Michigan Technological University Chemistry Department’s Syllabus
1400 Townsend Drive
Houghton, Michigan 49931-1295
www.chemistry.mtu.edu

1. Course Number, Title, Semester, and Year.

   CH1110 University Chemistry I (3), Spring, 2004. MWF 1305-1355
   This course is a first level course in the chemistry department’s listing of courses for the chemistry major
   certified by the American Chemical Society (ACS) and other majors requiring two semesters of
   chemistry.

2. Instructors, Address, Telephone Number, and Office Hours.

   Course Lecturer:          Rudy Luck, 19-701b, (487-2309)
                           rluck@mtu.edu
   Office Hours:             M,W,F 2:00 PM - 3:00 PM
   Lab Supervisor (CH 1111)  Pam Long, 19-508B, (487-3100) pclong@mtu.edu
   Learning Center Coordinator: Lois Blau, 19-206A, (487-2297) labla@mtu.edu
   Recitation Instructor     Dr. Sarah Green, 19-415, (487-3419)
                           sgreen@mtu.edu
                           Tuesdays at 10:05, 11:05 AM and 2:05 PM in 19-215

3. Purpose of this Syllabus.

   Welcome to University Chemistry I. This syllabus outlines the content of the course and contains the
   rules and regulations by which your performance will be assessed. It is important that you spend some time
   reading this in order to understand how the course is graded and when assignments are due. Furthermore, by
   having this detailed description of the course, you are in a position to read the relevant chapters in advance of the
   discussion of material in the lectures. This is helpful for a thorough comprehension of the course and it also helps
   you to comprehend the material faster and not be lost during the lectures. You should also do the examples as they
   occur throughout each chapter. Use a sheet of paper to block out the solutions and then immediately verify your
   answer. Then try the practice exercises. If you have any difficulty with the problems these can be discussed at the
   recitation periods, with a coach in the learning center or with me during office hours. Please take advantage of
   these opportunities.

4. Introduction.

   A general introduction to chemistry, which begins with the scientific method, and includes the structure of
   the atom, chemical calculations and a study of the composition of materials, their structures and properties, and
   related energy conversions. This course builds a sound foundation of vocabulary and conceptual knowledge in
   chemistry and this course should improve your quantitative and computing skills. These aims will be accomplished
   by a comprehensive understanding of approximately the first half of the required text. Students taking the course
   will attain an understanding of atomic and molecular structure, the mole, gases, chemical reactivity, valence and
   other common concepts. The course will also demonstrate the applicability of scientific concepts and thinking
   processes to significant current issues in science. The course consists of two and a half hours of lecture and one
   recitation session per week. You should have already been assigned to a particular recitation section. Information
   on the lab (i.e., CH1111) is available at
5. Short Course Description and Prerequisites.

A major objective of this course is to help you acquire knowledge of chemistry as the central, experimental natural science, which deals with the composition of materials, their structures and properties, and related energy conversions in living and nonliving systems. This first semester of a two-semester sequence of chemistry courses will provide students with an informed understanding of the nature of scientific reasoning, discovery, and invention through a systematic exploration of the basic concepts and practices of chemistry. The course will also demonstrate the applicability of scientific concepts and thinking processes to significant current issues in science. These aims will be accomplished by a comprehensive understanding of approximately the first half of the required text. This course is not recommended for students in programs requiring only one semester of first-year chemistry.

Prerequisite: A math ACT of 26 or higher (SAT 600), 3 years of high school mathematics and a good understanding of high school chemistry or a passing grade in CH1000, Preparatory Chemistry.

6. Textbooks.

The book listed below should be available from the bookstore and the "Recitation Study Package" will be freely distributed and is also available on line at
http://www.chemistry.mtu.edu/~rluck/courses/spring2004/spring2004CH1110/recitation/index.htm

Required. McMurray and Fay
"CHEMISTRY",


7. Course Objectives.

This course will consider scientific inquiry in historical and cultural contexts. Historical examples of scientific creativity will be provided as appropriate to the topic being covered. We will also look at the progress of physical and chemical discoveries and their impact on our way of life. In this way, we will learn to develop a respect for limits on resources and responsibilities which face modern citizens. Overall, this course will explore the distinctive nature of scientific thinking emphasizing:

* Distillation of seemingly disparate data into unifying concepts derived from theoretical constructs having wide applicability.
* Quantitative precision based on observation and experimental measurements; this requires the ability to do multiple, controlled laboratory experiments which can be replicated by others.

Students will develop a critical appreciation of the ways that scientists develop concepts and methods with practical applications which have direct implications for contemporary life. This course covers units on energy conversions, properties of solutions, gases and solids, structure of atoms, equilibrium and its relation to thermodynamics as well as everyday life, properties of materials in aqueous solution, and bonding and molecular structure with emphasis on geometry.

8. Teaching Methodology.

Lecture
Attendance at the lectures is required and will be recorded. Lectures assisted with transparencies, computer simulations, demonstrations, and some videotapes will constitute the major form of instruction for this course. From the outset, you are advised to read and study the required text. In fact you should read the relevant sections before coming to the lecture.

Homework
There will be weekly problem sets assigned. These are contained in the "Recitation Study Package". These must be attempted before your respective recitation. There are 20 questions per chapter. You can attempt these questions on line at http://www.chemistry.mtu.edu/~rluck/courses/spring2004/spring2004CH1110/recitation/index.htm
The entire quiz can be completed or (by clicking on the appropriate section) the chapter due that week. I also expect you to try problems at the back of the chapters in the text. To begin try the first three questions given for each group of questions. If you experience difficulty with any of them do some more questions from that section and seek out assistance at the learning center.

**Exams**
There will be three term exams held during lecture time and one final exam based on material covered in the lectures, the lecture demonstrations, the appropriate chapters in the text and from the problem sets. It is critical that you attend lectures and your attendance will be noted.

**Please note that there are no make-up exams and late problem set assignments are not accepted.**

If you have a university-approved absence and there is a scheduling conflict, your grade will be determined on the basis of the exams that you took.

The chemistry department also provides you with an additional source of assistance for this course by way of the Chemistry Learning Center (CLC), Chemical Sciences Building, Room 208, Lois Blau, Coordinator, Phone: 487-2297. Email: lablau@mtu.edu

**DAYTIME HOURS:** Monday through Thursday 10:00 a.m. - 4:00 p.m.
**EVENING HOURS:** Sunday through Wednesday 6:00 p.m. - 9:00 p.m.

The CLC is a free service provided by the Department of Chemistry and the University to provide support for students enrolled in first year chemistry lecture courses. The Center is staffed by upper level undergraduates (coaches) who have a good background in chemistry and are familiar with the courses. Services offered include weekly appointments, team learning groups, walk-in assistance, reference library, computer-assisted learning and a comfortable place to study chemistry. Stop by for more information.

If you have any questions about the first year chemistry lecture courses, feel free to stop by the First Year Chemistry Office in ChemSci 206A.

**CH0011 - Development of Chemistry Skills (1 credit)**

Students who would like to have a scheduled weekly appointment or participate in a team-learning group must be enrolled in CH0011. Students enrolled in CH0011 should stop by the CLC during the first week of class to sign up for a weekly appointment time with a coach or a Team Learning Group. You must attend your first weekly appointment or team meeting which begins the second week of classes. Grades in CH0011 are satisfactory/unsatisfactory based on attendance. You are expected to attend every appointment or group meeting. However, you are allowed to miss one appointment or three team meetings and still receive a satisfactory grade.

9. **Academic Integrity Policy.**

Standards of academic conduct are set forth in the University’s Academic Integrity Code, which can be found in the MTU Student Handbook or at [www.admin.mtu.edu/dos/acadinteg1.htm](http://www.admin.mtu.edu/dos/acadinteg1.htm). By registering for this course, you have acknowledged your awareness of the Academic Integrity Code, and you are obliged to become familiar with your rights and responsibilities as defined by the Code. Violations of the Academic Integrity Code will not be treated lightly, and disciplinary actions will be taken should such violations occur. This includes plagiarism or receiving inappropriate assistance on examinations and laboratory assignments. Cheating is an extremely serious academic offense. Allegations of cheating will be referred to the Dean of Student Affairs (Les Cook) for appropriate action. Please see me if you have any questions about the academic violations described in the Code or as they relate to particular requirements of this course.
10. Grading Policy.

Your grade will be assessed on the basis of three 60-minute exams (54% of the total grade), the recitation problem sets and quizzes (16% of the total grade) and one cumulative 2-hour final exam (30% of the total grade).

<table>
<thead>
<tr>
<th>Lecture part of the course</th>
<th>% of the final grade</th>
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<tbody>
<tr>
<td>Three 50 minute term exams</td>
<td>54</td>
</tr>
<tr>
<td>Recitation Problem Sets</td>
<td>10</td>
</tr>
<tr>
<td>Recitation Quizzes</td>
<td>6</td>
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<tr>
<td>one 2 hour final exam</td>
<td>30</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>100</strong></td>
</tr>
</tbody>
</table>

A grade of A and AB, (AB 85-89%, A 90-100%) in this course will imply that the student has mastered the full range of topics covered in the lectures and can very successfully apply these to solve the problems presented. The student can derive the important factors that lead to the best solution and makes particularly insightful contributions to tutorial and class discussions.

A grade of B or BC (BC, 75-79%; B, 80-84%) would imply that the student has a thorough understanding of the subject. The student can think things through and makes helpful contributions to tutorial and class discussions.

A grade of C or CD (CD, 60-69%, C, 70-74%) would suggest that the student understands the subject matter but there are gaps in the scope of understanding. Some topics need more work. The student takes part in tutorial and class discussions and listens carefully when not actively participating.

A grade of D (D, 50-59%) implies that the student has only partial knowledge of the subject. The student is unable to make effective use of this knowledge and does not understand what is going on in the classroom. Makes little or no contribution to the discussions in tutorial sessions or in the class.

The F grade (F, <50%) suggests that the student wasted a semester (i.e., four months) at MTU.

11. Description of Types of Examinations.

The three 50 minute and final exams will be a varying mixture of short and long answer questions.

Examples of these questions are:

1/ **Short answer**
Write out the molecular formula for nitric acid ________________.

2/ **Long answer**
List the important aspects that knowledge of the structure of DNA affords for mankind.
12. Detailed Schedule of Lectures and Examinations.

The lectures will be held in EERC 100 at 13:05-13:55 PM on Mondays, Wednesdays and Fridays.

<table>
<thead>
<tr>
<th>Date</th>
<th>Chapter</th>
<th>Topic</th>
</tr>
</thead>
<tbody>
<tr>
<td>12 / 14 / 16 (Jan.)</td>
<td>1</td>
<td>Chemistry: Matter and Measurement</td>
</tr>
<tr>
<td>21 / 23 / 26</td>
<td>2</td>
<td>Atoms, Molecules, and Ions</td>
</tr>
<tr>
<td>28 / 30 / 2 (Feb.)</td>
<td>3</td>
<td>Formulas, Equations, and Ions</td>
</tr>
<tr>
<td>4 / 9</td>
<td>4</td>
<td>Reactions in Aqueous Solution</td>
</tr>
<tr>
<td>11</td>
<td></td>
<td>First term exam (Chapters 1, 2 and 3)</td>
</tr>
<tr>
<td>13</td>
<td>4</td>
<td>Reactions in Aqueous Solution</td>
</tr>
<tr>
<td>16 / 18 / 20</td>
<td>5</td>
<td>Periodicity and Atomic Structure</td>
</tr>
<tr>
<td>23 / 25 / 27 (Mar.)</td>
<td>6</td>
<td>Ionic Bonds and Some Main-Group Chemistry</td>
</tr>
<tr>
<td>8 / 10 / 12 / 15</td>
<td>7</td>
<td>Covalent Bonds and Molecular</td>
</tr>
<tr>
<td>17</td>
<td></td>
<td>Second term exam (Chapters 4, 5 and 6) 6:00PM</td>
</tr>
<tr>
<td>19 / 22 / 24</td>
<td>8</td>
<td>Thermochemistry: Chemical Energy</td>
</tr>
<tr>
<td>26 / 29 / 31</td>
<td>9</td>
<td>Gases: Their Properties and Behavior</td>
</tr>
<tr>
<td>2 (Apr.)/ 5 / 7 / 9</td>
<td>10</td>
<td>Liquids, Solids, and Phase Changes</td>
</tr>
<tr>
<td>12</td>
<td>11</td>
<td>Solutions and Their Properties</td>
</tr>
<tr>
<td>14</td>
<td></td>
<td>Third term exam (Chapters 7, 8 and 9)</td>
</tr>
<tr>
<td>16 / 19</td>
<td>11</td>
<td>Solutions and Their Properties</td>
</tr>
<tr>
<td>21 / 23 / 26 / 28</td>
<td>12</td>
<td>Chemical Kinetics</td>
</tr>
<tr>
<td>30</td>
<td></td>
<td>Kinetics Prob. Set and Review for the final exam</td>
</tr>
</tbody>
</table>

Tuesday, May 4  12:30-2:30 PM  Final Exam
13. Recitation Problem Set Schedule

Your grade in these problem sets is based upon attendance and discussion at the recitation periods. If you fail to attend a recitation period you will be awarded a zero score for that chapter. You must work out the problems before attending the recitations. The Recitation Quizzes will be distributed during the recitation period. No make-up stuff is permitted here as well. The PS is also available at http://www.chemistry.msu.edu/~rluck/courses/spring2004/spring2004CH1110/recitation/index.htm

<table>
<thead>
<tr>
<th>Date</th>
<th>Chapter</th>
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<tbody>
<tr>
<td>Jan</td>
<td>DNA video.</td>
</tr>
<tr>
<td>13</td>
<td>1 Chemistry: Matter and Measurement</td>
</tr>
<tr>
<td>20</td>
<td>2 Atoms, Molecules, and Ions</td>
</tr>
<tr>
<td>27</td>
<td>3 Formulas, Equations, and Ions</td>
</tr>
<tr>
<td>3 (Feb)</td>
<td>10 Recitation Quiz 1</td>
</tr>
<tr>
<td>10</td>
<td>4 Reactions in Aqueous Solution</td>
</tr>
<tr>
<td>17</td>
<td>5 Periodicity and Atomic Structure</td>
</tr>
<tr>
<td>24</td>
<td>6 Ionic Bonds and Some Main-Group Chemistry</td>
</tr>
<tr>
<td>9 (Mar)</td>
<td>16 Recitation Quiz 2</td>
</tr>
<tr>
<td>16</td>
<td>7 Covalent Bonds and Molecular Structure</td>
</tr>
<tr>
<td>23</td>
<td>8 Thermochemistry: Chemical Energy</td>
</tr>
<tr>
<td>30</td>
<td>9 Gases: Their Properties and Behavior</td>
</tr>
<tr>
<td>6 (Apr)</td>
<td>13 Recitation Quiz 3</td>
</tr>
<tr>
<td>13</td>
<td>10 Liquids, Solids, and Phase Changes</td>
</tr>
<tr>
<td>20</td>
<td>11 Solutions and Their Properties</td>
</tr>
<tr>
<td>27</td>
<td></td>
</tr>
</tbody>
</table>
14. Lecture outline topics:

Chapter 1: Matter and Measurement
- Great ideas of chemistry
- Where did the elements come from?
- Structure of The Periodic Table
- Properties of Matter
- Measurement and Units
- Accuracy, Precision and Significant Figures

Chapter 2: Atoms, Molecules, and Ions
- Atomic Theory
- Discovery of atomic structure
- Modern view of the atom
- Periodic table
- Molecules and ions
- Nomenclature

Chapter 3: Formulas, Equations, and Moles
- Balancing chemical equations
- Formula units and moles
- Stoichiometry
- Chemical reactions performed in solutions
- Elemental analysis

Chapter 4: Reactions in Aqueous Solutions
- Important Industrial Chemicals
- Solubility/Electrolysis
- Acids and Bases
- Inorganic Equations
- Types of Reactions
- Oxidizing and Reducing Agents
- Redox Equations

Chapter 5: Periodicity and Atomic Structure
- Modern View of the atom
- Particles and waves, Black body, Einstein Photoelectric effect, Compton effect and electron diffraction (Davison & Germer)
- Quantum Confinement
- Schrödinger Wave Equation
- Classical Wave Equation
- Energy calculations
- Spectrum of Hydrogen
- Bohr model
- Matter waves and the Uncertainty Principle
- Wave Mechanics ($n$, $l$, $m_l$)

Chapter 6: Ionic Bonds and some Main Group Chemistry
- Periodic table
- Sizes of atoms
- Ionization Energies
- Electron affinities
- Born Haber
- Alkali earth
- Halogens and Nobel gases

Chapter 7: Covalent Bonds and Molecular Structure
- Chemical Bonds
- Why do chemical reactions occur
- Lewis Theory of Chemical Bonds
- Electronegativity
- Bond order
- Covalent Bonds
- Lewis structures
- Oxygen containing acids
- Bond energies
- Molecular Structures
- Formal Charge
- Steric Number
- Exceptions to the octet
- Molecular Geometry
- Dipole moments
- Predicting Molecular Shapes
- Theories on Bonding, Valence Bond Theory
- Orbital Hybridization/Hybrid orbitals
- Multiple bonds
- Molecular Orbital Theory (Bonding and Antibonding)
- MO configurations

Chapter 8: Thermodynamics
- Definitions
- Conservation of Energy
- Units/Heat capacity
- Standard Enthalpy Changes
- Hess's Law
- Entropy
- Gibbs Free Energy
Chapter 9: Gases, Properties and Behavior
- Nature of gases
- Pressure
- Gas Laws
- Avogadro's law
- Dalton's law of partial pressures
- Graham's law of effusion
- Derivation of Ideal gas Equation
- Deviations from Ideality (Van der Waals)
- Ozone hole

Chapter 10: Liquids, Solids and Phase changes
- Intermolecular Forces/Liquid & Solid
- Properties of gases, liquids and solids
- London Dispersion forces
- Vapor Pressure
- Clausius Clapeyron equation
- Phase changes / Diagrams
- Melting/freezing points
- H-bonds
- Structure of ice
- Crystal structures

Chapter 11: Solutions and their properties
- Units of Concentration
- Aspects of solutions
- Solution formation and energy changes
- Ideal solutions
- Colligative properties
- Colloids

Chapter 12: Chemical Kinetics
- Why rates/ examples
- Rate law determination
- 1st and 2nd order theory
- Mechanism
- Collision theory
- Arrhenius equation
- Catalyst

Course Agreement

I ___________________________ have studied and understood the course syllabus and I agree to abide

(write your name above)

with all the regulations stated within. This also applies to all the dates for the various exams, problem sets and quizzes. I understand that there are no make-up exams and that late assignments are not accepted.

Signature ____________________

Please remember your time for your recitation session and remember to sign up for CH0011, if necessary.

Person(s) who should be notified in the event of an accident

<table>
<thead>
<tr>
<th>Names</th>
<th></th>
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</thead>
</table>

<table>
<thead>
<tr>
<th>Phone Numbers</th>
<th></th>
</tr>
</thead>
</table>

College ___________ Major ___________ Minor ___________

Optional information

Local Address

________________________________________

________________________________________

________________________________________

Phone Number __________________

Email ______________________