely related, students will learn shooting techniques and correct movements in formalized situations. Shooting techniques are comprised of a systematic set of rules for handling the bow, while etiquette is composed of modes of traditional behavior. The goal of the class is to enable students to gain a scientific understanding of the rational postures/movements, and to learn to adapt their experiences into daily life.	Although learning shooting skills is the first priority, etiquette will also be learned step by step in each class as it is fundamental to posture and movement. Students will experience the fun and difficulties of Kyudo through games and competitions. 1. Guidance: Hazard prevention and safety measures. Summary of technique and etiquette 2. Introduction: Basics of shooting, Basics of standing posture 3. Holding the bow and gripping the string / two kinds of sitting posture ("Kiza," "Seiza") / three-breath-bowing 4. Principles of positioning the limbs (lower and upper body) / two kinds of bowing in sitting position ("Shikkenrei," "Seshshurei") / two-breath-bowing 5. Adjusting the body posture / the "Three Crosses" / two more kinds of bowing in sitting position ("Takushurei" , "Soshurei") 6. Settling the grip on the bow to control it correctly ("Tenouchi") / one more kind of bowing in sitting position ("Goshurei") 7. The leather archery glove ("Yugake") and its usage / walking in Kyudo 8. "The Five Crosses" and determining correct shooting form / the "Five Crosses" / "Suriashi" -walking 9. Drawing the bow / main points of "Uchiokoshi" and "Hikiwake" / synchronization of breathing and movements 10. Obtaining full draw length / drawing until "Yazuka" / various types of body turn 11. Arms and trunk forming a cross ("Tateyokujumonji," "Hanare no Jumonji") / turning the body while walking 12. Tips for reliably hitting the target (the four requirements in "Tsuneai") / moving forward and backward while kneeling ("Shikko," "Shitta") 13. Important technical points about hitting or missing the target (vertical and horizontal "Nobia") / "Soniyo" 14. The end of the shot (important aspects of "Zanshin") / synchronization of movements with breathing ("Kia") 15. Conclusion: Skill test - Hit 1m diameter target at a distance of 28m in the basic posture and movements	Students must attend class, as learning the body movements requires practice. Grades will be based on attendance rate and skill tests. Students will take a practical examination, shooting 70cm diameter target at a distance of 28m, according to the rules of formal technique and etiquette.

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Economics	The Japanese Mind: Understanding Contemporary Japanese Culture	Davis R. J., Ikeno O.	Tuttle Publishing	2002	0804832951	Textbook	Advanced Microeconomic Theory	Jehle G. A., Reny P. J.	Prentice Hall	2011	9780273731917	Reference						Students are required to prepare presentations reflecting typical behavior of their own culture. The preparation should start by the 10th week.	Prerequisite: introductory microeconomics Office hours: by appointment
Biology A	Essential Cell Biology	Alberts B, Bray D, Lewis J, Raff M, Walter P, Hopkin K, Johnson A, Roberts K	Garland Science	2012														Students will be expected to spend 1-2 hours per week, on average, reading relevant textbook material and completing assignments.	1)This is a general, entry-level course that is open to all students and is compulsory for FGL students in the AMB program. Although not essential, it is best taken as a set with Biology B (Essential Biochemistry, Spring 2017) to provide an overall view of cellular functions. High school-level familiarity with basic organic chemistry and biology is assumed. Japanese students and exchange students from any field of study are encouraged to enroll, knowing that this is an introductory course that is held completely in English. 2)Alberts' Essential Cell Biology, 3rd and 4th Edition, will be the main reference and several copies of the text will be available for loan at the FGL office. It is an entry-level textbook that comes with a useful DVD. 3)Instructor available for questions and consultation during office hours, Thursday 10:00-12:00, and by e-mail (mrobert@m.tohoku.ac.jp).
Sports A																		It is necessary to investigate various information on sports. The details will be announced in class.	
Sports A																			Archery equipment will be provided by the university. Piercings and other accessories must be removed before class. For safety reasons, please do not wear earrings or other accessories.

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CB23257	Sports A	Fall, Tue./3rd	Common Subjects-Health Sciences	1	AMB	Ryoichi NAGATOMI 永富 良一 (Graduate School of Biomedical Engineering)	2	J	Soccer			1st Guidance 2nd Practice game 3rd-15th League tournament	Attendance (80%). Group evaluations will also be given as each member's performance progresses (practical skills, understanding of strategy) (20%).
CB23258	Sports A	Fall, Tue./3rd	Common Subjects-Health Sciences	1	AMB	Toshihiko FUJIMOTO 藤本 敏彦 (Institute for Excellence in Higher Education)	2	J	Softball	The aim of "Sports A: Softball class is constructed of two part. First part is "Team management" and Second part is Coaching". Goal of first part is to lean the team management that is how to relation with team member using softball game. Goal of second part is to lean the coaching that is how to make menu of practice and to teach for member.	The aim of "Sports A: Softball class is constructed of two part. First part is "Team management" and Second part is Coaching". Goal of first part is to lean the team management that is how to relation with team member using softball game. Goal of second part is to lean the coaching that is how to make menu of practice and to teach for member.	First part. Team management. Number of classes:1-8. 1. Guidance. 2. Decision of own objective and team formation. 3. Softball practice and Communication with team mate. 4. Softball practice and team production. 5. Softball game and team condensation. 6. Softball game and leadership. 7. Softball game and norm within the team. 8. Softball game, review and team management. Second part. Coaching. Number of classes: 9-15. 9. Softball game and coaching theory 1: Assessment. 10. Softball game and coaching theory 2: Feedback. 11. Softball game and coaching theory 3: Teaching of softball practice. 12. Softball game and coaching theory 4: Study form. 13. Softball game and coaching theory 5: Reflection. 14. Softball game and coaching theory 6: Belief of teaching. 15. Softball game and review.	Examination 50% and short review report on every class 50%. Grades of the course will be assigned as follows: AA..... Excellent (90-100%) A..... Good (80-89%) B..... Fair (70-79%) C..... Passing (60-69%) D..... Failure (0-59%)
CB23260	Linear Algebra A	Fall, Tue./3rd	Expansion Subjects-Mathematics	2	AMC, IMAC-U	TRUSHIN, Igor (Institute for Excellence in Higher Education)	2	E	Fundamentals of linear algebra	The purpose of this class is to learn the basic notions and properties of vectors and matrices	One should understand and master methods of dealing with matrices and determinants	1.Properties of real vectors 2.Linear independence and basis 3.Rank of a matrix, sweeping out method 4-5.Addition, scalar and matrix multiplications 6.Regular matrix and basis 7.Determinants 8-9.Fundamental properties of determinants 10-11.Calculation of determinants 12.Cofactor expansion of a matrix 13.Inverse of a matrix 14.Cramer's rule 15.Final examination	Evaluation will be based on results of a tests and home work
CB31259	History and Human Society	Fall, Wed./1st	Core Subjects-Social Studies	2	FGL	Manabu NAKAGAWA 中川 学 (Institute for Excellence in Higher Education)	2	E	History of Tohoku University	What sort of a university is Tohoku University? This course aims to help students understand the characteristics and uniqueness of Tohoku University from a historical perspective.	The goal is for each of you to acquire the following knowledge and abilities through these lectures. (1) To be able to understand and explain Tohoku University's history by using some concrete example. (2) To be able to survey and describe the features of your university, department and laboratory from a historical point of view.	This course is centered on a lecture and a field trip. The contents and schedule are as shown below: (1) Introduction (2) Field trip (Sendai City Museum) (3) The Foundation of Tohoku Imperial University (4) Field trip (University Museum) (5) Open Door Policy (6) Development of University I (7) Development of University II (8) Student Life (9) Field trip (University Library) (10) International Students (11) World War II and Postwar Reforms (12) Field trip (University Archives) (13) University Campus (14) University Reforms (15) University Ideals	Half of your grade will be based on attendance and understanding of the course (Minute Paper*, 50%), while the other half will be based on a final paper (50%). *Students will be requested to complete the Minute Paper at the end of the class. A student absent more than 5 sessions will not be given any credit.
CB32257	Chemistry A	Fall, Wed./2nd	Expansion Subjects-Chemistry	2	FGL	ZHANPEISOV, Nurbosyn (Institute for Excellence in Higher Education)	2	E	Fundamentals of chemical bond theory	The nature of chemical bond is the fundamental concept to understand the structure and properties of atoms and molecules as well as any molecular substances. One will learn the electronic structure of atoms depending on its position in periodic table of elements, formation of bonds as well as different molecular associations based on quantum chemistry concepts.	One must understand the structure of the atom based on its electronic configuration as well as its relationship with chemical and physical properties of any element. One will learn the concept of wave equation, its application to diatomic molecules and chemical bonds in large molecular associations. Shape or structure of simple polyatomic molecule can be explained via concept on hybridization or hybrid molecular orbital formation as well as relationships between bond length and electronic configuration. One must understand the nature of bonding responsible for stability of molecular associations.	1. Introduction 2. Classical quantum theory and atomic model 3. Wave equation and basics of quantum chemistry 4. Electronic configuration and periodic table of elements 5. Covalent bond and ionic bond 6. Electronic structure of positively charged molecular hydrogen and diatomics 7. Hybrid molecular orbital and the shape of the polyatomic molecule 8. Mid-term test 9. Molecular complexes and intermolecular forces 10. Crystal structure motif and crystal field theory 11. Approximation methods, Valence-bond (VB) method 12. Hückel theory for ethylene, allyl 13. Hückel theory for butadiene and trimethylenemethane 14. Modern quantum chemistry 15. Term-end test	Evaluation will be based on class attendance, reports and on the results of mid-term and term-end tests.

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Sports A																			Each to bring own wear and soccer shoes
Sports A																			Place: Kawauchi field.
Linear Algebra A	Introduction to Linear Algebra.	Serge Lang	Springer.		0387962050														Review thoroughly by doing homework assignments.
History and Human Society																			Students will be requested to write a paper after each field trip. Students will be requested to write a final paper at the end of the semester. You must attend the first class session. The maximum number of participants for this course is 40 due to the circumstances of field trip. If there are more applicants than quota, participants will be selected by lottery. Office hours are from 13:00 to 16:00 on Thursdays. Make an appointment in advance via e-mail or other means. E-mail: manabun@m.tohoku.ac.jp.
Chemistry A	Physical Chemistry	Ira N. Levine		2008		Physical Chemistry: A Molecular Approach	D.A. McQuarrie and J.D. Simon		1997										We will have small quizzes, mid-term and term-end tests. The lecture attendance will be strictly controlled.

Code	Subject	Day/Period	Categories	Credit(s)	Object	Instructor (Position)	Semester	Language Used in Course E:English J:Japanese	Class Subject	Object and Summary of Class	Goal of Study	Contents and Progress Schedule of the Class	Evaluation Method
CB42230	World of Fine Arts	Fall, Thu./2nd	Core Subjects-Human Studies	2	FGL	Mitsuru HAGA 芳賀 満 (Institute for Excellence in Higher Education)	2	E	Japanese Art History	Art shows (and encompasses) the way we comprehend and understand this Universe. Therefore Art should be regarded as a visual philosophy; not as a mere illustration of history based on written documents. Thereupon, the importance of learning its history, in this case, Japanese Art History, can never be exaggerated.	The objective of this course is to provide an outline and basic knowledge about Japanese Art History ranging from the beginnings of human habitation in the Japanese archipelago to the present, including the art of the Jomon, Yayoi, Kofun, Asuka and Nara, Heian, Kamakura, Muromachi, Azuchi-Momoyama, Edo, Meiji, Taisho, Showa and Heisei Periods.	<ol style="list-style-type: none"> 1. Course Orientation. What is Art ? 2. Art of Jomon Period 3. Art of Yayoi and Kofun Periods 4. Asuka Hakuou Art- the Reception of Buddhism 5. Art of Nara Period 6. Art of Heian Period 1 7. Art of Heian Period 2 8. Art of Kamakura Period 9. Art of Nanbokuchō/Muromachi Period 10. Art of Momoyama Period 11. Art of Edo Period 1 12. Art of Edo Period 2 13. Art of Meiji Period 14. Art of Taisho, Showa and Heisei Periods (1) 15. Art of Taisho, Showa and Heisei Periods (2) 	Evaluation will be based on final report (70%), performance in the class room (30%).
CB43254	Chemistry B	Fall, Thu./3rd	Expansion Subjects-Chemistry	2	FGL	ZHANPEISOV, Nurbosyn (Institute for Excellence in Higher Education)	2	E	Fundamentals of physical chemistry	In this course, main emphasize will be given to the fundamentals and concepts that provide a basis for understanding physical chemistry, underline physical principles that govern the properties and behavior of chemical systems. It would be also as a learning basic course by giving a series of lectures on different topics of physical chemistry.	One must understand the fundamental relationships between the structure of a chemical compound and its physical (as well as chemical) properties. One must understand main concepts of state equations, main laws of thermodynamics, reaction equilibrium as well as reaction kinetics.	<ol style="list-style-type: none"> 1. Quantitative concepts of temperature, work, internal energy and heat 2. Classical mechanics and Newton's second law of motion 3. First law of thermodynamics 4. Barometric formula, van der Waals equation, enthalpy and heat capacity 5. Carnot heat engine, the second law of thermodynamics 6. Entropy, the third law of thermodynamics, thermodynamic equations of state 7. Kinetic theory of gases, model of a perfect gas 8. Types of average speeds, collision with a surface 9. Mid-term test 10. Reaction kinetics and reaction rate equation 11. First, second and third order reactions 12. Reversible first order reaction, parallel first order reaction 13. Consecutive first order reaction, mechanisms of chemical reactions 14. Radical reactions, unbranched and branched chain reactions 15. Term-end test 	Students must attend all these lectures. Evaluation will be based on class attendance, on the results of short and term-end tests, home works and reports.
CB44228	Health	Fall, Thu./4th	Common Subjects-Health Sciences	2	FGL	Ryoichi NAGATOMI 永富 良一 (Graduate School of Biomedical Engineering)	2	E	Health Science	Threats to health has long been determined by how well you are fed, and how well you could stay away from contagious bacteria and viruses. Yet, in the world where we know how successful aging would be accomplished, threats to health depend rather on your every day behavior, your life style. Moreover, thanks to the developed way of transportation of today's world, many people should confront with viruses we've never encountered. In this class we will discuss about the latest health care tips and topics with scientific background. We will make full use of multinational class, comparing the health care system in different countries and health tips with different cultural background.	The aim of the class is to encourage students to understand and interpret flooding amount of health care information based on scientific way of thinking.	The topics will vary and may be picked up upon discussion in the class. The topics covered in the previous classes were - 1. Welcome to the G30 Health Science class: a guide to the class. 2. How health care systems work 1. 3. How health care systems work 2. 4. What are risk factors? 5. Obesity 6. Exercise, physical activity and health. 7. Food and health. 8. Aging 9. Memory and cognition. 10. Genes and health. 11. Common cold and flu. 12. Physical training: how it works. 13. Sports injury 1. 14. Sports injury 2. 15. Drug abuse and drug allergy.	Participation is essential. I appreciate an active involvement in the discussion. Instead of an overall exam, Evaluation will therefore be based on participation and brief E-mail based reports about the discussion in the class with their own opinion on the topic after the classes.
CB52222	Calculus A	Fall, Fri./2nd	Expansion Subjects-Mathematics	2	FGL	TRUSHIN, Igor (Institute for Excellence in Higher Education)	2	E	Calculus of functions of one variable	The purpose of this class is to learn the basic notions of derivative and integral	One should understand fundamental definitions and theorems of calculus, master the basic techniques and applications which accompany them.	<ol style="list-style-type: none"> 1. Properties of real numbers 2. Limits of sequences and functions 3. Basic elementary functions, trigonometric functions, inverse functions 4. Continuous functions 5. The definition of derivative 6. The mean value theorem 7. L'Hospital's rule 8. Higher order derivatives 9. Taylor formula and Taylor series 10. Applications of derivatives, minimum and maximum values. 11. Indefinite integrals, computing basic indefinite integrals 12. Riemann integral and its properties 13. Improper integrals 14. Applications of integration 15. Final examination 	Evaluation will be based on results of a tests and home work
CB53220	Sports A	Fall, Fri./3rd	Common Subjects-Health Sciences	1	AMC	Akira SATO 佐藤 明 (Graduate School of Medicine)	2	J	Kyudo (Japanese Archery – Rules of Shooting and Etiquette)	As many of the students will be studying Kyudo for the first time, they will learn the basics of handling the bow and arrows, and drawing and releasing the bow. Students will learn how the skills in Kyudo are based on a deep understanding of the mechanics of the human body and the characteristics of the equipment; in addition to learning how to hit a target, they will gain a rational and aesthetic understanding of the postures and movements.	Because Kyudo techniques and etiquette are very closely related, students will learn shooting techniques and correct movements in formalized situations. Shooting techniques are comprised of a systematic set of rules for handling the bow, while etiquette is composed of modes of traditional behavior. The goal of the class is to enable students to gain a scientific understanding of the rational postures/movements, and to learn to adapt their experiences into daily life.	Although learning shooting skills is the first priority, etiquette will also be learned step by step in each class as it is fundamental to posture and movement. Students will experience the fun and difficulties of Kyudo through games and competitions. 1. Guidance: Hazard prevention and safety measures. Summary of technique and etiquette 2. Introduction: Basics of shooting. Basics of standing posture 3. Holding the bow and gripping the string / two kinds of sitting posture ("Kiza," "Seiza") / three-breath-bowing 4. Principles of positioning the limbs (lower and upper body) / two kinds of bowing in sitting position ("Shikkenrei," "Sesshurei") / two-breath-bowing 5. Adjusting the body posture / the "Three Crosses" / two more kinds of bowing in sitting position ("Takushurei" - "Soshurei") 6. Setting the grip on the bow to control it correctly ("Tenouchi") / one more kind of bowing in sitting position ("Goshurei") 7. The leather archery glove ("Yugake") and its usage / walking in Kyudo 8. "The Five Crosses" and determining correct shooting form / the "Five Crosses" / "Suriashi" -walking 9. Drawing the bow / main points of "Uchiokoshi" and "Hikiwake" / synchronization of breathing and movements 10. Obtaining full draw length / drawing until "Yazuka" / various types of body turn 11. Arms and trunk forming a cross ("Tateyokujumonji," "Hanare no Jumonji") / turning the body while walking 12. Tips for reliably hitting the target (the four requirements in "Tsumeai") / moving forward and backward while kneeling ("Shikko," "Shitta") 13. Important technical points about hitting or missing the target (vertical and horizontal "Nobia") / "Sonkyo" 14. The end of the shot (important aspects of "Zanshin") / synchronization of movements with breathing ("Kia") 15. Conclusion: Skill test - Hit 1m diameter target at a distance of 28m in the basic posture and movements	Students must attend class, as learning the body movements requires practice. Grades will be based on attendance rate and skill tests. Students will take a practical examination, shooting 79cm diameter target at a distance of 28m, according to the rules of formal technique and etiquette.

Subject	Textbook 1 - Textbook Title	Textbook 1 - Aurthur	Textbook 1 - Publisher	Textbook 1 - Publication Year	Textbook 1- ISBN/ISSN	Textbook 1 - Textbook/ Reference	Textbook 2 - Textbook Title	Textbook 2 - Aurthur	Textbook 2 - Publisher	Textbook 2 - Publication Year	Textbook 2- ISBN/ISSN	Textbook 2 - Textbook/ Reference	Textbook 3 - Textbook Title	Textbook 3 - Aurthur	Textbook 3 - Publisher	Textbook 3 - Publication Year	URL	Preparation and Review	In Addition	
World of Fine Arts	A History of Japanese Art	Noritake TSUDA	Tuttle Publishing	2009	9784805310311														The session time is limited and therefore self-directed learning is important. Students are required to prepare and review for each class.	
Chemistry B	Physical Chemistry	Ira N. Levine		2008			Physical Chemistry	R.J. Silbey, R.A. Alberty and M.G. Bawendi		2005			Atkins' Physical Chemistry	P. Atkins and J. de Paula		2006			We will have small quizzes, mid-term and term-end tests.	The lecture attendance will be strictly controlled.
Health																			I will occasionally organize group works, in which each group needs to search for information on a certain topic and report in the next class.	
Calculus A	Calculus: An Intuitive and Physical Approach	Morris Kline	Dover Publications.		978-048640453-0														. Review thoroughly by doing homework assignments.	
Sports A																				Archery equipment will be provided by the university. Piercings and other accessories must be removed before class. For safety reasons, please do not wear earrings or other accessories.

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CB53221	Sports A	Fall, Fri./3rd	Common Subjects-Health Sciences	1	AMC	Akira TAMAGAWA 玉川 明朗 (Graduate School of Medicine)	2	J	Badminton	In this class, students will learn the importance of physical activity and how to exercise appropriately through badminton, a recreational sport with which many students are already familiar. Also, by playing competitively they will experience the importance of expressing intent and relating to and communicating with others. This will foster their initiative and cooperativeness. The class will be conducted so that anyone can take it, regardless of their level of physical fitness or badminton ability. By hitting the shuttlecock back and forth with various partners, I hope that students will learn not only the technical abilities needed to enjoy rallying, but also social skills. The class aims to teach students to enjoy sports activities, and feel confident about engaging in sports in their everyday lives. Badminton uses a shuttlecock. The word "shuttle" means "to come and go." The player hits the shuttlecock, which their partner then returns, so the player then must hit it back to the partner again. This is essentially a form of communication. Both beginners and experts are welcome in this class.	Students will come to enjoy exercising through actively participating in physical activities. All students will learn to enjoy rallying and matches without fear of making mistakes. Students will acquire enough skill to participate in doubles matches. In this class, "learning to play" and "technique" do not refer only to skill at hitting the shuttlecock with the racket. They also include playing badminton under various conditions while observing others, in addition to the ability for self-observation. They will learn about "intangibles" that cannot be taught in classroom lectures with the objective of obtaining "awareness" of the present moment.	1st Class, guidance 2nd What kind of sport is badminton? 3rd Making contact between shuttlecock and racket 4th Misc. strokes pt. 1 5th Misc. strokes pt. 2 6th Misc. strokes pt. 3 7th Misc. strokes pt. 4 8th Misc. strokes pt. 5 9th Misc. strokes pt. 6 10th Basic skills for enjoying doubles games pt. 1 11th Basic skills for enjoying doubles games pt. 2 12th Basic skills for enjoying doubles games pt. 3 13th Basic skills for enjoying doubles games pt. 4 14th Basic skills for enjoying doubles games pt. 5 15th Concluding remarks From the 2nd class on, content will be arranged based on assessment of the students' skill level. Also, 1 v. 1 (singles) and 2 v. 2 (doubles) practice will be conducted while learning stroke skills. Content of instruction may be changed depending on student proficiency. The pace of the class may also change depending on the speed at which the students progress.	Needless to say, this class largely assumes participation as it is based on learning skills and practicing. On the 15th class there will be a lecture. A test may be given as well. Basically, the class will be graded as Pass - A (excellent) or Fail - D (poor).
CB53222	Sports A	Fall, Fri./3rd	Common Subjects-Health Sciences	1	AMC	Toshihiko FUJIMOTO 藤本 敏彦 (Institute for Excellence in Higher Education) Takahiro NAGAYAMA 永山 貴洋	2	J	Softball	The aim of "Sports A: Softball class is constructed of two part. First part is "Team management" and Second part is Coaching". Goal of first part is to lean the team management that is how to relation with team member using softball game. Goal of second part is to lean the coaching that is how to make menu of practice and to teach for member.	The aim of "Sports A: Softball class is constructed of two part. First part is "Team management" and Second part is Coaching". Goal of first part is to lean the team management that is how to relation with team member using softball game. Goal of second part is to lean the coaching that is how to make menu of practice and to teach for member.	First part. Team management. Number of classes:1-8. 1. Guidance. 2. Decision of own objective and team formation. 3. Softball practice and Communication with team mate. 4. Softball practice and team production. 5. Softball game and team condensation. 6. Softball game and leadership. 7. Softball game and norm within the team. 8. Softball game, review and team management. Second part. Coaching. Number of classes: 9-15. 9. Softball game and coaching theory 1: Assessment. 10. Softball game and coaching theory 2: Feedback. 11. Softball game and coaching theory 3: Teaching of softball practice. 12. Softball game and coaching theory 4: Study form. 13. Softball game and coaching theory 5: Reflection. 14. Softball game and coaching theory 6: Belief of teaching. 15. Softball game and review.	Examination 50% and short review report on every class 50%. Grades of the course will be assigned as follows: AA..... Excellent (90-100%) A..... Good (80-89%) B..... Fair (70-79%) C..... Passing (60-69%) D..... Failure (0-59%)
CB53224	Foundations of Calculus	Fall, Fri./3rd	Expansion Subjects-Mathematics	2	AMB	HANSEN, Frank (Institute for Excellence in Higher Education)	2	E	Foundations of Calculus	1. Academic Aims: An elementary introduction to calculus for functions of one or two variables. 2. Keywords: Continuity, derivative, integral, convex function, extreme value problems for functions of one or two variables, double integral.	The student will learn the notions of limit, continuity and differentiability, master differentiation, integration and extreme value problems for functions of one or two variables.	第1回 Sets and functions, infimum and supremum, sequence and convergence, proof by induction. 第2回 Continuity and differentiability, calculating with derivatives. 第3回 The extreme value theorem, the mean value theorem, De L'Hospital's rule. 第4回 Area and integration. 第5回 The logarithm, the exponential function, and the trigonometric functions. 第6回 Exercises on the blackboard. 第7回 Higher order derivatives. Taylor's and MacLaurin's theorems. 第8回 Convex functions of one variable. Extreme value problems. 第9回 The indefinite integral of rational functions. 第10回 One hour mid-term test, exercises. 第11回 Partial derivatives and total differentiation. 第12回 Extreme value problems for functions of two variables. 第13回 Double integrals and polar coordinates 第14回 Summary of the course and exercises. 第15回 Examination.	Evaluation: By class participation and by the result of the examination.
CB54225	Physics A	Fall, Fri./4th	Expansion Subjects-Physics	2	FGL	Takeshi KOIKE 小池 武志 Institute for Excellence in Higher Education	2	E	Classical Mechanics	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) 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 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".	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 and momentum, systems of particles, rotations, and Newton's law of gravitation.	Schedule of the course: 1. Orientation to WileyPlus + ORION system and course survey 2. Ch3: Vectors 3. Ch4: Motion in Two and Three Dimensions 4. Ch5: Force and Motion I 5. Ch6: Force and Motion II 6. Ch7: Kinetic Energy 7. Ch8: Potential Energy 8. Midterm (Lecture 2-7) 9. Ch9: Center of Mass 10. Ch10: Rotation 11. Ch11: Rolling, Torque, and Angular Momentum 12. Ch11: Rolling, Torque, and Angular Momentum 13. Ch13: Gravitation 14. Ch13: Gravitation 15. Course survey 16. Final examination (Lecture 10-14)	Evaluation will be based on a midterm exam (30%), final exam (30%), homework assignments (20%), attendance (10%), self-practice with ORION system (10%).

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Sports A																		It is necessary to investigate various information on sports. The details will be announced in class.	
Sports A																			Place: Kawauchi field.
Foundations of Calculus	Calculus: An intuitive and Physical Approach 2.ed.	Morris Kline	Dover Publications	1998	978-048640453-0												https://sites.google.com/site/frankhansentohoku2016	Homework: The students are required to solve excersises for each lecture.	The lecturer prepares presentation files for each lecture and post them on the homepage for the course.
Physics A	University Physics Vol. I 13th edition	Young and Freedman	Wiley	2011		textbook											https://www.wileyplus.com/	This course requires purchase of the WileyPlus system which costs \$40 USD. The system includes an electronic version of the required textbook with many integrated features to facilitate understanding of the subjects and problem solving skill in physics. The system also comes with a self-diagnostic tool, ORION, 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 in the first lecture.	For those planning to take Physics B or/and C, the WileyPlus account that is purchased in this course will be kept, and no additional payment is necessary. Survey of conceptual understanding of the subject will be conducted at the first and last lecture to assess effectiveness of the instruction method. For contact mailto: takeshi.koike.b6@tohoku.ac.jp