UNIVERSITY OF CALGARY
FACULTY OF SCIENCE
DEPARTMENT OF CHEMISTRY
COURSE SYLLABUS
WINTER 2020

1. Course: CHEM 209, General Chemistry for Engineers

LEC	DAY	TIME	ROOM	INSTRUCTOR	OFFICE	EMAIL	OFFICE HOURS
L01	TR	12:30-1:45	SB 103	Dr. Roxanne Jackson	SA 258	rjjackso@ucalgary.ca	TBA (see D2L)
L02	TR	8:00-9:15	ICT 102	Dr. Amanda Musgrove	SA 144F	amanda.musgrove@ucalgary.ca	TBA (see D2L)
Course Coordinator:				Dr. Amanda Musgrove	SA 144F	amanda.musgrove@ucalgary.ca	TBA (see D2L)
Tutorial & Lab Coordinator:				Dr. Roxanne Jackson	SA 258	rjjackso@ucalgary.ca	TBA (see D2L)

Course website can be reached via the course management system, D2L (https://d2l.ucalgary.ca).
Departmental Office: SA 229, Tel: 403- 220-5341, email: chem.info@ucalgary.ca

2. Course Description

Basic chemical concepts. Atomic and molecular structure. Chemical bonding. Chemical kinetics and equilibria. Acid-base and solubility equilibria. Oxidation-reduction phenomena and electrochemistry. The chemistry of water. The chemistry of energy sources. Basic environmental issues.

3. Textbook:

Using EITHER of the following texts are recommended for study in CHEM 209. Other texts and older editions are acceptable; however, it is the students' sole responsibility to ensure that they can identify the appropriate chapter readings and practice problems in alternate texts.

- *Chemistry: The Molecular Nature of Matter and Change*, 2nd Canadian Ed.; Silberberg M, Amateis P, Lavieri S, Venkatsewaran R, 2016, McGraw-Hill Ryerson. A copy of this text is available on reserve at TFDL: https://ucalgary-primo.hosted.exlibrisgroup.com/permalink/f/13e4ecq/01UCALG_ALMA21581999990004336
- *Free online option:* Open Educational Resource (OER) hosted on the course management system, D2L.

4. Topics Included and Suggested Readings:

Students are responsible for all material included in the lectures, laboratories, and tutorials. Most of the relevant material for these content areas are in the designated sections from the textbook: (*Silberberg*) Chapters 1-4, 6-10, 14-17 and 19 (*OER*): all chapters.

Note that some material is regarded as review of high school chemistry and will not be addressed in lectures; however, being fundamental to many other topics in chemistry, knowledge of these topics will be necessary for labs, tutorials, and exams.

All chapter references below are to the Silberberg course text. The OER text is split into files based on Big Ideas 1-3. Within each file, all topics in the OER text are relevant course material.

Background knowledge to review before the course begins:

Chapter 1: Keys to the Study of Chemistry
Although all sections are included; the focus will be on sections 1.4–1.6.

Chapter 2: The Components of Matter
Although all sections are included; the focus will be on sections 2.5–2.9.

Chapter 3: Stoichiometry of Formulae and Equations
All sections are included.

Chapter 4: Gases and the Kinetic-Molecular Theory
Sections 4.1–4.4 only are included.

Big Idea 1: How fast is a reaction?

Chapter 14: Kinetics: Rates And Mechanisms Of Chemical Reactions
All sections 14.1–14.7 are included.
In 14.5, omit the effect of molecular structure on rate (page 582).
In 14.6, omit reactions with a fast initial step and the steady-state approximation (pg. 589-591).
In 14.7, omit biological catalysts (page 595–596).

Big Idea 2: How far does a reaction proceed?

Chapter 15: Equilibrium: The Extent of Chemical Reactions
All sections are included.

Chapter 16: Acid–Base Equilibria
Sections 16.1–16.2 should be reviewed before lectures begin on this topic.
Sections 16.3–16.4 and selected topics from 16.6 (pg. 689-690) are included.

Chapter 17: Ionic Equilibria in Aqueous Systems
Sections 17.3 & 17.4 are included.
From Section 17.3, omit Selective Precipitation (page 741-742).
From Section 17.4, omit Complex Ions of Amphoteric Hydroxides (page 749–750).
While knowledge of Sections 17.1 & 17.2 is useful as background, they will not be treated directly in class.

Chapter 19: Electrochemistry
Section 19.1 should be reviewed before lectures begin on this topic.
All sections are included; omit parts of section 19.4 dealing with Gibbs Energy (pages 835-837).

Big Idea 3: How is structure important?

Chapter 6: Quantum Theory and Atomic Structure
Portions of Chapter 6.4 are included – omit definitions of quantum numbers and radial probability plots.

Chapter 7: Electron Configuration and Chemical Periodicity
All sections are included; omit electron configurations of transition elements (pages 283-284 and 295-296).

Chapter 8: Models of Chemical Bonding
Sections 8.1–8.3 and 8.5–8.7 are included.
In Section 8.2, omit the Born-Haber cycle and periodic trends in lattice energy (pages 310-314).

Chapter 9: The Shape of Molecules
All sections are included.

Chapter 10: Theories of Covalent Bonding
Sections 10.1 and 10.2 are included.
Omit discussion of sp^3d and sp^3d^2 hybridization (page 380)

Chapter 11: Intermolecular Forces
Section 11.3 is included.

5. Laboratory Experiments: (6 weeks, 3 hours biweekly)

Big Idea 4: How is laboratory work an essential component of an experiential science such as Chemistry?

0. Check-in and Introduction to Laboratory Techniques (*mandatory*)
   Topic: Introduction to the CHEM 209 laboratory courses (background knowledge)
   Skills: Safety, academic integrity, and correct use of balances, pipets, and volumetric flasks.
   In-lab worksheet report

1. Kinetics of the Iodine-clock Reaction at the Microscale
   Topic: *How fast is a reaction?* (Learning Objectives 1,3,5)
   Skills: Making solutions / handling glassware, determining rate of reaction, making observations
   In-lab worksheet report

2. Equilibrium Constant for the Formation of $Fe(SCN)^{2+}$
   Topic: *How far does a reaction proceed?* (Learning Objectives 10-15)
   Skills: UV-VIS spectrometry, solution preparation, graphical data analysis
   Formal written lab report

3. Determination of the Acid Number of Food Oils
   Topic: *How far does a reaction proceed?* (Learning Objectives 16-19)
   Skills: Acid-base titrations, sample preparation, analytical reporting
   Formal written lab report

4. Making Anodized Aluminum Products
   Topic: *How far does a reaction proceed?* (Learning Objectives 23-29)
   Skills: Safety, electrolysis and anodization, experimental design
   Informal worksheet lab report

5. Properties of Surfactants
   Topic: *How is structure important?* (Learning Objectives 36, 38, 42, 43)
   Skills: Making a surfactant, filtration, observations
   In-lab worksheet report

6. Lecture, Laboratory, & Tutorial Schedule

Week Starting:	Tentative Schedule for Lecture Topics: (See Learning Objectives doc. on D2L)	Lab Schedule: Odd sections (B01, B03, …, B23)	Lab Schedule: Even sections (B02, B04, …, B24)	Tutorial Schedule:
January 13	Introduction *How fast are reactions?* Chemical Kinetics (LO 1-4)	**Orientation**	*No lab*	*No Tutorials*
January 20	*How fast are reactions?* Chemical Kinetics (LO 4-8)	*No lab*	**Orientation**	**Tutorial 1** *Background Knowledge*
January 27	*How fast are reactions?* Chemical Kinetics (LO 7-9)	**Experiment 1**	*No lab*	**Tutorial 2** *Kinetics*
February 3	*How far does a reaction proceed?* Equilibrium (LO 10-13)	*No lab*	**Experiment 1**	**Tutorial 3** *Kinetics*
February 10	*How far does a reaction proceed?* Acids & Bases (LO 13-15)	**Experiment 2**	*No lab*	**Tutorial 4** *Equilibrium*
February 17	**Term break: no classes, labs, or tutorials**			
February 24	*How far does a reaction proceed?* Acids & Bases (LO 16-19) Solubility (LO 20)	*No lab*	**Experiment 2**	**Tutorial 5** *Acid & Base* **MIDTERM**: Thurs Mar 5, 7-9 PM.
March 2	*How far does a reaction proceed?* Solubility (LO 20-23)	**Experiment 3**	*No lab*	***No Tutorials***
March 9	*How far does a reaction proceed?* Electrochemistry (LO 24-27)	*No lab*	**Experiment 3**	**Tutorial 6** *Acid-base & Solubility*
March 16	*How far does a reaction proceed?* Electrochemistry (LO 27-31)	**Experiment 4**	*No lab*	**Tutorial 7** *Electrochemistry*
March 23	*How is structure important?* Electron Configuration (LO 32-34)	*No lab*	**Experiment 4**	**Tutorial 8** *Electrochemistry*
March 30	*How is structure important?* Atoms & Bonding (LO 35-39)	**Experiment 5**	*No lab*	**Tutorial 9** *Electron Config & Bonding*
April 6 *	*How is structure important?* Covalent Bonding (LO 39-42)	*No lab*	**Experiment 5****	**Tutorial 10** *Atomic structure & Shapes*
April 13*	*How is structure important?* Intermolecular Forces (LO 42-43)	*No lab*	*No lab*	*No Tutorials*

Last day of classes: April 15. Final exam period: April 18 – 29.

** Sections B18 and B20 will have make up lab during the week of April 6 (due to the Good Friday holiday). Details will be announced via email (check your @ucalgary account) and on D2L.

*April 10: Good Friday holiday: University closed. April 13: Easter Monday holiday. No classes or labs.

Department Approval_____Electronically Approved_____Date_____January 6, 2020_____