Introduction to Chemistry

Course Code			
Class Times	Mon/Wed/Thu A(9:00~12:00)	**Classroom**	Bldg 500-Lxxx
Equivalent Year Level	1	**Course Credit**	3

Instructor	Seokmin SHIN	**Sessions**	1-14
Office	Bldg502-225	**Email**	sshin@snu.ac.kr

❑ Instructor's Profile

Seokmin SHIN
Professor, Department of Chemistry, College of Natural Sciences, Seoul National University

Seokmin Shin received a Bachelor's degree with Honors in 1985 and a Master's degree in 1987 from the Seoul National University. He continued his graduate studies at the University of Chicago, where he worked under the supervision of Stuart A. Rice. His Ph.D. thesis concerned the structures and phase transitions of interfaces, especially on Langmuir monolayers. He was a postdoctoral fellow with John C. Light at the University of Chicago and with Horia Methiu at the University of California, Santa Barbara. He joined the Seoul National University as a faculty member in 1995, where he is presently Professor of Chemistry. He was a visiting Professor at the Institute of Molecular Science, Japan in 1998. He worked with Vijay Pande as a visiting Scholar at Stanford University in 2007. The main focus of his research is to study dynamical processes involved in the chemical changes leading to specific functions of molecular systems. His research concerns the development of theories, mathematical frameworks and computational methods for describing dynamics of complex molecular systems. He investigates chemical reactions in condensed matter, self-assembly at surfaces/interfaces, and protein dynamics by computer simulations. He is also interested in bio/chem-informatics studies involving proteins and nucleic acids.

Education
Ph.D., Department of Chemistry, University of Chicago
M.S., Department of Chemistry, Seoul National University
B.A., Department of Chemistry, Seoul National University

Most Recent Works
"Conformational Sampling of Metastable States: Tq-REM as a Novel Replica Exchange Method." MinJun Lee, Jeseong Yoon, Soonmin Jang and Seokmin Shin, Phys. Chem. Chem. Phys. 2017, 19, 5454-5464.
"A molecular dynamics study on controlling self-assembly of β-sheet peptides with designer nanorings." SeongByeong Park, Myungsoo Lee and Seokmin Shin, Chem. Asian J., 2015, 10, 1684-1689.

❑ Course Information

Course Description	The abilities to control and design various materials, termed as Molecular Engineering or Molecular Technology, are essential for other applied technologies such as BT, ET, IT and NT. Chemistry as Molecular Science provides fundamental Knowledge for such applied technologies. Chemists are expected to play leading roles in the frontiers of basic sciences and the emerging technologies for the future. In this course, students will learn fundamentals of molecular science based on concepts of modern chemistry. Starting from basic concepts of chemistry, such as atom, chemical bonding, molecular structure and molecular motions, we will try to obtain understanding on the principles of chemical changes and chemical equilibrium, based on thermodynamics. We will investigate the properties of materials world by studying various chemical reactions and deepen our understanding on the principles of dynamical changes in nature by applying chemical kinetics.
Course Evaluation	Class participation 30% Midterm exam 35% Final exam 35% **Attendance** will be important for keeping up with class. Good attendance and **active participation** will be reflected in grade.
Course Materials	P. Atkins & L. Jones, "Chemical Principles: The Quest for Insight"
Class Policy	*(Insert as necessary)*
Etc. *(e.g. Guidelines)*	

❑ Course Schedule

Session 1 (Jun. 27, Wed) - Topic : General Overview

Session 2 (Jun. 28, Thu) - Topic : Atoms: The Quantum World

- ✓ Historical Background
- ✓ Schrodinger Equation
- ✓ Hydrogenic Atom
- ✓ Multi-electron Atom
- ✓ Periodicity of Atomic Properties

Session 3 (Jul. 2, Mon) – Topic: Chemical Bonds

- ✓ Octet rule
- ✓ Ionic vs Covalent bond
- ✓ Lewis structure
- ✓ Covalent and ionic character of real bonds

Session 4 (Jul. 4, Wed) – Topic: Molecular Shape and Structure

- ✓ VSEPR Model
- ✓ Valence bond and hybridization
- ✓ Molecular orbital Theory
- ✓ Conjugated polyenes and resonance structures

Session 5 (Jul. 5, Thu) – Topic: The properties of Gases

- ✓ Definition of pressure, volume and temperature
- ✓ Absolute temperature
- ✓ Ideal gas equation
- ✓ Kinetic molecular theory of ideal gas
- ✓ Maxwell-Boltzmann speed distribution
- ✓ Real gas

Session 6 (Jul. 9, Mon) – Topic: Liquids and Solids

- ✓ Inter-molecular forces
- ✓ Macroscopic manifestation of intermolecular forces
- ✓ Solids
- ✓ Band structures in solid
- ✓ Introduction to nano-materials

Session 7 (Jul. 11, Wed) – *Mid-term Exam*

Session 8 (Jul. 12, Thu) – Topic: Thermodynamics

- ✓ 1st law of thermodynamics
- ✓ Enthalpy
- ✓ 2nd law of thermodynamics
- ✓ Entropy
- ✓ 3rd law thermodynamics
- ✓ Gibbs free energy

Session 9 (Jul. 16, Mon) – Topic: Physical Equilibria

- ✓ Phase and phase transition
- ✓ Vapor pressure
- ✓ Phase diagram
- ✓ General concepts of solution
- ✓ Colligative properties

Session 10 (Jul. 18, Wed) – Topic: Chemical Equilibria

- ✓ Reaction at equilibrium
- ✓ Equilibrium and reversibility
- ✓ Dynamic equilibrium
- ✓ Equilibrium constant K
- ✓ Le Chatelier's principle

Session 11 (Jul. 19, Thu) – Topic: Acids and Bases

- ✓ Definition of Acids and Bases

- ✓ Acid/base reaction
- ✓ Strong/weak acids and bases
- ✓ Buffers
- ✓ Polyprotic acids and bases
- ✓ Titration

Session 12 (Jul. 23, Mon) – Topic: Electrochemistry

- ✓ Redox reaction
- ✓ Half-cell reaction
- ✓ Galvanic cell
- ✓ Nernst equation
- ✓ Electrolysis
- ✓ Batteries

Session 13 (Jul. 25, Wed) – Topic: Chemical Kinetics

- ✓ Reaction rates
- ✓ Integrated rate law
- ✓ Reaction mechanisms
- ✓ Microscopic view
- ✓ Catalyst

Session 14 (Jul. 26, Thu) – Topic: Frontiers in Modern Chemistry

Session 15 (Jul. 27, Fri) – *Final Exam*