The goal of the course is two-fold:
1. To strengthen the student’s understanding of basic chemistry, important for any well-rounded applied science student, and directly applicable in every field of engineering.
2. To apply chemical principles to a number of selected material science concepts and basic chemical engineering issues.

Intended Student Learning Outcomes

By the end of this course students should be able to:
- Know and understand basic microscopic models of Matter so they can build up macroscopic models of materials
- Use concepts of gas theory to calculate system conditions and measure changes.
- Understand the development of mathematical models of microscopic level properties
- Understand and use Thermodynamics to determine energy changes in isobaric, adiabatic and isothermal system processes, both chemical and physical
- Recognise and describe phase diagrams for single and multi-component (solutions) systems, including distillations, fractional melting and alloys

Lectures Week 1

Gases and their behaviours

Topics
- Overview of the Gaseous state
  - Properties of gases
  - Pressure, volume, temperature, amount
  - Gas Laws, Boyle’s Law, Charles Law, Avagadro’s Law
  - The Ideal Gas Law
  - Mixtures of gases, Dalton’s Law of partial pressures
  - Real Gases: Van der Waals equation, compressibility factor
  - Kinetic Molecular theory of gases.

Lectures Weeks 2 and 3

Thermodynamics

Topics
- Introduction to Thermodynamics, definitions
- Standard state
• Laws of thermodynamics
  o Zeroth, first and second laws.
• Internal energy
• Heat and work
• Exothermic and endothermic processes
• Measurement of energy processes
  o Constant pressure and constant volume systems
  o Reversible systems
  o Calorimetry
  o Isothermal and adiabatic processes
• Enthalpy
• More Kinetic molecular Theory
• Thermodynamics in Chemical reactions
  o Formation reactions,
  o Standard enthalpy of formation
  o Standard enthalpy change
  o \( \Delta H \) versus \( \Delta U \)
• Practical applications of thermodynamics

Lectures week 4

Molecular structure

Topic
• Lewis Dot structures
  o Valences and hypervalences
  o Ionic and covalent bonding
  o Octet rule
  o Multiple Bonds
  o Formal Charges
  o Resonance
  o Lewis acids and Bases
  o Radicals
• VSEPR theory
  o Basic geometries
  o AXE classification
  o Structures and shapes
• Valence-bond Theory
  o Hybridization
    ▪ sp, sp\(^2\), sp\(^3\), sp\(^3d\), sp\(^3d^2\).
  o Multiple bonds and hybridization
    ▪ \( \sigma \) and \( \pi \) bonds.
• Molecular orbital Theory
  o Linear Combination of Atomic Orbitals (LCAO)
  o Molecular orbitals
    ▪ \( \sigma \) and \( \pi \) bonds \( \sigma^* \) and \( \pi^* \) anti-bonds.
    ▪ Diatomic molecules
  o Band Theory
    ▪ Conductors, semiconductors and insulators
- Doping of semiconductors
- Diodes and LEDs
  - Bond Energies
  - Electronegativity and dipole moments
- Structure of Solids
  - Classification of solids
  - Point groups, Lattices and Unit cells
  - Metals and ionic solids
  - Calculation techniques

**Lectures week 5**

**Solutions**

3 lectures

**Topic**
- Enthalpy of solution
- Liquid solutions
  - Composition/calculations
- Liquid-vapour equilibrium
  - Dalton’s Law
  - Raoult’s Law
  - Binary phase-diagrams
    - Tie-lines
    - Distillation
    - The Lever Rule
    - Azeotropes
- Solid-liquid phase transitions
  - Binary phase diagrams
    - Eutectic points
    - Crystallization from a melt
- Solubility
- Henry’s Law
- Colligative Properties
  - Vapour pressure lowering
  - Boiling point elevation
  - Freezing point depression.

**Grading Scheme**
- Quizzes (Weeks 2,3,4,5) 40%
- Final examination 50%
- Mastering Chemistry on-line Work* 10%

* Note that the Mastering Chemistry on-line assignments will be due each week on Monday morning at 8:30 am. The first assignment will be due on 21-Jan-2019 and there will be one assignment due every Monday following. Your access code from APSC131 should still work for this course. And for 132 later in the year.
Grading Method
All components of this course will receive numerical percentage marks. The final grade you receive for the course will be derived by converting your numerical course average to a letter grade according to Queen’s Official Grade Conversion Scale:

<table>
<thead>
<tr>
<th>Grade</th>
<th>Numerical Course Average (Range)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A+</td>
<td>90-100</td>
</tr>
<tr>
<td>A</td>
<td>85-89</td>
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<tr>
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<td>D-</td>
<td>50-52</td>
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<td>F</td>
<td>49 and below</td>
</tr>
</tbody>
</table>

Evaluation

Late Policy
- Weekly homework assignments that are past due will receive a grade of zero.
- Quizzes are done in tutorial. You are either present or not for those. If you choose to not show up, then you choose to not get those points.
- Final Exams are administered by the exams office. Please make sure you have contacted them for any accommodations you may need. Delaying contacting them may result in your not receiving any consideration.

1. Location and Timing of Final Examinations

The Final exam is scheduled for Feb 22, 1:00-4:00 pm in Walter Light Hall Auditorium.

2. Statement on Academic Integrity

Academic Integrity is constituted by the six core fundamental values of honesty, trust, fairness, respect, responsibility and courage (see www.academicintegrity.org). These values are central to the building, nurturing and sustaining of an academic community in which all members of the community will thrive. Adherence to the values expressed through academic integrity forms a foundation for the “freedom of inquiry and exchange of ideas” essential to the intellectual life of the University (see the Senate Report on Principles and Priorities http://www.queensu.ca/secretariat/policies/senate/report-principles-and-priorities).
Students are responsible for familiarizing themselves with the regulations concerning academic integrity and for ensuring that their assignments conform to the principles of academic integrity. Information on academic integrity is available in the Arts and Science Calendar (see Academic Regulation 1 http://www.queensu.ca/artsci/academic-calendars/regulations/academic-regulations/regulation-1), on the Arts and Science website (see http://www.queensu.ca/artsci/academics/undergraduate/academic-integrity), and from the instructor of this course. Departures from academic integrity include plagiarism, use of unauthorized materials, facilitation, forgery and falsification, and are antithetical to the development of an academic community at Queen's. Given the seriousness of these matters, actions which contravene the regulation on academic integrity carry sanctions that can range from a warning or the loss of grades on an assignment to the failure of a course to a requirement to withdraw from the university.

3. **Calculator Policy**

As noted in Academic Regulation 9.2, “Calculators acceptable for use during quizzes, tests and examinations are intended to support the basic calculating functions required by most Arts and Science courses. For this purpose, the use of the Casio 991 series calculator is permitted and is the only approved calculator for Arts and Science students.”

4. **Copyright of Course Materials**

“This material is designed for use as part of APSC131 at Queen's University and is the property of the instructor unless otherwise stated. Third party copyrighted materials (such as book chapters and articles) have either been licensed for use in this course or fall under an exception or limitation in Canadian Copyright law.

Copying this material for distribution (e.g. uploading material to a commercial third-party website) can lead to a violation of Copyright law. Find out more about copyright here: http://library.queensu.ca/copyright.”

5. **Privacy Statement for Instructors Who Use External Software in Their Course**

This course makes use of Crowdmark for marking exams. Be aware that by logging into the site, you will be leaving onQ, and accessing Crowdmark’s website. Your independent use of that site, beyond what is required for the course (for example, purchasing the company’s products), is subject to Crowdmark’s terms of use and privacy policy. You are encouraged to review these documents, using the link(s) below, before using the site.
- Crowdmark - https://crowdmark.com/privacy/queens/

6. **Accommodations for Disabilities**

Queen's University is committed to achieving full accessibility for people with disabilities. Part of this commitment includes arranging academic accommodations for students with disabilities to ensure they have an equitable opportunity to participate in all of their academic activities. The Senate Policy for Accommodations for Students with Disabilities was approved at Senate in November
7. Academic Consideration for Students with Extenuating Circumstances

Queen’s University is committed to providing academic consideration to students experiencing extenuating circumstances that are beyond their control and are interfering with their ability to complete academic requirements related to a course for a short period of time, not to exceed three months. Students receiving academic consideration must meet all essential requirements of a course. The Senate Policy on Academic Consideration for Students in Extenuating Circumstances was approved at Senate in April, 2017 (see http://www.queensu.ca/secretariat/sites/webpublish.queensu.ca.uslcwww/files/files/policies/senateandtrustees/Academic%20Considerations%20for%20Extenuating%20Circumstances%20Policy%20Final.pdf) Each Faculty has developed a protocol to provide a consistent and equitable approach in dealing with requests for academic consideration for students facing extenuating circumstances. Arts and Science undergraduate students can find the Faculty of Arts and Science protocol and the portal where a request can be submitted at: http://www.queensu.ca/artsci/accommodations. Students in other Faculties and Schools who are enrolled in this course should refer to the protocol for their home Faculty.

If you need to request academic consideration for this course, you will be required to provide the name and email address of the instructor/coordinator. Please use the following:
Instructor/Coordinator Name: Michael Mombourquette
Instructor/Coordinator email address: mjm5@queensu.ca