Language: English

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2021 Academic Year Course Description and Syllabus

Course Name	Instructor Name
Basic Chemistry 1(2credits) [BIOI131] Fundamental Chemistry(2credits) [ENES205] Chemistry A(2credits) [SESI141]	Hideki Kawai

Course numbers are displayed in blue color after course names.

Semester
Spring Semester

Course Sub Title (for general course and seminors)
General Chemistry A

General Description
Lectures in this introductory course will focus on basic concepts related to inorganic chemistry and physical chemistry. Topics will include the atomic theory and its structure, atomic orbitals and electron configuration, quantum theory and the electronic structure of atoms, periodic relationships among the elements, and inorganic and coordinated compounds. We will also cover reduction-oxidation reactions and electrolysis, three states of matter, properties of gases, solubility and colligative properties, chemical equilibrium, and chemical reactions. This course shares study topics as the regular Japanese version of Chemistry A, but will be instructed in English. Students can choose either Japanese or English instruction.

Goals and Objectives
The purpose of this course is to understand atomic structure and atomic orbitals, the principles underlying similarity and periodicity in elements, and hybrid orbitals in the formation of complex structure of transition metals. Basic topics in physical chemistry will be explained.
Specific objectives include:
*To solve basic calculations in Chemistry
*To understand atomic theory and its structure from the stand point of quantal theory
*To understand periodicity of elements based on electron configuration of atoms
*To memorize methods to name chemical compounds
*To be able to explain reduction-oxidation reactions and electrolysis
*To be able to explain the difference in ideal and real gas laws
*To understand the properties of matters
*To be able to solve problems for solubility and colligative properties
*To understand the concept in chemical reaction and equilibrium

General Education / Faculty Courses: Most relevant Learning Outcomes for this course.

◎ Students are able to learn the knowledge necessary in the specialized field and utilize it.
○ Students are able to have an inquiring mind/intellectual curiosity and collect the related knowledge from a wide range of information media.
○ Students are able to analyze the issues/problems and solve them through critical/creative thinking.
Students are able to communicate with each other in a group.
Students are able to properly describe opinions and claims of their own.

Students are able to actively take an action under their self-management and display their leader ship.

Students are able to have a sense of ethics and be aware of the social contribution and responsib ility.

Students are able to be conscious of their contribution to the international communities.

Course Syllabus

	Content	
Class 1	Lecture contents	Orientation Atomic structure: Quantum theory and the electronic structure of atoms 1 Classical physics to quantum theory, Two components of light
	Self-study Assignments	*Study OpenStax Chemistry, Chapter 2 (Contents of Basic Chemistry) Chapter 6, Section 6.1 *Refer to the website: http://www.chem1.com/acad/webtext/virtualtextboo k.html > Get used to using the site > Study 5. Getting serious about atoms: a. Primer on quantum theory of the atom b. Atomic structure and the periodic table 1. Quanta: a new view of the world 2. Light, particles and waves 3. The Bohr atom
Class 2	Lecture contents	Atomic structure: Quantum theory and the electronic structure of atoms 2 Relationship between energy and quanta, Duality of light, Electron orbital and quantization of its energy, Wave and particle duality of electrons, Boh r's model, de Broigle's model
	Self-study Assignments	*Study OpenStax Chemistry, Chapter 6, Section 6.2, 6.3 *Refer to the website: http://www.chem1.com/acad/webtext/virtualtextboo k.html >Study: 5. Getting serious about atoms: a. Primer on quantum theory of the atom b. Atomic structure and the periodic table 4. The quantum atom 5. Atomic electron configurations
Class 3	Lecture contents	Atomic structure: Quantum theory and the electronic structure of atoms 3 Quantum numbers, atomic orbital, electron configuration, the Build-up pri nciple, Hund's rule, Pauli's exclusion principle
	Self-study Assignments	*Study OpenStax Chemistry, Chapter 6, Section 6.4~6.5 *Refer to the website: http://www.chem1.com/acad/webtext/virtualtextboo k.html
Class 4	Lecture contents	Moles and concentrations Moles, molarity, molality, weight percentage, mole percentage, dilution Stoichiometry of Chemical Reactions Balancing chemical equations
	Self-study Assignments	*Study OpenStax Chemistry, Chapter 3 > Study: 3. The basics of atoms, moles, formulas, equations, and nomen clature: 2. All about Avogadro's number and the mole. 3. Formulas and their meaning. 4. Chemical equations and stoichiometry

		>Study: 7. Solids and Liquids b. Solutions: their chemistry and physical properties 1.Solutions and concentrations
Class 5	Lecture contents	Stoichiometry of Chemical Reactions Classifying chemical reactions, oxidation-reduction and oxidation number , reaction stoichiometry, reaction yields, quantitative chemical analysis *Refer to the website: http://www.chem1.com/acad/webtext/virtualtextbook.html Study: 31. The fall of the electron (Oxidation-Reduction)
	Self-study Assignments	*Study OpenStax Chemistry, Chapter 4
Class 6	Lecture contents	Thermochemistry Energy Basics, Calorimetry, Enthalpy
	Self-study Assignments	*Study OpenStax Chemistry, Chapter 5 *Refer to the website: http://www.chem1.com/acad/webtext/virtualtextbook.html
Class 7	Lecture contents	Gases Gas laws, The ideal gas equation, Dalton's law of partial pressure, kinetic molecular theory of gases, Deviation from ideal behavior
	Self-study Assignments	*Study OpenStax Chemistry, Chapter 9 Gases *Refer to the website: http://www.chem1.com/acad/webtext/virtualtextbook.html >Study: 6. Properties of gases: matter at its simplest 1. Observable properties of gases. 2. Ideal gas model: the basic gas laws 3. Moles and mixtures of gases, Dalton's law. 4. Molecules in motion ("KMT-lite"). 6. Real gases and critical phenomena
Class 8	Lecture contents	Liquids and Solids Intermolecular forces in liquids and solids Kinetic molecular theory of liquids and solids, Properties of liquids, Phase changes and diagram, Crystal structure and types, Xray diffraction
	Self-study Assignments	*Study OpenStax Chemistry, Chapter 10
Class 9	Lecture contents	Physical properties of solutions Solubility, Henry's law, Raoult's law, Colligative properties of electrolytic and nonelectrolytic solutions
	Self-study Assignments	*Study OpenStax Chemistry, Chapter 11 *Refer to the website: http://www.chem1.com/acad/webtext/virtualtextbook.html >Study: 7. Solids and Liquids b. Solutions: their chemistry and physical properties 1. Solutions and concentrations 2. Solution types and energetics 3. Solutions of non-volatile compounds: Raoult's law and colligative properties 4. Osmotic pressure and osmosis 5. Solutions of volatile liquids and distillation. 6. Solubility of salts: solubility equilibria 7. Ions and electrolytes, electrolytic conduction
	Lecture contents	Kinetics Rate of a reaction, The rate law, The relation between reactant concentration and time, Activation energy, collision theory, and temperature depend

		ence of rate constants, reaction mechanisms, Catalysis
Class 10	Self-study Assignments	*Study OpenStax Chemistry, Chapter 12 Kinetics *Go to the website: http://www.chem1.com/acad/webtext/virtualtextbook.html >Study: 26. Chemical kinetics and reaction mechanisms 1. Rate of a reaction, rate laws 2. How rates of reactions change with time 3. Collision and activation: the Arrhenius law 4. Mechanisms: how reactions take place 5. Kinetics of reactions in solution 6. Catalysts and catalysis 7. Experimental methods of chemical kinetics
Class 11	Lecture contents	Chemical equilibrium The concept of equilibrium, Equilibrium constant, The relationship between chemical kinetics and chemical equilibrium, Factors that affect chemical equilibrium
	Self-study Assignments	*Study OpenStax Chemistry, Chapter 14 *Refer to the website: http://www.chem1.com/acad/webtext/virtualtextbook.html >Study: 20. All about Chemical Equilibrium 1. Introduction to chemical equilibrium. 2. The Le Châtelier principle. 3. K and Q: what the difference? 4. Writing and understanding equilibrium. 5. Understanding equilibrium calculations.
Class 12	Lecture contents	THERMODYNAMICS The three laws of thermodynamics, Spontaneous process, Entropy, The second law of thermodynamics, Gibbs free energy, Free energy and chemical equilibrium
	Self-study Assignments	*Study OpenStax Chemistry, Chapter 16 *Refer to the website: http://www.chem1.com/acad/webtext/virtualtextbook.html >Study: 23. Thermodynamics of chemical equilibrium All about entropy, free energy, and why chemical reactions do or don't take place. 1.Energy spreading and spontaneous change 2.Entropy rules! ,,,,, but what is entropy? 3.The Second Law and the availability of entropy 4.Free energy and the Gibbs function 5.Free energy and equilibrium 6.Some applications of entropy and free energy
Class 13	Lecture contents	ELECTROCHEMISTRY Chemistry and electricity, galvanic cells and electrodes, potential differences at interfaces, cell potentials and thermodynamics, Nernst equation and its applications, batteries and fuel cells, electrochemical corrosion, electrolytic cells and electrolysis
	Self-study Assignments	Study OpenStax Chemistry, Chapter 17 *Refer to the website: http://www.chem1.com/acad/webtext/virtualtextbook.html >Study: 24. All about electrochemistry
Class 14	Lecture contents	REPRESENTATIVE METALS, METALLOIDS, NON-METALS Periodicity, Representative metals, metalloids, General properties of nonmetals, Hydrogen, Carbon, Nitrogen and Phosphorus, Oxygen and Sulfur, The halogens, Rare gas

	Self-study Assignments	Study OpenStax Chemistry, Chapter 18
Class 15	Lecture contents	TRANSITION METALS and COORDINATION CHEMISTRY Properties of transition metals, Coordination chemistry of transition metals, spectroscopic and magnetic properties of coordination compounds
	Self-study Assignments	*Study OpenStax Chemistry, Chapter 19 *Refer to http://chemwiki.ucdavis.edu/Analytical_Chemistry/Analytical_Chemistry_2.0/10_Spectroscopic_Methods/10A%3A_Overview_of_Spectroscopy

Evaluation/Assessment

Assessment	Percentage	Evaluation Criteria (Explanation)
Final Exam	40%	
Midterm		
Papers		
Performance/Works		
Continuous Assessment (quizzes, assignments, etc.)	60%	Weekly review assignments. Assignments are due before the class. After the deadline, 10% of the score is reduced every 24 hours.
Other		

Grading Method:ABC

Course Materials

1. Chemistry, OpenStax College, https://cnx.org/contents/havxkyvS@9.124:uXg0kUa-@4/Introduction

PowerPoint slides and other study materials will also be provided.

Reference Materials

1. Chemistry Virtual Textbook (http://www.chem1.com/acad/webtext/virtualtextbook.html)
2. http://chemwiki.ucdavis.edu/
3. http://www.chem.ox.ac.uk/vrchemistry/
4. Chemistry, 12th ed., Chang and Goldsby, McGraw-Hill, 2015
5. Student Solution Manual for Chemistry, 12th ed., Chang and Goldsby, 2016
6. General Chemistry I 13th ed. Brown, Bursten, and others (Japanese translation), Maruzen
7. General Chemistry II 13th ed. Brown, Bursten, and others (Japanese translation), Maruzen

Chemistry Virtual Textbook will be often used along the OpenStax Chemistry textbook.

Advice for Prospective Students

Understanding of the "Basic Chemistry" course is required.
It is important to study the contents of the textbook before each class to understand lectures.

Active participation is strongly encouraged. Be ready to discuss lecture topics in class with your colleagues. Make sure to work on and submit your assignments.

Estimated time to prepare and to review for each class session. (incl. assignments, tests, papers, etc) : 6hrs

Implementation of Active Learning

No

Will you use ICT for class or to support self-learning?

Yes
- Portal site (forum, questionnaire functions)

How to give feedback for assignments (mid-term exams, reports, etc.)

Give feedback via portal site or email regardless of class hours.

Language used in class

English

Language score requirement for class registration

TOEFL iBT 61 (PBT 500) or TOEIC 590 or more will be necessary to understand lecture materials without problem. Students with less scores but have TOEFL iBT 45 (PBT 450) or TOEIC 445 will require extra efforts to obtain credits.

Instructor Profile

Spent more than 20 years in the US since 1988. Received the Bachelor of Chemistry degree in 1992 and Ph.D. in Pharmacology in 1998 both from the University of Minnesota-Twin Cities (U.S.A.). After 10 years of research experience, returned to Japan in 2009.
Actively involved in research in the field of Neuroscience (Neurobiology, Neuropharmacology, Neurophysiology). Research theme is function and plasticity in cerebral cortex. Research topics include cortex formation, synaptic plasticity and genetic control in learning and memory, and repair of cortical dysfunction.

Enrollment and Selection

No limit in the number of registered students as this is a required class for Department of Science and Technology in Sustainable Innovation. ITCEP students can take this course as one of the program requirement. Because lectures and exams are given in English, you will need English skills to listen and read. Students who have scores below the requirement but strongly wish to take the course require permission from the instructor.

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