A. COURSE INFORMATION
Course number/section: 1412.004
Class meeting time: TR 11H00–12H15
Class location: EN-101
Course Website: https://bb9.tamucc.edu

B. INSTRUCTOR INFORMATION
Instructor: Yves Coeckelenbergh
Office location: CS211
Office hours: T10H00-11H00, 14H00-15H00, W10H00-11H00, 14H00–15H00, R10H00-11H00
Telephone: 825 2987
e-mail: yves.coeckelenbergh@tamucc.edu

C. COURSE DESCRIPTION
The continuation of CHEM 1411 – General Chemistry I, the foundation course of chemistry with emphasis on quantitative aspects. Laboratory involves development of basic skills. This course counts toward the natural science component of the University Core Curriculum. Prerequisite: CHEM 1411 – General Chemistry I and MATH 1314 – College Algebra or equivalent math competency as well as SMTE 0093 for the laboratory component of the course.

As the follow-up to General Chemistry I this course assumes a good knowledge of the basic tools of chemistry such as measurement, unit management, elementary mathematics and stoichiometry. Students must be familiar with the properties and structures of atoms and molecules including electron configuration, periodicity and atomic associations. The concept of energy applied to reactivity must be understood qualitatively and quantitatively. The course applies a rigorous, quantitative approach to chemistry and emphasizes rational thinking and analysis rather than memory and number crunching. It follows a logical approach. The lectures, assignments and examinations will stress both concepts and context.

The laboratory brings the experimental component to the course along with extensive review and problem solving.

The core of the course will be the study of chemical thermodynamics leading to the understanding of free energy and chemical equilibrium. Two major types of reactions, acid-base and oxidation-reduction, will be extensively studied in that context. The time dependence of chemical reactions will be studied through chemical kinetics. At the end of the course the student should know the “fundamentals” and be prepared to follow more advanced courses such as analytical chemistry, inorganic and organic chemistry, biochemistry or physical chemistry.
D. **PREREQUISITES AND COREQUISITES**

CHEM 1411, MATH 1314, SMTE 0093.

E. **REQUIRED TEXTBOOK(S), READINGS AND SUPPLIES**

The course material contains handouts, slides and exercises. It is available free of charge on Blackboard. The course shell includes also the course syllabus, useful links, grades and other information. The commercial textbook assigned to General Chemistry II is the same as for General Chemistry I (Silberberg McGraw-Hill). It is however optional as well as its online extension (Connect). There are plenty of resources available online such as tutorial and recorded lectures. Some are textbook extensions like Connect and require a purchase while others are free. Their quality varies from excellent to despicable and in case of doubt you should ask the advice of your instructor. Keep in mind however that the exams are exclusively based on the content of the lectures, handouts, slides and homework and that dispersed information might reduce your ability to concentrate on the important concepts of the course.

**Supplies:** A calculator is optional. Students are encouraged to minimize the use of their calculator in order to focus on the problem solving rather than a plug-in formula based approach. Lab coat and goggles are required for the laboratory.

F. **STUDENT LEARNING OUTCOMES AND ASSESSMENT**

Assessment is a process used by instructors and students to help improve learning. Assessment is essential for effective learning because it provides feedback to both students and instructors. A critical step in this process is making clear the course’s student learning outcomes that describe what students are expected to learn to be successful in the course. The seven student learning outcomes (SLO’s) for this course are listed below.

By collecting data, essentially grades on exams, quizzes, laboratory assignments and class discussions, and sharing it through Blackboard with students on how well they are accomplishing these learning outcomes students can more efficiently and effectively focus their learning efforts. This information can also help instructors identify challenging areas for students and adjust their teaching approach to facilitate learning.

The following learning outcomes will be assessed through the duration of the course. They should be understood as components of the scientific learning closely related to each other.

In this context the overall learning outcome consists in the ability to analyze a problem, sort all the available data, design a problem solving strategy, solve the problem and, most important, report the work in a clear, concise, logical and comprehensive manner.
SLO 1: Apply a quantitative approach to solve simple chemical problems.

SLO1 will be tested by the ability to:

a) Express experimental and calculated results with the proper units and level of uncertainty.
b) Explain the concept of mole and calculate the Avogadro number.
c) Calculate the molar mass of a molecule from the isotopic composition of the constituting elements.
d) Describe a chemical reaction with the appropriate equation.
e) Apply the reaction table to the solution of stoichiometric problems.
f) Determine concentrations through several methods (volumetric, gravimetric, colligative properties and spectrometric) and convert various units of concentrations.

SLO2: Describe a chemical system with a macroscopic approach.

SLO2 will be tested by the ability to:

a) Map the behavior of matter in terms of intermolecular interactions
b) Calculate macroscopic variables and state functions in standard and non-standard conditions
c) Compare reversibility and irreversibility
d) Apply the law of conservation of energy $\Delta U = q + w$
e) Calculate entropy with the Clausius inequality and the Boltzmann equation
f) Define temperature
g) Calculate free energy and characterize a chemical reaction (spontaneity and orientation).

SLO3: Identify a chemical equilibrium and calculate its parameters.

SLO3 will be tested by the ability to:

a) Determine the components of a chemical equilibrium
b) Calculate the reaction quotient from approximated activities
c) Calculate the equilibrium constant from thermodynamic functions
d) Explain the behavior of a system away from equilibrium
e) Solve equilibrium problems with the reaction table.

SLO 4: Specify acids, bases and buffers, explain their reactivity.

SLO4 will be tested by the ability to:

a) Define acid and base and describe their mechanism of action
b) Describe the acid-base behavior of water and calculate its equilibrium functions
c) Identify strong acid, strong base, weak acid, weak base and buffer
d) Calculate concentrations of acid-base systems and convert to p-scale
e) Describe the titration of various species qualitatively and quantitatively
f) Calculate the result of adding a strong acid or a strong base to a buffer.
SLO5: Identify and describe RedOx reactions.

SLO5 will be tested by the ability to:

a) Define oxidation, reduction and determine the oxidation state
b) Find the direction of the electron flow from the half-cell reduction potential
c) Calculate a cell potential in non-standard condition using the Nernst equation
d) Balance a RedOx equation in acidic and basic environment.

SLO6: Analyze the kinetics of a chemical reaction.

SLO6 will be tested by the ability to:

a) Calculate the rate and rate constant of a reaction from experimental data
b) Calculate the concentration of reactants and products at a given time
c) Determine the rate law
d) Calculate half-lives.

SLO7: Design and run chemical experiments.

SLO7 will be tested by the ability to:

a) Manipulate chemical apparatus with dexterity
b) Apply mathematics to the study of chemical systems
c) Design an experiment following a system solving heuristics
d) Report the experimental process and data in a notebook
e) Write a comprehensive laboratory report.

Summary of Student Learning Outcomes.

By the end of this course, students should be able to:

1. Solve quantitative chemical problems.
2. Describe macroscopically a chemical system.
3. Calculate the parameters of a chemical equilibrium.
4. Calculate the parameters of an acid-base process.
5. Calculate the parameters of an oxidation-reduction process.
6. Describe a reaction in kinetics terms and calculate rate law and half-lives.
7. Design and run chemical experiments.
G. INSTRUCTIONAL METHODS AND ACTIVITIES

The following guidelines are recommended:

1- Attend the lectures

2- Review all the slides and if you have difficulties with anyone of them be tenacious until you grasp the concepts

3- Repeat the exercises done in class

4- Do the homework. Be tenacious. Don’t worry so much about the answer than the problem solving strategy. All problems are corrected in class anyway. After correction do them again.

5- Reading the handouts posted on Blackboard is mandatory. Reading a textbook is optional and a complement, not a substitute to the lecture

6- When available, Special Instruction sessions are optional, also a complement, not a substitute.

7- If you use other resources such as CASA, friends, online chat, etc…. be careful and wise. Do not accept alternate explanations unless checked with your instructor. There is a lot of material to be learned in a very short semester and a third person, if not a chemist, might not have learned all the concepts taught in the course.

8- If you don’t do well in the first exam catch up the missing lectures, slides and homework and keep working hard.

9- if you have difficulties with the course, speak to the Professor.

Students not planning regular class attendance, daily review of the lectures, reading, completion of the assignments and study should consider another learning option.

Student should not try “outsmart the system”. Your Professor organizes the course for maximum learning. Short cuts, better ways to explain things, tricks to answer questions are only deceptive. If you know a faster way to find the answer to a problem (like short cutting the reaction table) think that your instructor might have taken the long way to illustrate an important concept or a method to be used later in the course. In case of doubt speak to your Professor.
H. MAJOR COURSE REQUIREMENTS AND GRADING

Final grade will be calculated as follows:

First Examination: 100 points
Take Home Examination: 100 points
Third Examination: 100 points
Final examination: 200 points
Quizzes, homework and class participation: 100 points
Laboratory 100 points

Final letter grading for the course will be: A> 90%, B>80%, C>70%, D>60 %, F < 60%.

Exams:

There will be three examinations (including one take-home) and one final examination. Students are allowed to bring a pen or pencil, a non-communicating calculation device, the data table previously distributed in class and a maximum of 10 pages of handwritten notes. No communication between students is allowed.

For the take home examination student collaboration is allowed but the final product must be personal. Plagiarism will be graded zero. Special consideration will be given to the presentation, the intermediate calculations and the logical approach.

The final examination is a comprehensive exam where no notes are allowed.

The presentation is important. Answers must follow a self-explanatory logic. The reading must be clear. All calculations must be presented in detail and absolutely with the proper units.

Missed exams without a valid excuse will be graded zero. Most of the questions of the exams will consist in problems similar to those seen in class or homework assignments.

Students must be seated no later than 5 min before the start of the exam. There should be as much distance between each student as the classroom configuration allows and the desk must be empty with the exception of specifically authorized items.

Students are not allowed in the classroom after the start of the exam without the permission of the instructor. In any case no student will be admitted after the first exam-taker has left. Student leaving the room will not be allowed to return unless authorized by the instructor. All material including intermediate calculations will be given to the instructor at the end of the exam. A picture ID is required.

There are no make-up exams. All excuses must be requested in advance with the obvious exception of emergencies. Students with a university approved scheduled absence (athletics,
Homework and quizzes:

Homework assignments will be posted on Blackboard. Homework must be completed by the due date. They will be kept by the student unless instructed otherwise. A quiz to be graded will be held either on the due day or on the next lecture day. It will cover part of the homework. After completion of the quiz each exercise will be corrected in class and there will be time for Q&A. At the end of the semester the homework grades might be updated to take account of effort, regularity and progress.

I. COURSE CONTENT/SCHEDULE

The schedule below is a preliminary outline of the lectures susceptible to be modified. It is the student’s responsibility to keep up with changes to this schedule. The reading and problem assignments should be completed in due time. Failure to stay current will greatly affect your ability to keep up during the lecture and, therefore, will impact your grade in this course.

<table>
<thead>
<tr>
<th>Week</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>19JAN</td>
<td>Introduction, syllabus, baseline quiz, lab safety</td>
</tr>
<tr>
<td>24JAN</td>
<td>Mathematics for chemistry (review)</td>
</tr>
<tr>
<td>26JAN</td>
<td>Fundamentals, the language of chemistry (review)</td>
</tr>
<tr>
<td>31JAN</td>
<td>State of matter, intermolecular interactions</td>
</tr>
<tr>
<td>02FEB</td>
<td>Ideal gases</td>
</tr>
<tr>
<td>07FEB</td>
<td>Solutions, concentrations</td>
</tr>
<tr>
<td>09FEB</td>
<td>Review</td>
</tr>
<tr>
<td>14FEB</td>
<td>First Examination</td>
</tr>
<tr>
<td>16FEB</td>
<td>Energy, enthalpy, first law of thermodynamics</td>
</tr>
<tr>
<td>21FEB</td>
<td>Clausius inequality, Boltzmann equation</td>
</tr>
<tr>
<td>23FEB</td>
<td>Free Energy</td>
</tr>
<tr>
<td>28FEB</td>
<td>Chemical Equilibrium</td>
</tr>
<tr>
<td>02MAR</td>
<td>Chemical Equilibrium</td>
</tr>
<tr>
<td>07MAR</td>
<td>Review</td>
</tr>
<tr>
<td>09MAR</td>
<td>Take Home Examination</td>
</tr>
<tr>
<td>21MAR</td>
<td>Acid –base chemistry</td>
</tr>
<tr>
<td>23MAR</td>
<td>Acid-base chemistry</td>
</tr>
<tr>
<td>28MAR</td>
<td>Buffers</td>
</tr>
<tr>
<td>30MAR</td>
<td>Advance titration</td>
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<tr>
<td>04APR</td>
<td>Advance titration</td>
</tr>
<tr>
<td>06APR</td>
<td>Electrochemistry</td>
</tr>
</tbody>
</table>
11APR    Electrochemistry
13APR    Review
18APR    Third Examination
20APR    Kinetics
25APR    Nuclear Chemistry
27APR    Review for the Final Examination
02MAY    Review for the Final Examination

09MAY    11H00 FINAL EXAMINATION.

Note: Changes in this course schedule may be necessary and will be announced to the class by
the Instructor. The assignments and exams shown are directly related to the Student Learning
Outcomes described in Section F.

J. COURSE POLICIES

Attendance is mandatory. Tardiness and early leaving must be explained.

Absolutely no communication devices or chatting allowed during lecture and
examination. Students using phones, other communication device or chatting
without a specific authorization will be told to leave the room with a grade of zero.
Second infraction will be sanctioned by a Failing grade for the entire course.

Food is not allowed in class.

K. COLLEGE AND UNIVERSITY POLICIES

• Academic Integrity (University)
  University students are expected to conduct themselves in accordance with the
  highest standards of academic honesty. Academic misconduct for which a student is
  subject to penalty includes all forms of cheating, such as illicit possession of
  examinations or examination materials, falsification, forgery, complicity or
  plagiarism. (Plagiarism is the presentation of the work of another as one’s own
  work.) In this class, academic misconduct or complicity in an act of academic
  misconduct on an assignment or test will result in a failing grade.

• Classroom/Professional Behavior
  Texas A&M University-Corpus Christi, as an academic community, requires that each
  individual respect the needs of others to study and learn in a peaceful atmosphere. Under
  Article III of the Student Code of Conduct, classroom behavior that interferes with either
  (a) the instructor’s ability to conduct the class or (b) the ability of other students to profit
from the instructional program may be considered a breach of the peace and is subject to
disciplinary sanction outlined in article VII of the Student Code of Conduct. Students
engaging in unacceptable behavior may be instructed to leave the classroom. This
prohibition applies to all instructional forums, including classrooms, electronic
classrooms, labs, discussion groups, field trips, etc.

• **Statement of Civility**
  Texas A&M University-Corpus Christi has a diverse student population that represents
the population of the state. Our goal is to provide you with a high quality educational
experience that is free from repression. You are responsible for following the rules of the
University, city, state and federal government. We expect that you will behave in a
manner that is dignified, respectful and courteous to all people, regardless of finance, sex,
ethnic/racial origin, religious background, sexual orientation or disability. Behaviors that
infringe on the rights of another individual will not be tolerated.

• **Deadline for Dropping a Course with a Grade of W (University)**
  The grade of W will be assigned to any student officially dropping a course. Please
consult with the instructor before you decide to drop to be sure it is the best thing to
do. Just stopping attendance and participation **WILL NOT** automatically result in
your being dropped from the class. Should dropping the course be the best course of
action, visit the Office of the University Registrar for the Course Drop Form
that must submitted. No student is eligible to receive a W without completing the
official drop process by this deadline. Please consult the Academic Calendar
([http://www.tamucc.edu/academics/calendar/](http://www.tamucc.edu/academics/calendar/)) for the last day to drop a course.

• **Grade Appeals (College of Science and Engineering)**
  As stated in University Procedure 13.02.99.C2.01, Student Grade Appeal Procedures, a
student who believes that he or she has not been held to appropriate academic standards
as outlined in the class syllabus, equitable evaluation procedures, or appropriate grading,
may appeal the final grade given in the course. The burden of proof is upon the student to
demonstrate the appropriateness of the appeal. A student with a complaint about a grade
is encouraged to first discuss the matter with the instructor. For complete details,
including the responsibilities of the parties involved in the process and the number of
days allowed for completing the steps in the process, see University Procedure
13.02.99.C2.01, Student Grade Appeal Procedures. These documents are accessible
through the University Rules website
at [http://www.tamucc.edu/provost/university_rules/index.html](http://www.tamucc.edu/provost/university_rules/index.html), and the College of
Science and Engineering Grade Appeals webpage
at [http://sci.tamucc.edu/students/GradeAppeal.html](http://sci.tamucc.edu/students/GradeAppeal.html). For assistance and/or guidance in the
grade appeal process, students may contact the chair or director of the appropriate
department or school, the Office of the College of Science and Engineering Dean, or the
Office of the Provost.

• **Disability Services**
  The Americans with Disabilities Act (ADA) is a federal anti-discrimination statute that
provides comprehensive civil rights protection for persons with disabilities. Among other things, this legislation requires that all students with disabilities be guaranteed a learning environment that provides for reasonable accommodation of their disabilities. If you believe you have a disability requiring an accommodation, please call (361) 825-5816 or visit Disability Services in Corpus Christi Hall 116.

If you are a returning veteran and are experiencing cognitive and/or physical access issues in the classroom or on campus, please contact the Disability Services office for assistance at (361) 825-5816.

http://disabilityservices.tamucc.edu/

- **Statement of Academic Continuity**
  In the event of an unforeseen adverse event, such as a major hurricane and classes could not be held on the campus of Texas A&M University–Corpus Christi; this course would continue through the use of Blackboard and/or email. In addition, the syllabus and class activities may be modified to allow continuation of the course. University facilities (i.e., emails, web sites, and Blackboard) should be operational within two days of the closing of the physical campus. However, students need to make certain that the course instructor has a primary and a secondary means of contacting each student.

**L. OTHER INFORMATION**

- **Academic Advising**
  The College of Science & Engineering requires that students meet with an Academic Advisor as soon as they are ready to declare a major. The Academic Advisor will set up a degree plan, which must be signed by the student, a faculty mentor, and the department chair. Meetings are by appointment only; advisors do not take walk-ins. Please call or stop by the Advising Center to check availability and schedule an appointment. The College’s Academic Advising Center is located in Center for Instruction 350 or can be reached at (361) 825-3928.

**GENERAL DISCLAIMER**

I reserve the right to modify the information, schedule, assignments, deadlines, and course policies in this syllabus if and when necessary. I will announce such changes in a timely manner during regularly scheduled lecture periods.

*In choosing to take this course, you are agreeing to abide by the course rules. Should you have concerns or questions, you are to discuss them with the instructor as soon as possible.*
However, you are bound by these rules, regulations, and standards from the first day of the class throughout the duration of the course.

This is a course about learning chemistry with a strong emphasis on concepts. Problems are given to illustrate concepts. Solving a problem without the concept or trying to learn concepts without a quantitative problem solving approach are both meaningless.

We will learn in this course how to solve real problems from the initial statement to the final solution. The emphasis will be the problem solving, learning, and discovery. The actual answer will be significant, but the methodological learning and subsequent grading will mainly focus on the analytical and deductive ability to be presented in a rational manner.

Do not make things more complex than they are, but not too simple either.

Syllabus for the Laboratory.
There will be 10 labs and one final exam. The exam will be graded over 200 points. Each lab will be graded over 100 points. At the end of the course the notebook will be graded over 200 points. The total will be converted to 100 points for inclusion in the course final grade. The first two labs are graded by quiz. The grading of labs 3-10 is distributed between the following domains.

All labs will count (no drop out grade). Unattended labs or late reports will be graded zero unless justified with a valid reason.

The grading pattern follows. It can be modified in function of the circumstances to be explained by the instructor.

Notebook presentation of the work (25 points/lab):

Each lab must be prepared in accordance with the specific instructions posted by the instructor on Blackboard and the required material from lectures and textbooks. Additional reading is optional but recommended. Each student will write in the notebook a presentation of the work containing the title, the objectives, the procedure, the concepts behind the experiment and the references. The presentation of the work will be shown to the instructor for grading at the beginning of each lab session.

Conducting the experiment (25 points/lab):

Once the Presentation of the work has been approved students will start the experiment as follows:

a) Setup the work station including the equipment installation and glassware labeling to be recorded in the notebook
b) Conduct the experiment carefully recording all steps and all data in the notebook on a structured manner
c) Dispose of the chemicals following the safety guidelines, clean, dry and store the equipment

Calculations, problem solving, quiz and report (50 points/lab):

All calculations must be performed in the lab. The layout and labeling with the proper units will indicate the level of understanding of the students. A simple error analysis based on the proper significant figures must be included. Additional problems related to the experiment can be worked on and the session might be concluded by a graded quiz.

Each student will prepare a typed report to be handed in paper format to the instructor at the beginning of the following lab. The report will include the Presentation of the work, the experiment journal and data, an error analysis and a conclusion.
Grading of the notebook (200 points/semester)

The notebook will be graded at the end of the semester for a total of 200 points. Emphasis will be put on the reproducibility of the experiment from the information available in the notebook.

Grading of the final exam (200 pts)

The final lab will consist in an experiment similar to one previously performed. The report will be written in the lab after completion of the experiment and graded over 200 points.

Final grade

The final grade will be obtained from the sum of each lab grade (900 points) plus the notebook (200 points) and the final exam (200 points).

The final lab grade will be converted to a grade over 100 points and included in the total grade for the course.

Safety Rules

_Students are required to complete successfully the online safety presentation before the first lab._

_A complete presentation of the chemical safety issues at Texas A&M Corpus Christi (points a, b, c, d and e) can be consulted at http://safety.tamucc.edu/_

A summary of the main points follows.

a- Wear ANSI Z-87.1, 1989 goggles at all time in the laboratory. Do not use contact lenses. Be aware of the eyewash station place and use.
b- Do not ingest any food or drink
c) Wear clothing providing maximum body coverage including close shoes and gloves. Long hair must be tied. In case of large spill remove the contaminated clothing and use the safety shower.
d) Never touch nor taste chemicals
e) Use the hood for any reaction involving gas phase dangerous chemicals
f) Beware of the breakability of glass
g) Do not use any electronic device other than required for the experiment
h) Stow your personal belonging in the designated storage area
i) In case of an accident, even minor, notify immediately your instructor.

Laboratory Rules of Conduct

a) Your work station and the laboratory equipment must be clean and operational. If such is not the case inform the instructor immediately. After the lab is finished clean off your work station and equipment so that it is in good shape for the next student.
b) Reagent dispensers must be kept in their original location. Excess reagent should not be put back in the dispensers but treated as waste.

c) All material must be weighted on weighting paper or in a container.

d) Spills must be cleaned after notification of the instructor.

e) Stoppers must be kept in your hand while pouring reagent.

NFPA 704

The National Fire Protection Agency (NFPA), in section 704 of the National Fire Code, specifies a colored diamond system for identifying the hazards associated with materials. The following ranking is used.

Blue – Health
0 No hazard other than an ordinary combustible material (peanut butter)
1 Only short term irritation and minor residual injury (turpentine)
2 Intense exposure can cause temporary incapacitation or residual injury (ammonia)
3 Short exposure can cause temporary incapacitation or residual injury (chlorine gas)
4 Very short exposure can cause death or major residual injury (hydrogen cyanide)

Red – Flammability
0 Will not burn (water)
1 Will burn if preheated (olive oil)
2 Will burn if moderately preheated or exposed to relatively high temperature (diesel)
3 Can be ignited at ambient temperature (gasoline)
4 Volatile material burning easily

Yellow – Reactivity
0 Stable under fire and not reacting with water (liquid nitrogen)
1 Stable unless elevated temperature and pressure (phosphorus)
2 Violent chemical change at high temperature and pressure or reacting violently with water (calcium metal)
3 Explosive upon contact with an initiating source or water (fluorine gas)
4 Can explode by itself at normal temperature and pressure

White – Other Hazards
W Hazardous when in contact with water
OX Oxidizer
Non-standard symbols such as corrosive (CORR), acid (ACID), alkaline (ALK), biological hazard (BIOL), poison (POI), cryogenic (CRYO) and radioactive are also used
Material Safety Data Sheet (MSDS)

The Occupational Safety and Health Administration (OSHA) requires that MSDS be available to employees for potentially harmful substances handled in the workplace. Commonly used MSDS databases can be accessed through the Environment, Health and Safety homepage at TAMUCC (http://safety.tamucc.edu/)

Waste Management

The experimental design follows the principles of green chemistry which includes, if possible, the use of non-polluting chemicals, a minimization of waste and a secure treatment and disposal of the waste that cannot be avoided.

General guidelines and checklists are available on the Campus labs section of the E, H & S home page http://safety.tamucc.edu/index.php?n=Site

Furthermore technical information on types of hazardous waste, containers and chemical tables can be found in the Texas A&M University Safety Manual http://ehsd-online.tamu.edu/documents/TAMUSafetyManual/14-WAST1.HTM

Chemical wastes are defined as

- Chemical components listed in the Texas A&M document
- Mixtures containing a listed hazardous waste
- Material meeting the definition of one of the following:
  - Ignitability (flashpoint < 60°C or supports combustion)
  - Reactivity (e.g., water reactives, cyanides, explosives, unstable chemicals)
  - Corrosivity (pH < 4 or > 10)
  - Toxicity (ex. Pesticides, heavy metals, poisons)

Specific waste disposal instructions will be included in the student documentation.

Supplies:
Coat, goggles, marker, ruler, notebook (any bounded notebook with numbered pages).

**Guidelines for writing the laboratory notebook**

The notebook is the central piece of your laboratory experience. It is an extensive record of your activities in the lab describing the experiments as you do them, the observations as you make them. You will record all your data, their analysis, and the calculations leading to the results to be presented in your laboratory report.

The guidelines are as follows.

- The notebook must be bound with numbered pages

- All entries should be recorded in ink and in real time (directly) as you perform the experiment and the calculations. Errors should be crossed and not erased. You will use the information in the notebook to write your report and need to reconstruct accurately the experiment.

- Each page must be signed and dated

The notebook will be checked by your instructor and graded. The main criterion for grading will be the ability for someone else to repeat your work by reading your account.
Guidelines for writing the laboratory report

You will be asked for some experiments to write a lab report. The objective is to learn how to write a scientific paper. A report, like a scientific paper, formulates hypotheses, observes processes, records data, analyzes data, calculates or deduct results and states conclusions. It will include the following fields.

- **Title**: The title might be the name of the experiment or a more elaborate statement. The front page must include your name, the name of the course and the date the report is due. There should be a statement indicating what is your own work in compliance with academic integrity and the shared work authorized by your instructor.

- **Objective**: State the objective in your own words, what scientific principles are being tested, what are the learning objectives.

- **Procedure**: This is where you describe what you have actually done and how you did it. A procedure is a specification of series of actions, acts or operations which have to be executed in the same manner in order to always obtain the same result in the same circumstances.

- **Data collection**: This is one of the most critical portions of the lab report. Without good data recording in the laboratory notebook, completion of the lab write up beyond this point becomes futile. Presentation of data in tables allows easy following of the coming data manipulations. Tables should be clearly labeled as to their content and numbered for ease of referral in the discussion section.

Part of the data may involve making observations (color changes, temperature changes, melting point, boiling point, the physical appearance of a chemical substance, etc.). Sometimes extra observations you make may provide extra clues. Keep your eyes open.

- **Calculation**: One clear example of each different type of calculation should be presented as a check of your work. Do not include pages full of each and every calculation; it just wastes your time and paper. Who wants to read 3 pages of the same calculations with different numbers?

- **Error analysis**: Some estimation of the experimental uncertainty is necessary to help explain the results and to verify if the scientific principle tested holds.

- **Conclusion**: It requires looking at the experimental title, the purpose, the data and calculation sections of the lab report and bringing them all together. Sometimes it involves the comparison of the student's experimentally derived answer to a known literature value. Other times, it requires the student to stress the main point of the experiment.
Data and results reporting

Measured numbers are reported with their range of uncertainty or with the last digit as the first doubtful digit. It is important to take account of the instrumental precision and use the appropriate number of digits. A smaller number does not take advantage of the precision of the measurement. Reporting with too many digits is an aberration.

Furthermore when you carry out calculations based on measurements it is important to remember that the results cannot be more precise than the initial data.

The number of significant figures of the initial data depends on the precision of the instrument and the skill of the observer. The rules for significant figures resulting from calculations have been explained in your lecture and textbooks.

Scientific measurements are often done repetitively to eliminate the impact of random error. The more measurements, the higher the precision. Uncertainty calculations are performed with statistical methods such as the Gaussian analysis with means and standard deviation.

It is important to understand the difference between precision (the agreement between two readings) and accuracy (closeness to the actual value) and the type of error responsible for lack or precision versus lack of accuracy.

Graphing is also an important experimental tool and can be used for different purpose: data visualization, quantity calculation and extrapolation. You will need to practice graphing taking the following into consideration.

- Use graph paper or a correctly prepared computer graph
- Label axes properly
- Dimension the size of the graph to fit the data
- Use the abscissa for the independent variable and the ordinate for the dependent variable
- Use a pencil on graph paper and indicate the points with a cross (not a bubble).

It is sometime useful to calculate the best fit to a curve. Regression techniques such as the least square for fitting a straight line can be used.
Tentative Schedule with the corresponding session of the Student Manual v1.3:

Week 1  Fundamentals (dry lab) Session 1
Week 2  Fundamentals (dry lab) Session 2
Week 3  Gas Law relation between macroscopic variables Session 3
Week 4  Determination of a Molar Mass Session 4
Week 5  Solutions, Solubility, Intermolecular Interactions Session 5
Week 6  Titration I Volumetric Analysis Session 6
Week 7  Thermodynamic Function with van’t Hoff plot Session 7
Week 8  Chemical Equilibrium Session 8
Week 9  Chemical Analysis of a Titration Session 9
Week 10 Oxidation-Reduction Reactions Session 10
Week 11 EXAMINATION.