The Syllabus is subject to change. Any changes will be announced at least once during lecture and posted to D2L as Syllabus-Rx, where x will be greater than the previous value (for example, the version handed out the first day of class usually has x = 1.00).

This introductory college chemistry course is a one semester course with an emphasis on applications to engineering fields.

**Course Description:** Modern principles of chemistry with an emphasis on applications in engineering fields.

**Lecture:** MWF 8:00 – 8:50 AM in Chem 190

**Sections:** Discussions 601 – 605 and Labs 801 – 809

**Instructor:** Dr. Thomas Sorensen  Phone: 229-4012

**Office Hours:** MWF 10:00 – 10:50 AM in Chem 109

Course web-site: d2l.uwm.edu (Spring 2019 Chem 105)

**Prerequisites:** Not open to those with credit in Chem 104. Not a prerequisite for Chem 221, 341, or 343. Prerequisite: score of 1 on chem placement test, Level 30 on Math Placement Test or a satisfactory grade (a "C" or better) in any appropriate math course equal to or greater than UWM Math 105 or 108; or in grade C in Chem 100.

In order for you to be successful in this course you will be required to set-up problems and solve linear and quadratic equations.

**Course Materials:** See D2L for additional details and options.

<table>
<thead>
<tr>
<th>Component</th>
<th>Estimated Cost</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>ALEKS 360 + Prep (aleks.com)</td>
<td>$70 – $150</td>
<td>Required, includes two (2) codes + ebook</td>
</tr>
<tr>
<td>Lab Notebook</td>
<td>$30 – $45</td>
<td>Required, in Bookstore</td>
</tr>
<tr>
<td>Lab Manual</td>
<td>$10 – $25</td>
<td>Required, on D2L</td>
</tr>
<tr>
<td>State Approved Safety Goggles</td>
<td>$5 – $15</td>
<td>Required by the first lab</td>
</tr>
<tr>
<td>Non graphing Calculator</td>
<td>$10 – $50</td>
<td>Required, for exams</td>
</tr>
<tr>
<td>Number 2 pencils</td>
<td>$0.05 – $0.50</td>
<td>Required, for exams</td>
</tr>
<tr>
<td>Student Solution Manual</td>
<td>$50 – $95</td>
<td>Recommended</td>
</tr>
<tr>
<td>ACS General Chemistry Study Guide</td>
<td>$12 – $20</td>
<td>Recommended (same as for Chem 102/104)</td>
</tr>
<tr>
<td>Burge and Overby, 3rd Ed.</td>
<td>$125 – $315</td>
<td>Recommended</td>
</tr>
</tbody>
</table>

1. Always check with your instructor before purchasing materials, they might be able to save you some money.

2. Safety goggles are absolutely mandatory. They must seal around the eyes and have shielded vents. You must have these prior to the first laboratory period, and they must be worn at all times while you are in the laboratory.

3. Graphing calculators will not be permitted for exam use.

4. To ensure proper grading, a Number 2 pencil must be used on all Scantron sheets.

**Policies:** *UWM:* You must follow the policies and procedures outlined in the current Schedule of Classes. See: http://www.uwm.edu/Dept/SecU/SyllabusLink.pdf

*Department of Chemistry and Biochemistry:* You are expected to fully understand these policies including the limits placed on the maximum amount of material that can be missed, excused or otherwise, and still pass the course.

*Drop, Section Change:* These are done on PAWS. Make sure to follow all the rules established by UWM and the Department of Chemistry and Biochemistry.

*Incomplete:* An Incomplete can be given only to a student who has been doing satisfactory (C) work but who is unable to continue attending the course for a reason judged valid. The request for an Incomplete must be accompanied by documentation.
**Academic Dishonesty:** Cheating on an examination or other graded material will result in a grade of zero as a minimum consequence. Failure in the course and referral to the Dean may also occur. In short, academic dishonesty in any form will not be tolerated.

**Lecture:** It will be a significant advantage for you to attend every lecture. You are responsible for all material presented in lecture. If you miss a lecture, you are responsible for obtaining the lecture material. Unannounced quizzes/attendance may be given/taken at any time during lecture; your average on these determines your lecture grade.

**Homework + Prep:** You will need to establish your ALEKS accounts and complete your Initial Assessment right away (see D2L for details). Your homework grade is based on your average for all the objectives and the total number of topics you have mastered/learned as of the last day of class (May 9, 2019). The Prep portion of ALEKS must be completed by March 3, 2019.

ALEKS is due each Sunday by 11:59 PM except for the last Objective with is due May 9, 2019 (the day before Study Day). It generally includes material from the previous week and the start of the following week.

**Discussion:** There will be a quiz given in each of your scheduled Discussion meetings which will be graded based on such things as attendance, participation, and correctness of worked problems which are combined four (4) times during the semester. Your average of the four (4) combined scores constitutes your Discussion grade.

**Laboratory:** Labs will start January 28, 2019. Make sure that you have your lab manual, safety goggles, and have completed all pre-lab assignments before your scheduled lab period. You will not be allowed to participate in lab unless you have prepared for the correct lab and pass the lab quiz. **Experiments are done in the order listed in the current version of the syllabus, not in the order they appear in your manual.** Completed labs are due by the start of the next lab period. Proper attire must be worn at all times during laboratory. Labs cannot be rescheduled or taken late:

- you must attend your scheduled lab and personally collect your own data
- if you are late for lab, or not allowed to participate for any reason, you will receive a grade of zero (0) for that lab
- failure to follow safety procedures will result in expulsion from laboratory and a grade of zero (0) for the lab
- labs turned in late will receive a score of zero (0)
- if you get a zero on more than two (2) labs or if your average is less than 60%, you fail laboratory and fail the course

**Laboratory Practical:** The in-laboratory Laboratory Practical is graded as you execute various techniques while you complete your experiments. If you get less than 60%, you fail laboratory and fail the course.

**Early/Make-Up/Late Work:** There are no early, make-up, or late exams, homework, quizzes, or labs. For a scheduled absence (e.g., University athletics, music, etc.), the instructor must be notified at least 24 hours prior to the absence. If an exam or lab is missed for a non-medical reason not approved beforehand, a grade of zero (0) will be given. For medical absences, a written letter signed by your physician is required. For an excused absence the next lab or exam will count double.

**Assessment:** Your course grade will be determined from the following elements:

<table>
<thead>
<tr>
<th>Assessment</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Laboratory + Practical</td>
<td>150 pts</td>
</tr>
<tr>
<td>Homework + Prep</td>
<td>150 pts</td>
</tr>
<tr>
<td>Discussion + Lecture</td>
<td>100 pts</td>
</tr>
<tr>
<td>Hour Exam I</td>
<td>Tuesday, 2-12-19, 5:30 – 6:30 PM</td>
</tr>
<tr>
<td>Hour Exam II</td>
<td>Tuesday, 3-12-19, 5:30 – 6:30 PM</td>
</tr>
<tr>
<td>Hour Exam III</td>
<td>Tuesday, 4-16-19, 5:30 – 6:30 PM</td>
</tr>
<tr>
<td>Redemption Exam</td>
<td>Tuesday, 5-7-19, 5:30 – 6:30 PM</td>
</tr>
<tr>
<td>ACS Final Exam</td>
<td>See Schedule of Classes</td>
</tr>
</tbody>
</table>
**Approximate Schedule for General Chemistry for Engineers (Chem 105), Semester II, 18-19**

<table>
<thead>
<tr>
<th>Week of</th>
<th>Lecture</th>
<th>ALEKS&lt;sup&gt;a&lt;/sup&gt;</th>
<th>Laboratory&lt;sup&gt;c&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jan 22</td>
<td>Ch 1-7 Rev</td>
<td>Initial Assessment, Prep</td>
<td>Safety Quiz (on D2L), No Labs</td>
</tr>
<tr>
<td>Feb 28</td>
<td>Ch 1-7 Rev</td>
<td>Obj1&lt;sup&gt;b&lt;/sup&gt;</td>
<td>Skills &amp; Errors</td>
</tr>
<tr>
<td>Feb 4</td>
<td>Ch 8</td>
<td>Obj2&lt;sup&gt;b&lt;/sup&gt;</td>
<td>Bohr’s Model&lt;sup&gt;d&lt;/sup&gt;</td>
</tr>
<tr>
<td>Feb 11</td>
<td>Ch 9</td>
<td></td>
<td>FEMO&lt;sup&gt;d&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

*Exam I, Tuesday, 2-12-19, 5:30 – 6:30 PM through Ch 9*

*Second lab of the week: Nomenclature (I & II, on D2L)*

<table>
<thead>
<tr>
<th>Prep portion of ALEKS due: March 3, 2019</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mar 4</td>
</tr>
<tr>
<td>11</td>
</tr>
</tbody>
</table>

*Exam II, Tuesday, 3-12-19, 5:30 – 6:30 PM through Ch 13*

<table>
<thead>
<tr>
<th>Improvement Lab, Friday, in lecture</th>
</tr>
</thead>
<tbody>
<tr>
<td>Apr 18</td>
</tr>
<tr>
<td>Apr 25</td>
</tr>
<tr>
<td>Apr 1</td>
</tr>
<tr>
<td>Apr 8</td>
</tr>
<tr>
<td>Apr 15</td>
</tr>
</tbody>
</table>

*Exam III, Tuesday, 4-16-19, 5:30 – 6:30 PM through Ch 17*

| May 22  | Ch 18 | Obj11<sup>e</sup> | Buffers |
| May 29  | Ch 19 |                  | TBA |
| May 6   | Rev   | Obj12 | No Labs |

*Redemption Exam, Tuesday, 5-7-19, 5:30 – 6:30 PM Covers lectures and the text*

<sup>a</sup> See ALEKS for exact due dates. Start assignments well before their due dates.

<sup>b</sup> An ALEKS assessment is required before you are allowed to start the next assignment.

<sup>c</sup> Traditional write up OR submitted to D2L dropbox, as specified in lecture.

<sup>d</sup> Includes one or more graded Techniques for the Laboratory Practical.

You will find that your understanding of the material increases as you work more problems. Please get help when you need it. Sometimes 10 – 15 minutes spent in the TA or my office saves hours of confusion and frustration. I will attempt to remain on schedule as much as possible, but changes may be made with reasonable notice.

If you fail laboratory, score less than the 35<sup>th</sup> percentile on the final exam, or miss the final exam for any reason other than a legitimate medical excuse, you cannot pass the course regardless of your other grades. **Some Advice:** We will cover a large amount of material in this course. The amount of time you need to spend reading and solving problems is significant. You are expected to read the material before each lecture and should not expect all assigned material to be explicitly covered in class. Write down questions that you have and note things that you don’t understand; bring your questions to me or your TA for discussion. If you are having trouble with the material, you must seek help fast or the rapid pace of the course will leave you far behind. The TAs and I are available and eager to help you.

**How to do well in the course:**

- Read the appropriate section(s) of the book before the material is presented in lecture — that is, come prepared for class.

- Attend lecture, discussion and laboratory sessions — and take them seriously. Be punctual and take notes.

- Do problems as they are assigned – *don’t wait* until right before an exam when they may seem overwhelming.
• Form a *study group* with others in the class and work on homework questions together. Teaching one another is perhaps the best way to learn.

• Try to make your own connections between material presented during different lectures. Don’t just assume because we say that something is connected that you understand the connections.

• If you have problems, *see me and/or your TA* and find out the ways that we can help you.

**D2L Resources include:**

• Information on ALEKS.

• Chapter Summaries, examples, and additional Laboratory materials.

• Nomenclature summary with common polyatomic ions.

• PowerPoint slides for each chapter.

• Some old exams from previous semesters.

• Important News items.

• Your grades.

**Laboratory Reports:** For additional information on Safety, techniques, Vernier equipment, how and where to submit reports, and how reports are graded see ‘Important Laboratory Information’ on D2L.

**Learning Objectives**

Because this is a general education course, there are GER Distribution Outcomes of providing the ‘students with a broad body of knowledge’ (UWM Fac. Doc. 1382, p. 2, II, par 1). Additionally, this course has objectives of:

• developing of ‘a strong foundation of verbal and quantitative skills’

• understanding ‘the rules of methods and processes’ (UWM Fac. Doc. 1382, p. 1, par. 2)

• introducing ‘major concepts of a natural science discipline, providing insights into its breadth and its relationship to other disciplines’

• illustrating ‘relationships between experiments, models, theories and laws’

• illustrating ‘the generation and testing of data and the application of concepts and knowledge to the solution of problems’ (UWM Fac. Doc. 1382, p. 3, par. 7)

In order to set these objectives within the framework of this course, a set of objectives have been designed to give you a better understanding of what you are expected to learn over the course of the semester, and some indication of how it will be measure as to what degree this has occurred. These will be incorporated through all types of assessments but will be formally measured on the weekly quizzes and hourly exams. In order to prepare for this, there will be certain objectives which will be presented each week in discussion with exercises for practice.

*The examples of how these may be measured are examples ONLY and should not be interpreted as an inclusive ‘check list’.*

**Objective 1:** Understand spatial scale, particularly to the very sizes (on the order of atoms).

As an example you should be able to: estimate measurement, conceptualize relative sizes, use measurement tools skillfully, correctly compare numbers, convert measurements and scales, be able to compare specific objects (atoms and molecules, for example) by size and use the atom as a starting point in representing matter and changes.
Objective 2: Understand the language of chemistry including naming simple compounds.

As an example you should be able to: properly define important key terms, give a name for a chemical formula of a simple compound, give the chemical formula for a name, give the charges and names for the monoatomic and polyatomic ions of interest (these will be specified).

Objective 3: Understand the relationship between macroscopic, particle and symbolic representations of matter including atom relationships in molecules and compounds.

As an example you should be able to: identify macroscopic vs particle representations, read chemical formula, represent bonding detail in molecules, know that some elements exist as diatomic molecules, and be able to interpret organic chemical formulas from line drawings.

Objective 4: Understand the relationship between the composition of atoms and their properties.

As an example you should be able to: identify the number of protons, neutrons, and electrons for any isotope or ion, approximate the relative abundance of certain isotopes given the periodic table and additional information (for example, the number of isotopes and the number of neutrons in each), and calculate weighted averages, isotopic masses or relative abundances.

Objective 5: Understand the basics of chemical reactions.

As an example you should be able to: balance chemical equations, correctly use terms and states of matter and correctly represent chemical formula.

Objective 6: Understand the basics of mixtures and chemical reactions involving water as a solvent.

As an example you should be able to: define key terms of mixtures, represent solutions on a macroscopic and particle-level, quantitatively represent concentrations using various units, interpret graphs of solubility and temperature for ionic compounds, quantitatively express solubility of gases, qualitatively and quantitatively use colligative properties.

Objective 7: Understand quantitative relationships between substances represented in a balanced chemical equation.

As an example you should be able to: do stoichiometric calculations involving moles, masses, volumes, pressures, particles, and concentrations of reactants and/or products also including limited quantities of a reactant.

Objective 8: Understand the basics of the properties and behavior of gases on both the macroscopic and particle level.

As an example you should be able to: relate pressure, volume, temperature and amount of an ideal gas, explain the ideal gas law in terms of gas particles, and calculate properties of a mixture of gases.

Objective 9: Understand the role of energy in a chemical reaction, particularly heat.

As an example you should be able to: define key terms including heat, work, and energy, identify key components of the first law of thermodynamics, calculate heat, heat capacity and specific heat, calculate change in enthalpy for a reaction by Hess’s law, and interpret an energy diagram.

Objective 10: Understand the basics of quantum mechanics as it applies to assigning quantum numbers to electrons in atomic orbitals as well as writing electron configurations.

As an example you should be able to: define key terms, know the rules for assigning quantum numbers, know the general rules for relative energy of atomic orbitals, apply Hund’s rule and determine paramaticity of elements in the ground state.
Objective 11: Understand periodicity of certain properties of the elements.

As an example you should be able to: define key terms, give periodic trends for certain properties, and give general descriptive chemistry facts.

Objective 12: Understand chemical bonding and molecular shape.

As an example you should be able to: be able to draw a Lewis dot structure, determine a molecular shape from VSEPR theory, determine molecular polarity and determine bond order.

Objective 13: Understand that breaking chemical bonds is an endothermic process.

As an example you should be able to: be able to correctly identify both an energy diagram and thermochemical equation showing the endothermic process of breaking a chemical bond.

Objective 14: Understand properties of liquids and solids.

As an example you should be able to: define key terms, correlate properties of liquids, interpret a phase diagram, identify differences between types of solids, and calculate properties of elemental cubic crystals.

Objective 15: Understand the experimental nature of science.

As an example you should be able to: define all components of the scientific method, identify key experiments and the conclusions made (particularly in atomic and electronic theory), conduct simple experiments in laboratory, use measurement tools accurately, and read equipment to the correct number of significant figures and maintain the correct number of significant figures throughout the calculations.

Objective 16: Understand how reactions take place over time.

As an example you should be able to: define key terms in kinetics, express the rate of reaction by change in concentration over time, graphically depict change of reaction rates over time, use initial rates to determine reaction order and rate constants, write and derive a rate law, graphically determine the relationship between concentration and time for different reaction orders, write and use integrated rate laws, graphically depict activation energy, calculate activation energy using experimental data, write an overall reaction and rate law given a mechanism, and identify a catalyst and intermediate.

Objective 17: Understand the basic principles of equilibrium.

As an example you should be able to: define key terms in equilibrium, write an equilibrium constant, describe equilibrium in terms of reaction rates, express the difference in large and small equilibrium constants, express equilibrium constants of gases in concentration and partial pressure, convert between these constants, use reaction quotients to determine reaction direction, calculate equilibrium constants and changes in concentrations, express the effect on equilibrium by changing system conditions.

Objective 18: Understand equilibrium of aqueous systems.

As an example you should be able to: define key term in acid/base and solubility equilibria, represent and calculate concentrations of acids or bases in water, represent and calculate concentrations when acids and bases react in water, calculate pH and pOH, order and calculate relative strengths of acids, bases and salts, represent non-aqueous systems of acids and bases, interpret titration curves, represent and calculate concentrations of ionic species in a saturated solution, use equilibrium values to qualitatively analyze a mixture of ionic species.

Objective 19: Understand the role of energy in a chemical reaction and how this applies to spontaneity of a reaction (integrating Objective 9).
As an example you should be able to: define key terms in thermodynamics, represent entropy changes for simple systems, integrate enthalpy and entropy for a system and surroundings, identify key components of the second and third laws of thermodynamics, calculate changes in entropy, enthalpy and Gibbs free energy for a system and integrate spontaneity and equilibrium with thermodynamic calculations and estimations.

Objective 20: Understand reactions involving the transfer of electrons.

As an example you should be able to: define key terms in electrochemistry, balance redox reactions, represent electrochemical cells including cell diagrams, calculate standard cell potentials given standard reduction potentials under both standard and non-standard conditions (Nernst equation), integrate thermodynamics and equilibrium and identify differences between spontaneous (batteries) and non-spontaneous (electrolysis) processes.